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### Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>CDC</td>
<td>Centres for Disease Control</td>
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<td>CE</td>
<td>Choice experiment</td>
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<td>CRF</td>
<td>Certified residue free</td>
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<td>CV</td>
<td>Contingent valuation</td>
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<td>DALY</td>
<td>Disability Adjusted Life Year</td>
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<td>DARD</td>
<td>Department of Agriculture and Rural Development</td>
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<tr>
<td>DfT</td>
<td>Department for Transport</td>
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<td>EFSA</td>
<td>European Food Safety Authority</td>
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<td>FBD</td>
<td>Foodborne disease</td>
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<td>FSA</td>
<td>Food Standards Agency</td>
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<td>GMO</td>
<td>Genetically modified organism</td>
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<td>HRQL</td>
<td>Health related quality of life</td>
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<td>IID</td>
<td>Inflammatory intestinal disease</td>
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<tr>
<td>NICE</td>
<td>National Institute for Health and Care Excellence</td>
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<tr>
<td>QALD</td>
<td>Quality adjusted life day</td>
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<tr>
<td>QALY</td>
<td>Quality adjusted life year</td>
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<tr>
<td>TEV</td>
<td>Total economic value</td>
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<td>UK</td>
<td>United Kingdom</td>
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<td>VMD</td>
<td>Veterinary Medicines Directorate</td>
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<td>VPF</td>
<td>Values of preventing fatalities</td>
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<td>VSC</td>
<td>Value per statistical case</td>
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<td>VSL</td>
<td>Value of statistical life</td>
</tr>
<tr>
<td>WTA</td>
<td>Willingness to accept</td>
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<tr>
<td>WTP</td>
<td>Willingness to pay</td>
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Key findings

The Food Standards Agency (FSA) is responsible for food safety policy and enforcement from the moment foods exit the farm or are imported in the UK to the point of sale to the final consumer (FSA, 2011c). As part of this remit, the FSA is also responsible for the strategy for reducing microbiological foodborne diseases (FBD) and for allergen, chemical and radiological safety.

To assess the most efficient and effective ways of performing these activities, the FSA uses epidemiological data on the FBD burden, and economic data on the cost of the burden of FBD. Currently the FSA’s estimate of the cost of FBD in the UK comprises: NHS costs, lost earnings and other expenses related to FBD and the costs of pain, grief and suffering associated with illness and/or death from other literature.

The objective of this study was to assist the FSA to prepare a research programme to estimate this cost, i.e. to estimate the willingness to pay (WTP) to avoid pain, grief and suffering associated with illness and/or death specifically related to FBD, chemical and radiological contaminants and allergens.

In order to achieve this objective, the study reviewed the relevant economic valuation literature; investigated the suitability of different economic valuation methods and recommends the next steps of research.

There are no price or consumption data from actual food or related markets which can be used to estimate WTP to avoid pain, grief and suffering in this context. Most of the existing survey-based valuation studies have been designed with a very narrow focus (e.g. one food product, one FBD, a small number of possible changes in the risk of FBD) – these are too narrow for transferring the evidence across the FSA activities. Thus, there is indeed a need for new research. The literature reviewed here and economic valuation experience in other contexts shows such research is feasible.

We recommend a three-part research programme to estimate WTP to avoid pain, grief and suffering caused by:

1. Microbiological FBD: a choice experiment in which ‘safer food’ is defined in terms of risk, severity and duration of FBD, food types and type of people who are affected. Respondents would be asked to choose their most preferred outcome including the associated extra food costs.

2. Chemical and radiological contaminants: a contingent valuation study in which the respondents are asked to state their WTP for different FSA activities or the outcomes of FSA activities (e.g. maintaining or reducing the current level of contaminants).

3. Allergens: could be included in the choice modelling exercise in (1) above as a cause of particular symptoms or could have a separate contingent valuation design for a specific FSA led action to reduce the risk associated with allergens (e.g. WTP for changes to product labelling).

The research should follow the best practice work plan for a stated preference study involving qualitative research (focus groups, cognitive interviews), pilot survey, several iterations of the questionnaire, main survey, data analysis, reporting and peer review throughout the research. Some approximate costs are provided for three different specifications: high specification (all three surveys listed above undertaken separately); medium specification (survey 1 above, a booster sample for people with allergies and some WTP questions on chemical and radiological contaminants included in the same survey); and, low specification (survey 1 above alone). A more detailed research proposal would be required once the FSA’s priorities for new evidence are determined.

Research could be phased to allow for economies of scale in the qualitative research phase but staggered at the main survey stage to spread the cost, and address the highest priority research needs first. For example, it is possible to start with a number of focus groups to test preferences related to all three surveys and decide based on the findings of the qualitative research which specification to commission. Such a phased approach is common in large scale valuation exercises like this.

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In order to maximise utility of the study there is a significant benefit in working with others also carrying our research in the area. This should be included in the design as a matter of course.
Summary

Background

The Food Standards Agency (FSA)’s core remit covers food safety policy and enforcement from the moment foods exit the farm or are imported in the UK to the point of sale to the final consumer (FSA, 2011c). As part of this remit, the FSA is also responsible for the strategy for reducing microbiological foodborne diseases (FBD) and for chemical and radiological safety.

In this context, the key FSA objectives include (FSA, 2011a):

- Monitoring trends in foodborne illness.
- Promoting a hazard analysis-based approach to food safety management.
- Promoting and providing guidance for producers, retailers, caterers and the general public.

To meet these objectives the FSA undertakes a range of regulation and enforcement activities:

- Approval and monitoring of food premises.
- Cooperation with local enforcement officers.
- Monitoring.
- Guidance and advice for industry.

To assess the most efficient and effective ways of performing these activities, the FSA uses epidemiological data on the FBD burden, and economic data on the cost of the burden of FBD.

Currently the FSA’s estimate of the cost of FBD in the UK comprises: NHS costs, lost earnings and other expenses and the costs of pain, grief and suffering association with illness and/or death.

The FSA currently uses an estimate of the economic cost of from transport related injuries and death. This may or may not be the same (or sufficiently similar) to the economic cost of the pain, grief and suffering related to food related illness and/or death.

The objective of this study was to help the FSA to prepare a research programme to estimate this cost, i.e. to estimate the willingness to pay (WTP) to avoid pain, grief and suffering associated with illness and/or death caused by FBD, allergens, chemical and radiological contaminants.

The study included a review of the relevant economic valuation literature and an investigation of the suitability of different economic valuation methods for future research.

The process of economic valuation

Economic valuation investigates individuals’ preferences for a change in the provision (quality and/or quantity) of a good or services.

In order to design an economic valuation study, the following questions need to be answered:

1. **What is the good to be valued?** In this instance the overall good to be valued is ‘safer food’. This context needs to be presented in order to ensure that the respondents do not pay for anything more than what they will be asked to value, i.e. the cost of pain, grief and suffering due to microbiological foodborne diseases, chemical and radiological contamination and allergens.

2. **What is the change in the good to be valued?** The FSA can change the current incidence of risk, severity and duration of FBD through activities it undertakes. A valuation study could be designed to value pain, grief and suffering associated with each or all of these changes.

3. **Whose values should be taken into account?** The preferences (and hence values) of the entire population should be taken into account including the risks to an individual’s own health and others

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2 Willingness to Accept Compensation (WTA) to tolerate pain, grief and suffering is not pursued further in this research as it is likely to be ‘incentive incompatible’ (there is no budget constraints limiting WTA statements so any number, especially in an emotive subject as food safety, can be given).
such as vulnerable groups (elderly, children, those with allergies, etc.). If the WTP of specific groups (e.g. those with allergies) is of interest to the FSA, booster samples or separate surveys can be conducted.

4. **What methodology should be used to estimate economic value?** Appropriateness of all three types of data should be explored, in the order of: market price, consumption and revealed preference data and stated preference data. If the first two types of data which are based on consumer behaviour are not appropriate, then stated preference method should be considered. Whether a method is appropriate or not depends on whether the data exist to meet the research objective (the FSA's evidence need), and if it does, whether it can be collated. This study found market prices and revealed preference data to be inadequate and recommends a stated preference approach.

**Existing economic value evidence for foodborne disease**

Twenty nine economic valuation studies fully or partially about foodborne diseases were reviewed, looking in particular for analysis of the pain, grief and suffering due to such diseases. The use of similar economic evidence by FSA-like organisations in three other countries was also assessed.

Most of the existing valuation studies have been designed with a very narrow focus (e.g. one food product, one FBD, a small number of possible changes in the risk of FBD). Therefore, in most cases the results of these studies these cannot be transferred to appraise other food products, FBDS or a greater set of risk changes.

As for all other valuation contexts, studies from outside the UK (but from countries sufficiently similar to the UK) can be transferable only as an indication of the kind of values that may be estimated in the UK. It would not be advisable to use them for policy appraisal.

Studies to date (regardless of their focus and location) are useful in understanding the relative merits to different valuation designs. The approaches suggested further on in this study exploit the methodological advancements made over the years.

**The recommended valuation approach**

1. **Microbiological FBD:** a choice experiment in which ‘safer food’ is defined in terms of risk, severity and duration of FBD, food types and type of people affected. Respondents would be asked to choose their most preferred outcome including the associated extra food costs.

2. **Chemical and radiological contaminants:** a contingent valuation study in which the respondents are asked to state their WTP for different FSA activities or outcomes (for example, maintaining or reducing the current level of contaminants).

3. **Allergens:** could be included in the choice modelling exercise in (1) above as a cause of particular FBD symptoms or could have a separate contingent valuation design for a specific FSA led action to reduce the risk associated with allergens (for example, WTP for changes to product labelling related to potential allergens).

Both contingent valuation and choice modelling designs are finalised through qualitative research (focus groups, detailed interviews with debriefings) and testing (pilot surveys). Some design elements can only be finalised through such research.

**Microbiological FBD**

**Which method and why?**

A choice experiment design is recommended for estimating the WTP to avoid pain, grief and suffering due to microbiological FBD for the following reasons:

- There seems to be sufficient knowledge and data to define the impact pathway and the changes FSA activities could achieve in the risk of FBD as well as links to pain, grief and suffering and who is at risk.
- The high number and variety of activities that the FSA undertakes (and may wish to subject to economic analysis) means a contingent valuation for each decision is impractical.
If required, the choice modelling exercise could be followed by:

- A contingent valuation question that reduces the risk of all microbiological FBD to the lowest feasible level (the extent of potential reduction in risk, symptoms severity and duration etc., should be determined by the FSA).
- A scoring system to establish whether individuals have preferences for different types of activities the FSA could undertake to reduce microbiological FBD risk.

**Whose values?**

The choice experiment should be applied to a sample of respondents that are representative of the overall UK population, with boosted samples for different groups, if the FSA is interested in the WTP of different groups.

**Expected results**

A choice experiment would produce results in terms of:

- £ per household (to avoid the pain, grief and suffering associated with a unit change) per attribute per year.
- Attributes can include different types of FBD, risk, severity, duration and similar factors.

The results can also be summarised in a look-up table that enables the FSA to find values: £ per household per year per attribute. The FSA will need to identify minimum and maximum impacts of its activities in terms of changes in these attributes to identify the appropriate value estimate and aggregate the values.

**Chemical and radiological contaminants**

**Which method and why?**

A contingent valuation design is recommended as it is not possible to define the choice experiment (CE) attributes at the same level of detail as for microbiological FBD. General descriptions of outcomes will still have to be provided.

The disadvantage of this approach is that it may be more difficult to isolate the WTP for FBD-related pain, grief and suffering. Whether this disadvantage can or cannot be overcome (and hence the final decision on whether contingent valuation or choice modelling designs are to be preferred) can only be established through qualitative research. If not, alternative designs can be tested at that stage.

**Whose values?**

The survey should be applied to a sample of respondents representative of the overall UK population, with boosted samples for different groups, if the FSA is interested in the WTP of different groups, for example, the elderly or immunocompromised (note that the latter will have to be self-declared in any survey and there are associated ethical issues).

**Expected results**

The results can be expressed in units of £ per household per year for a change from the current situation to the new improved situation, or £ per household per year for the FSA activity(ies) or outcomes of FSA activity(ies). How the results are expressed will depend on the final methodological design adopted.

**Allergens**

**Which method and why?**

There are two options here:

- Impacts of allergens can be included as an attribute in the same choice experiment as the microbiological FBD to estimate WTP to avoid pain, grief and suffering (explaining only those with allergies would be affected); or
WTP for specific FSA activity(ies), such as changes to product labelling, can be estimated through a contingent valuation design. It may be possible to isolate WTP for pain, grief and suffering from other perceived benefits but this can only be concluded during qualitative research.

**Whose values?**

Both options above can be applied to a representative sample of the general population and/or a special sample of those with allergies (which should still have sufficient variation in terms of socio-economic characteristics). The sample would need to be identified through self-declaration.

**Expected results**

The results can be expressed in units of £ per household per year to avoid pain, grief and suffering associated with a case of allergic reaction. If sufficient variety in allergy symptoms and severity and risk can be provided, a look-up table similar to the one for microbiological FBD can be prepared.

If a particular FSA activity like changes to product labelling mentioned above is presented, the result will be in terms of £ per household per year for such a labelling system (or other FSA activity(ies) described).

**Implementing the recommended valuation approach**

The research is recommended to follow a best practice work plan for a stated preference study involving qualitative research, pilot survey, several iterations of the questionnaire, main survey, data analysis, reporting and peer review throughout the research.

Options are provided for three different specifications: high specification (all three surveys listed above); medium specification (survey 1 above, a booster sample for people with allergies and some WTP questions on chemical and radiological contaminants included in the same survey) and low specification (survey 1 above alone). A more developed research proposal would be necessary once the FSA’s precise evidence needs are established.

Research could be phased to allow for economies of scale in the qualitative research phase but staggered at the main survey stage to spread the cost, and address the highest priority research needs first. For example, it would be possible to start with a number of focus groups to test preferences related to all three surveys and decide, based on the findings of the qualitative research which specification to commission. Such a phased approach is common in similar large scale valuation exercises.
1 Introduction

This report is a formal deliverable prepared as part of a study to identify a method to estimate consumer willingness to pay for food safety health outcomes. The study was delivered by a team from ICF GHK and eftec for the UK Food Standards Agency (FSA).

The assignment reviewed existing evidence and literature related to the estimation of consumer willingness to pay for food safety health outcomes and recommended options for a research programme for the FSA to follow to develop a set of WTP values. The study ran from January 2013 to August 2013 and included the review of 29 economic valuation studies and how similar analysis is undertaken by official agencies in three other countries (USA, Australia and New Zealand) and discussions with the FSA.

1.1 Background

It is estimated that there are about a million cases of foodborne disease (FBD) in the UK each year, resulting in 20,000 hospital admissions and 500 deaths. Most of this illness is caused by microbial pathogens such as viruses and bacteria. They can contaminate food at any stage of the food chain. The total economic cost of illnesses caused by foodborne pathogens has been estimated at £1.9 billion a year (FSA, 2012b).

The Food Standards Agency (FSA)’s core remit covers food safety policy and enforcement from the moment foods exit the farm or are imported in the UK to the point of sale to the final consumer (FSA, 2011c). As part of this remit, the FSA is also responsible for the strategy for reducing microbiological foodborne diseases (FBD) and chemical and radiological safety.

In this context, the key FSA objectives include (FSA, 2011a):

- Monitoring trends in foodborne illness.
- Promoting a hazard analysis-based approach to food safety management.
- Promoting and providing guidance for producers, retailers, caterers and the general public.

To meet these objectives the FSA undertakes a range of regulation and enforcement activities:

- Approval and monitoring of food premises.
- Cooperation with local enforcement officers.
- Monitoring.
- Guidance and advice for industry.

To assess the most efficient and effective ways of performing these activities, the FSA uses epidemiological data on the FBD burden, and economic data on the cost of the burden of FBD. Currently the FSA’s estimate of the cost of FBD in the UK comprises of: NHS costs, lost earnings and other expenses and the costs of pain, grief and suffering association with illness and/or death³.

The FSA currently does not have an estimate of the economic cost specifically related to the pain, grief and suffering caused by FBD, chemical and radiological contaminants and allergens. Instead values of preventing fatalities (VPF) published by the Department for Transport (DfT) are used: in particular, the ‘human cost’ component of the VPF: pain, grief, suffering to the individual, family and friends and for fatalities, the intrinsic cost of life enjoyment (excepting consumption of goods and services).

³ The assessment of a decision involves comparing the cost of FSA intervention (regulatory cost and cost to the businesses and customers) and the benefit of FBD avoided (avoided NHS costs, lost earnings and pain, suffering and grief).
The DfT VPF estimate dates back to 1991 and it is not specifically related to food safety health outcomes. This is not an ideal situation as ever more scrutiny is being given to interventions and decisions at a time when resources are scarce and competitiveness is a pressing concern. Therefore, the FSA commissioned this study “to investigate if it would be feasible (and result in a more accurate assessment of the costs and benefits) to estimate a Willingness to Pay (WTP) to prevent a fatality from FBD or avoid illness associated with FBD”. Such a study can update the 1991 estimates and better link them to the food – health context thereby also test (by comparing these to transport estimates) whether the value of avoiding pain, grief and suffering is context specific.

The objective of this study is to assist the FSA to prepare a research programme to estimate this cost, i.e. to estimate the Willingness to Pay (WTP) to avoid pain, grief and suffering associated with illness and/or death caused by microbiological pathogens, chemical and radiological contaminants and allergens.

The specific objectives are to:

- Review and document current international approaches for valuing social impacts resulting from food safety initiatives.
- Critically review estimated values of existing WTP studies.
- Provide a critical review and appraisal of the methods available for the valuation of food safety outcomes.
- Provide a comparative analysis of advantages and disadvantages of the key approaches and methodologies to estimate consumer WTP.
- Recommend an approach or methodology that satisfies FSA requirements (if considered feasible).
- Recommend an appropriate experimental design and methods (e.g. questionnaires, sampling protocols).
- Identify key issues and debates within the academic literature regarding the validity and reliability of the recommended approach/approaches.

1.2 Report structure

The rest of this report is structured as follows:

- Section 2 summarises the conceptual approach to economic valuation.
- Section 3 summarises how the appropriate economic valuation approach was identified.
- Section 4 discusses how the conceptual approach to economic valuation can be applied in the context of FBD.
- Section 5 outlines the research steps necessary to implement the recommended approach.

The report also contains the following annexes:

- Annex 1: The FSA (its role and its evidence needs) (to provide further background).
- Annex 2: Foodborne diseases and food contaminants (to help determine the scope and define the ‘good’ being valued).
- Annex 3: Sets out the process of how the project team designed the recommended economic valuation approach.
- Annex 4: Existing economic value evidence related to FBD.
- Annex 5: Focus group protocol.
- Annex 6: References.
2 Economic valuation: conceptual approach

This section introduces important concepts which should be considered when planning research to estimate WTP to avoid the pain, grief and suffering associated with microbiological FBD, chemical and radiological contaminants and allergens and any resulting fatality. It sets out the questions which should be addressed to identify the most appropriate valuation approach for this purpose. The answers provided here and the detail that follows in Section 4 is based on the literature review and experience of the team.

2.1 What is economic value?

Economic valuation investigates individuals' preferences for a change in the provision (quality and/or quantity) of a good or service. In the context of this study, the change under consideration is the reduction in the pain, grief and suffering associated with microbiological FBD, chemical and radiological contaminants and allergens and any resulting fatality.

There are many reasons why people may have preferences for, or attach different values to, a good or service. The typology used by economists to explain these reasons is called 'total economic value' (TEV). The TEV typology breaks down the reasons why people may have values for a good or service, for example because they make use of it directly now (use value), may want to use it in future (option value), may be concerned about others using it now (altruistic value), and may be concerned about others using it in future (bequest value). For environmental and cultural goods and services, people may also value these for the sake of their existence without any human use (existence value). In the context of this study, use values correspond to benefits from consuming safe food and securing this consumption for the future for self (option value) and for others (bequest value). Individuals could also benefit from knowing that others (in particular vulnerable groups) have access to safe food. Annex 4 provides a more detailed description of TEV.

Valuation methods generate outputs in monetary terms by observing or asking for statements of what individuals are willing to pay (or accept as compensation) for the changes in question. These are generally reported for the entirety of TEV as separate estimation of each motivation for value is difficult and not necessary. The monetary expression of individuals' preferences in the context of this study may include:

- Consumer willingness to pay (WTP) to avoid microbiological FBD, chemical and radiological contaminants and allergens from food or food related products.
- Consumer WTP for risk reductions in relation to specific illnesses e.g. specific types of FBD such as campylobacteriosis and listeriosis and specific types of food related chemical and radiological contaminants and allergens.
- Consumer WTP for risk reductions in relation to specific outcomes e.g. symptoms, chronic sequelae, mortality, latent and contemporaneous illnesses, duration in hospital.

In a survey based (stated preference) method, it is also possible to isolate WTP for 'pain, grief and suffering' associated with the above by reminding respondents that other components of costs are covered elsewhere. Such isolation is not possible for methods that use data from consumer food purchase behaviour and market prices.

2.2 The four key questions to answer when designing an economic valuation study

There are four key questions which need to be answered to develop a valuation research strategy:

1. What is the good to be valued?
2. What is the change in the good to be valued?
3. Whose values should be taken into account?
4. What methodology should be used to estimate economic value?
Answers to each of these questions, in the specific context of this study, are provided below.

2.2.1 What is the good to be valued?

The term ‘good’ is used here in its meaning in economic analysis: any tangible or intangible product or service that increases human wellbeing. In the context of this study, the good is safe(r) food. This is a rather broad definition in that it concerns all threats to safety and all food types. However, only by starting with this broad definition, it would be possible to hone in on the WTP to avoid risk, grief and suffering. If the good is defined as the risk, pain, grief and suffering specifically associated with microbiological pathogens, chemical and radiological contaminants and allergens, the WTP estimated may capture all preferences about safe food overestimating the WTP component needed.

2.2.2 What is the change in the good to be valued?

Economic valuation is never about an absolute all-encompassing value. There are two reasons for this. Firstly, the absolute value for most goods and services subject to valuation is infinite (for example, food, clean air, clean water etc.). Secondly, even if not infinite, it is not necessary to know the absolute value as policy decisions are typically about marginal, i.e. relatively small, changes to the provision of goods and services. Therefore, the values estimated by economic valuation should match the magnitude of change rather than the absolute value. Irrespective of the good or service valued, valuation is always about whether people prefer (or not) a change in the quality and/or quantity of that good.

In terms of this study, the change under consideration is the likely change(s) due to the activities of the FSA. These changes could be in terms of:

- The risk to human health due to microbiological pathogens, chemical and radiological contaminants and allergens (as listed in Annex 2).
- The severity of symptoms (from a one-off mild nausea to death).
- The duration of symptoms (e.g. number of days symptoms suffered).
- Who is at risk (e.g. elderly, children, people with allergies)?

The valuation could be conducted ex post (of a change that has already happened) or ex ante (of a planned and measured or indeed a hypothetical yet still realistic change). The WTP to secure (forgo) the defined change can then be compared, alongside other measures of benefit, to the (public and private sector) costs of implementing the relevant policy.

If the change being valued relates to the risk of mortality, the value measured is referred to as Value of Statistical Life (VSL). VSL is the aggregation of individuals’ willingness to pay for fatal risk reduction and therefore the economic value to society to reduce the statistical incidence of premature death in the population by one.

2.2.2.1 The change in the good is defined using qualitative and quantitative methods

Qualitative evidence on the relationship between food consumption and FBDs:

- The different types of microbiological FBDs, the types of food affected, the causes of the disease (for example, poor food hygiene) and the impacts of the diseases (short and long term). Similar information is needed for other contaminants associated with food safety risks, such as allergens, chemical and radiological contaminants.
- How to reduce risks of contracting the microbiological FBDs and/or being exposed to chemical and radiological contaminants, and allergens, and also changes can be expected to be possible in terms of the FSA’s remit.

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4 It is understood that the main application here will be in ex ante appraisal of individual options for actions by the FSA and also the relative priority given to these options
Quantitative evidence on the factors likely to affect individuals’ WTP:\(^5\):

- The current level of risk of contracting the FBD (for example, the number of incidents in a given year, the type of incidents that occur most often).
- The likely change resulting from proposed measures to reduce the risk of contracting the microbiological FBDs (e.g., how many incidents could be avoided) – or minimum and maximum risk reductions that are feasible (even if details of how to achieve these reductions are not yet designed).
- If information on impact pathways for chemical and radiological contaminants and allergens allows this risk reduction to be reported, these should also be included. If not, types of FSA actions targeted at reducing the occurrence of these contaminants and allergens should be valued.
- The severity of the microbiological FBD, or illness from chemical and radiological contaminants and allergens expressed in some kind of standardised unit (for example, sick days, type of symptom, probability of death).
- The duration of different symptoms.
- The number of people (the population) affected.

Both qualitative and quantitative evidence listed above are likely to influence individuals’ WTP and hence should be covered in a valuation study. The form of this coverage depends on the valuation method chosen. Annex 3 provides a discussion of the change in the good to be valued.

### 2.2.3 Whose values should be taken into account?

Economic valuation should investigate the preferences of those who benefit and those who lose from a given change. Gaining an understanding of the type and scale of beneficiary groups is an important part of the initial stage of any valuation study as this understanding shapes the subsequent selection of method, data and sampling strategies.

In the context of FSA interventions (or wider measures that reduce the risk of getting a FBD and/or the consequence associated with having one), the benefits accruing to the entire population and to sub-groups (e.g., elderly, children, pregnant women, those who are allergic to specific types of food) may be different. The ‘losers’ are those who have to finance the change. The two groups may overlap, i.e. consist of the same people (e.g., if the intervention is funded from tax revenue or through higher prices for food being purchased). Costs subsumed by food producers and retailers are included in the cost of FSA intervention and hence need not be estimated separately.

However, individuals’ may also have altruistic preferences for others affected by microbiological FBD, chemical and radiological contaminants and allergens. Such altruistic motivations need to be acknowledged as they could be significant for certain beneficiary groups (e.g., children). Some of these altruistic motivations may in fact be linked to the cost incurred by the individual (e.g., cost of time, lost work days, inconvenience imposed on the carer if caring for a child or the elderly).

### 2.2.4 What methodology should be used to estimate economic value?

There are three principal methods commonly used to estimate economic value:

1. **Market prices**
   
   Valuation using market prices requires that the good is bought or sold (i.e. ‘traded’). Market prices should be used whenever possible when the good has a market price that can be verified and trusted (e.g., cost to buy a type of food, price of labour). For example, labour market prices are already used to estimate the cost of work days lost due to

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\(^5\) This list includes the factors that are related to the health outcomes. There are other factors that are related to the individual (e.g., socioeconomic factors, health state and previous experience with the relevant symptoms etc.) which are also crucial factors and are taken into account in the recommended approach in Sections 4 and 5.
health outcomes. However, as pain, grief and suffering are not traded goods, data on market prices cannot provide a direct measure of WTP required in this context.

2. Revealed preferences

Valuing a change using revealed preferences involves analysis of customer behaviour data relating to a traded good to infer the value of a good that is not traded. For example, consumers can pay for cleaning products that can reduce the health risks associated with food preparation\(^6\). The volume of sales of these products for the given price could indicate how important (valuable) people think this risk reduction is, i.e. a trade-off between the reduction in risk and cost of the product. The price premium paid for food from a production process associated with a lower health risk can also be used to value the unit risk reduction and associated outcomes. However, whether an individual consumer makes this purchase and how much they pay depend on the availability of alternatives and what information the individual has on the products and relative risks. In addition, this approach is likely to capture a WTP to avoid all outcomes of FBD: medical expenses, loss of productivity and pain, grief and suffering\(^7\). **Stated preferences**

Stated preference data are collected through surveys. Data that are needed to estimate WTP and explain the variations in WTP statements across different change scenarios and across individuals are collected. These include attitudes, behaviours and preferences (trade-offs they make between reduced FBD risk and outcomes and money). If correctly designed, the surveys can elicit specific willingness to pay to avoid pain, grief and suffering (net of other motivations for paying for safer food). There are two main types of stated preference methods: (i) contingent valuation in which respondents are presented with a given policy choice and asked for their WTP, and (ii) choice experiment in which respondents are presented with several choices of different policy options, each defined in terms of its characteristics (or attributes) and are asked to choose their most favoured. As one of the attributes is the cost, respondents’ WTP is inferred through the choices they make.

There are two other methods that have been used to assess people’s preferences for different health outcomes:

- **Quality-adjusted-life-years (QALYs)** — different health states are expressed on a scale between 0 for death and 1 for full health and then these values are multiplied by how long the states last. One QALY is equivalent to 1 year of life in full health (Weinstein and Stason, 1977). Individuals can be asked for their relative preference for different health outcomes expressed as QALYs.

- **Subjective wellbeing** is measured by global evaluations of life overall (e.g. life satisfaction) or by experiences of daily effects (e.g. feelings about yesterday). Different risks can be assessed by the individual in terms of their effect on the wellbeing.

QALYs are widely used in health decision making. By comparing how many QALYs different health interventions are expected to generate with how much those interventions are expected to cost, it is possible to show the cost effectiveness of different uses of resources (Dolan and Metcalfe, 2012). The same comparison and contribution to cost effectiveness can also be achieved by using subjective wellbeing scores.

It is possible to use QALYs as part of quantifying the health outcomes which then can be valued in monetary terms. This would need to be further tested.

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\(^6\) The method that analyses spending to reduce risk faced by the individual is also called ‘aversive behaviour’.

\(^7\) *Medical expenditure and lost income and productivity due to FBD are already provided by the IID study (FSA, 20001c) and hence are outside the scope of this study.* http://www.foodbase.org.uk/results.php?f_report_id=320
Selecting the appropriate valuation approach

In order to determine what the best approach is, in terms of the valuation methods / value evidence data, the following criteria are used (UKWIR, 2010):

- If market price data exist and are relevant for the given analysis, such data should be preferred as they can be verified.
- If market price data do not exist then revealed preference data are preferred as they show how people’s actual behaviour reflects their preferences.
- If neither market nor revealed preference data exist or are not appropriate, stated preference data should be used.

The methodological development for this study reviewed market prices and revealed preference literature, first. No data have been found from actual food or related (e.g. vegetable washes) markets which can be used to isolate WTP to avoid pain, grief and suffering associated with FBD.

The review of the stated preference studies showed that these have been designed with a very narrow focus (e.g. one food product, one FBD, a small number of possible changes in the risk of FBD) – too narrow (not generalizable) for transferring the evidence across the FSA activities.

The findings of the literature review, and a summary of the studies reviewed, are included in Annex 4. The valuation studies reviewed show that:

- It is possible to produce a valuation of pain, grief and suffering, lost leisure time, and other costs that cannot be estimated through market prices or revealed preference (e.g. basic cost of illness approach).
- Most have determined what their affected population is by using census data to compile a demographically similar sample based on age, gender, education level, income, and household size.
- Most have valued a change in risk but some have sought to value the severity of a FBD in terms of its pain, grief and suffering through the use of QALYs. The QALYs can then be valued using existing valuations or could potentially be used to quantify the change valued in a new WTP study.
- Individual preferences for risk reductions vary. This variation has been explained by socio-economic characteristics such as income, age, health states and previous experience of FBD, whether the household has children and whether they prepare most of their food at home.
- The term ‘consumer’ can be broad (i.e. general population) without making a distinction between households and businesses.
- Surveys have limitations in how information on disease incidence is presented. More detailed and realistic data on the health consequences of FBD should be presented for more detailed WTP estimates.
- WTP can be estimated despite the randomness of foodborne illness cases (i.e. no one can predict exactly who will suffer from the hazard).
- There seems to be differences between WTP estimates from elderly (lower WTP for FBD avoided) and for FBD affecting children (higher WTP for FBD avoided).
- Statistically more robust results can be produced if a real and binding payment mechanism can be used (e.g. increase in general taxation, cost of weekly food shopping).

The evidence base raises questions, but also provides some signposts, about how far values can be regarded as generally applicable or case-specific, and how the complexity of disease, impact, population variation can be managed.
Given that (a) market prices and revealed preference data are not sufficient to isolate a WTP for pain, grief and suffering and that (b) stated preference method has been successfully used in the literature for FBD related issues, a **stated preference approach** is deemed to be the only way to estimate WTP for pain, grief and suffering alone.

A stated preference study could also allow WTP for different FBD ‘scenarios’ (risk, severity, duration) to be estimated; and collect data on what (if anything) people spend money on to reduce the risk of FBD they believe they face.

Both contingent valuation and choice modelling are able to generate WTP estimates for a given FSA activity (directly with contingent valuation (CV), inferred through summing up values of individual attributes with choice modelling). The WTP estimates can then also be used for comparing relative benefits of different FSA action options. This depends on how much information FSA has to link its actions to outcomes that are included in the valuation questionnaires. This is why it is crucial that FSA is involved in the design of the survey questionnaires, in particular identifying, defining and quantifying the attributes.

In order to select which of the two stated preference methods would be the most appropriate in a given valuation case, the following criteria can be used:

- **The nature of the good and the change to be valued, and how much is known about these:**
  - If there are a small number of well-defined policy choices to make, then contingent valuation should be preferred: through this the actual policy choices could be presented to respondents.
  - If policy choices are not yet known, or there are many possible policy choices as in the case of the FSA, then choice experiment is preferred: through this different policy options can be defined in terms of their attributes. The levels of the attributes are set to cover all known eventualities so that different policy options can be created using combinations of different levels of different attributes.
  - However, choice modelling can only be possible if attributes and their levels can be agreed upon. This need not be the result of scientific analysis, but stakeholder agreement may sometimes suffice.
  - The more familiar the individuals are with the good and the change presented, the better their ability will be to process more information about the good / change. For this reason choice modelling (which provides more information in the form of attributes and levels these take) should be applied.

- **Data and time available for valuation:** Analysis using market prices usually takes shorter time. Revealed preference methods are mistakenly thought to be easier than stated preference methods, while in reality could require just as complex and time consuming surveying to collect data and econometric models to analyse them.

Notwithstanding the above considerations about contingent valuation and choice modelling, good practice studies typically use both designs in the same survey. It is recommended that, subject to information availability for microbiological FBD, chemical and radiological contaminants and allergens, both CV and choice experiments (CE) are included in the FSA survey.
4 Defining the recommended approach

This section provides further detail on the recommended stated preference approach by answering the four key valuation questions included in Section 2. The answers are based on the lessons learnt from the literature review as well as consultation with the FSA. It is important to note that definitive answers to the four questions can only be established through qualitative research. Practical guidance about how to undertake such research is provided in Section 5.

4.1 What is the good to be valued?

The FSA is interested in obtaining a WTP to avoid pain, grief and suffering associated with microbiological pathogens, chemical and radiological contaminants and allergens. Our recommended approach is to use stated preference design as stated in Section 3. However, as there are different levels of information (in particular on impact pathways) available for the three causes above, slightly different valuation designs may be required. These differences are explained further below and in Section 5.

When faced with food consumption choices people are likely to have an overall WTP for safe, tasty and nutritious food and are unlikely to automatically think about the WTP specifically associated with avoiding pain, grief and suffering. Therefore, the overall good needs to be described in a familiar way, i.e. ‘safer food’. Once the familiar context is established, it would be possible to focus on the specific good, i.e. safer food that has less than current risk of microbiological FBD, chemical and radioactive contaminants and allergens. As well as risk, other attributes of safer food could also be included in the design, such as:

- **Risk of FBD:** Prevalence of FBD in the population (expressed on individual or household basis).
- **Severity of symptoms:** Non-hospitalised, hospitalised, death OR gastroenteritis; non-gastroenteritis illnesses; sequelae OR QALYs, DALYs, quality adjusted life day (QALD).
- **Duration of symptoms:** Hours, days, death.
- **At risk population:** Total population, sub-populations, and vulnerable groups.
- **Food type:** Meat, vegetables, dairy, fish, processed, fresh etc.

Whether or not any or all of these attributes, and others that may be identified, can be applied to all three food risks to human health will require further work. Such work will involve FSA input in identifying the impact pathways and qualitative research to determine the level of information respondents can process. It is our understanding at the moment that considerably more is known from medical and epidemiological sources about the role of microbiological contaminants in FBD compared to the role of chemical and radiological contamination.

4.2 What is the change in the good to be valued?

4.2.1 Microbiological contamination

There is a significant amount of information available from medicine, epidemiology and social and economic research about microbiological pathogens and related FBD. Examples of how the potential attributes of safe food associated with microbiological contamination can be defined are provided in Table 4.1.

Individuals would be asked to choose between different options that present different levels of each attribute. These levels are the likely future minimum and maximum values the attributes can take due to the influence of the FSA activities. The difference between these levels and the current situation is effectively the change individuals are asked to value for each choice option.
The ‘cost’ attribute provides a means to compare between preferences expressed across the other attributes.

Table 4.1 Attributes of ‘safer food’ in the context of FBD and the levels these may take

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Levels of the attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of FBD</td>
<td>e.g. expressed as 1 in 100,000 of the population, based on reported and estimated outbreaks, cases, hospitalisations, deaths, number of allergic reactions (different severity), cases of death due to chemical and radiological contamination. In addition or instead of these expressions of national risk, risk to individual groups or the individual can also be presented. However, there are two problems with individual risk presentation. The first is that such individual risk may not be possible to calculate (and not entirely within the control of the FSA, e.g. person’s own food preparation habits). The second is that such statements are likely to invite emotional responses which are not valid in economic analysis and may even render the survey unworkable. Before a final decision on this can be made, different expression of risk (and their comprehension by the individuals) must be tested through qualitative research.</td>
</tr>
<tr>
<td>Severity of symptoms</td>
<td>Non-hospitalised, hospitalised, death OR Gastroenteritis; non-gastroenteritis illnesses (invasive listeriosis, toxoplasmosis, hepatitis A); sequelae (haemolytic uraemic syndrome, irritable bowel syndrome, Guillain-Barré syndrome and reactive arthritis) OR QALYs, DALYs, QALD</td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td>Hours, days, death.</td>
</tr>
<tr>
<td>Who is at risk?</td>
<td>All, children, elderly, those with allergies, etc.</td>
</tr>
<tr>
<td>Food type</td>
<td>All, meat, chicken, fish and seafood, fruit and vegetables etc.</td>
</tr>
<tr>
<td>Cost</td>
<td>e.g. £x increase in weekly food bill or general taxes of other vehicle. No change in the current situation. X is varied across policy combinations and/or individual respondents. These values are randomly distributed and determined through qualitative research. They are not directly linked to the actual cost to the FSA or the industry of providing different levels of the above attributes.</td>
</tr>
</tbody>
</table>

The FSA cannot eliminate the risk of FBD and hence the pain, grief and suffering associated with it. As such the economic valuation methodology should only value the change that is reasonable to expect the FSA to deliver. That is, potential changes to the attributes should relate to the activities of the FSA and the likely impact the FSA can reasonably expect to have. This is so that the WTP for avoiding pain, grief and suffering can be linked to the amount or pain, grief and suffering that can reasonable avoided through the FSA activities and so that the results can be used in the appraisal of these activities. WTP estimates would reflect the individual’s preferences to avoid pain, grief and suffering to themselves and others (the latter through the ‘who is at risk?’ attribute). However, the risk will be presented at the UK level since the true risk to an individual is not possible to calculate and, even if it was, would likely to lead unrealistically high WTP expressions or refusal to take part in the survey (the so called ‘protest’ zero response in the literature).

Further detail about how the change to be valued is defined is included in Annex 3.

Chemical and radiological contamination

Due to the complex impact pathways, the change that can be initiated by the FSA with respect to chemical and radiological contaminants seems only likely to be described in

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8 The relationship between chemical and radiological contamination and illness is not straightforward. Instead of asking about individual attributes, individuals could be asked about their values in more general terms that will result in a WTP value of use to the FSA.
general terms: maintain current standards, improve current standards etc. or in more quantitative terms if quantitative data are available.

Individuals could be asked about how they value (FSA) activities to control chemical and radiological contamination, what they perceive the benefit to be of knowing that such contaminants are controlled, and what (if anything) they are willing to pay for activities to control the contaminants. Individual FSA activities (e.g. a better labelling system or tighter controls at food production stage) can also be tested.

**Allergens**

The change in the attributes of safe food associated with allergens could be expressed in terms of the number and severity of allergic reaction symptoms (including death). This could be in a separate survey or as an additional attribute to the list in Table 4.1 above.

Determining individuals’ WTP to avoid symptoms associated with allergens is complicated by the fact that allergens only cause symptoms to individuals with food allergies. Eliciting WTP values related to allergens will require that questions are posed to two groups; those with allergies, and those who do not have allergies but may still be willing to pay something to reduce the pain, grief and suffering of those who do. The valuation questions could be formulated using the attributes of safe food listed above, or could be constructed as simpler choices between different FSA activities. How these two groups can be sampled (together or separately) is discussed in Annex A3.4.

### 4.3 Whose values should be taken into account?

Two questions need to be addressed to determine whose values should be taken into account in a valuation study related to WTP to avoid pain, grief and suffering associated with FBD.

1. **Who / what group(s) to ask the WTP question to?**

   A sample representative of the general population should be included in the valuation survey as everyone is a consumer of food. If WTP of special groups needs to be estimated, for example those with allergies, it would be necessary to sample a higher proportion of these groups as they are unlikely to be well represented in a sample of the overall population.

2. **Who / what group(s) to ask the WTP question about?**

   The valuation survey should establish whether individuals hold altruistic values related to avoiding grief, pain and suffering related to FBD. That is, the survey should capture individuals’ willingness to pay for other individuals / groups to avoid grief, pain and suffering associated with FBD. This could include, for example, an individual’s WTP to reduce the risks of elderly people contracting FBD.

   This is why the ‘who is at risk?’ attribute is added to the list of potential attributes in Table 4.1. Questions about who is affected should be asked of the general population to ensure responses from a representative sample of the overall population, rather than a limited sample of households with vulnerable members (such households are likely to provide a higher WTP value).

Further discussion on the population of interest can be found in Annex 3.

### 4.4 What methodology should be used to estimate economic value?

As mentioned in Section 3, the evidence review and consideration of the needs of the FSA suggest that a ‘stated preference’ approach is the most appropriate. Different stated

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9 Identifying potentially suitable quantitative data would require additional research during the initial design stage for a valuation study.

10 The evidence review (Annex 4) demonstrates that the general population is the most common choice in the previous studies.
preference methods will be necessary for the different types of contaminants: microbiological, chemical, radiological and food allergens (this is subject to qualitative research).

4.4.1 FBD caused by microbiological pathogens

A choice modelling design is recommended for this for the following reasons:

■ The impact pathway can be defined. There seems to be sufficient knowledge and data to define the notion of ‘safer food’ in terms of the attributes of risk of FBD, food type, symptom description, duration and severity, food type and who is at risk and so on.

■ At the same time, the large number and variety of activities that the FSA undertakes (and hence needs to subject to economic analysis) makes a contingent valuation for each decision impractical.

The choice modelling exercise could be followed by:

■ A contingent valuation question that eliminates all risk of all FBD or minimises it (how low the risk, symptoms, duration etc., can go should be determined by the FSA).

■ A scoring system to see if individuals have preferences for different types of activities the FSA can undertake.

Expected results

A choice modelling would produce results in terms of:

■ £ per household to avoid the pain, grief and suffering associated with a unit change per attribute per year. Household is generally used to match the household budget. Alternatively, the question can be set for WTP per individual.

■ The results can also be summarised in a look-up table that allows for the FSA to find values: £ per household per year to avoid pain, grief and suffering for different combinations of FBD risk – severity – duration. The FSA will need to identify what risk, severity and duration outcomes their activities will result in, to be able to read across such a table and aggregate the values.

■ The aggregation will be as follows: £ per household (or individual) per 1 unit change per attribute per year multiplied by total unit change per attribute per year, summed over all attributes, UK household (or individual) population and the appraisal period. For example, £ per household per 1% reduction in risk of FBD per year x X% reduction to be delivered by the FSA action appraised x 24 million households. Only those attributes that are affected by a given FSA action should be included in the sum. Although WTP is expressed per attribute it is still to avoid pain, grief and suffering.

4.4.2 Radiological and chemical contaminants

It is not possible to identify attributes and hence design a choice modelling study for these contaminants because, as mentioned above, not enough is known about contaminant to FBD impact pathways. Therefore, definition and quantification of attributes are not possible at this stage.

A contingent valuation design is recommended for these contaminants. Instead of inferring values for individual attributes, the economic valuation approach can instead present an overall description of the activities and ask individuals for their WTP for the activities (or to avoid the pain, grief and suffering).

The disadvantage of contingent valuation is that it may be more difficult to isolate the WTP for pain, grief and suffering alone. Qualitative research is required to determine whether this disadvantage can be overcome (and hence the final decision on whether contingent valuation or choice modelling designs are to be preferred).
Expected results

The results can be expressed in units of £ per household per year for a change from the current situation to the new improved situation, or £ per household per year for the FSA activity(ies) described.

4.4.3 Allergens

There are two options for estimating WTP for pain, grief and suffering associated with allergens:

1. The health outcomes caused by allergens can be included in the same choice experiment as those caused by microbiological pathogens to estimate WTP to avoid pain, grief and suffering, and/or,

2. WTP for specific FSA activity(ies) such as the changes to product labelling can be estimated through a contingent valuation design. This would not isolate WTP for pain, grief and suffering but reflect the WTP based on all perceived benefits.

Expected results

The results can be expressed in units of £ per household per year to avoid pain, grief and suffering associated with a case of allergic reaction. If sufficient variety in allergy symptoms and severity and risk can be provided, a look-up table similar to the one for microbiological pathogens could be prepared.

If a particular FSA activity is presented to respondents, like the changes to product labelling mentioned above, the result will be in terms of £ per household per year for that activity (such a labelling system).
Implementing the recommended approach: next steps for research

This section outlines how the recommended stated preference approach could be implemented. The best practice work plan for this approach (based on Bateman et al, 2002) applies to all stated preference studies (regardless of the specifics of the design). The outline of the questionnaire included in Section 5.2 is also generally applicable, with the exception of the valuation scenario section which will vary depending on whether a contingent valuation or choice modelling approach is used.

There are various options for the FSA to consider as it looks at how to move forward with the stated preference approach. These options, specified by reference to scale, sample, design and cost, are presented in Section 5.3.

For the sake of brevity, FBD is used in this section to cover illnesses associated with microbiological pathogens, chemical and radiological contaminants and allergens.

5.1 Stated preference work plan

There are nine standard steps in a stated preference study (Figure 5.1). The first six steps typically include several iterations as the clearest and most neutral form of wording is identified. This section describes each of the nine steps.

5.1.1 Step 1: Initial analysis of available evidence

Initial analysis involves literature review, discussions with the client to establish evidence needs and required format of results and making a research plan. This study, which explored if valuing WTP for FBD-related pain, grief and suffering is possible, constitutes this first step. Further input would be required from the FSA in Steps 2 and 3, in particular, to provide the necessary information, steer and approval of the questionnaire before Steps 4, 5 and 7.

5.1.2 Step 2: Focus groups

Focus groups are semi-structured discussion groups led by a moderator in which participants are presented with cues and prompts about the topic of interest. The main aim of these groups is to ensure that the definitions of FBD, attributes, causes and all other information are credible, meaningful and easily understood by participants. It is also an opportunity to test how the participants can be encouraged to think about pain, grief and suffering in isolation of the other attributes of food. If it seems not possible for participants to isolate their WTP for FBD-related pain, grief and suffering in the recommend approach, alternative designs would need to be tested through these groups. Finally, different ways of asking WTP questions would also be tested.

Annex 5 presents a list of topics that should be covered in focus groups. There is iteration between each focus group; lessons learnt in one group are reflected in the revisions to the protocol for the next, to maximise the benefit of each group.

5.1.3 Step 3: Initial questionnaire design

Based on the initial analysis and focus group findings, a questionnaire is drafted to be tested first through cognitive interviews (Step 4). The sections which should be included in a stated preference questionnaire are listed and explained in Section 5.2.
5.1.4 Step 4: Cognitive interviews

Cognitive interviews are one-to-one interviews that take the respondent through the stated preference questionnaire and then through debriefing questions to ascertain their comprehension of the key sections of the questionnaire (in particular the valuation section). The aim of this step is to establish whether the respondent understood what they were asked to value is the same as what was intended by the question.

The questionnaire from Step 3 is revised in light of the information gathered from cognitive interviews.

5.1.5 Step 5: Pilot survey

The pilot survey involves applying the full questionnaire in the same conditions (that is, survey mode) as the main survey but to a small sample of respondents. If the pilot survey is successful, that is it produces responses in line with expectations or the differences can be explained, then the questionnaire is revised for the final time and goes on the field (Steps 6 and 7). Several iterations of the pilot survey (with revised questionnaires) may be required if problems with the design are revealed during the first round.
5.1.6  Step 6: Final questionnaire design

The questionnaire is finalised, incorporating any necessary revisions identified during the pilot survey. This could include, for example, removing / adding questions and expanding levels of the attributes. Section 5.2 provides further information about each section of a typical stated preference survey.

5.1.7  Step 7: Main survey

At this step in the process the questionnaire is applied to the full sample. There are two aspects of the main survey that should be decided early on in the work plan: sample size and interview method.

For a typical stated preference study a minimum sample size generally ranges between 350 - 2000 depending on the complexity of the questionnaire – the more complex the questionnaire the larger the sample required. As there is a limit to how many questions an individual can handle it is sometimes recommended to have split samples in the questionnaires. This enables different sample groups to see different versions of the questionnaire. In addition, larger sample sizes provide a larger number of observations and hence greater statistical power for subsequent data analysis. All options for sampling are discussed in Annex 3.

Interviews could be in-person (with the help of an interviewer) or online (self-administered). The latter is much less costly and thus enables much larger sample sizes. While online panels are becoming increasingly common to ensure representativeness and variety, the feasibility of explaining complex information through an online survey remains to be tested. For complex questionnaires with unfamiliar topics, in-person interviews are recommended. For a survey about WTP for FBD-related pain, grief and suffering the online method may suffice as food consumption and choice is one of the most familiar decisions individuals have to make on a daily basis. It is recommended that a limited number of in-person interviews are conducted to provide responses to compare the online responses to. The two modes should first be tested at the pilot survey stage for comparability as there are likely to be mode effects. Furthermore, representativeness of participants in panel surveys is a particular issue for food because some of the most vulnerable groups are the least likely to engage.

5.1.8  Step 8: Data analysis

Data analysis involves statistical and econometric analysis of all questionnaire responses. This includes:

- Analysis of the sample demographics (gender, age, income, education, etc.) to assess representativeness.

- Statistical summaries of the responses to all questions, especially attitudes/perceptions, uses, experiences with FBD and reasons behind choice modelling and contingent valuation responses.

- Identification of the factors that explain the variance in the WTP results (e.g. socio-economic characteristics, levels of different attributes, type of FSA activity considered, individuals’ attitudes, behaviours, life stages etc.).

- Appropriate validity testing.

- Estimation of a transferable function that explains WTP (and also generates the look-up tables.

A number of different econometric models may be utilised in analysing the data (for example, conditional logit, nested logit, and mixed logit models). The aim is to identify the ‘best-fit’ specification that explains the variation in the data.

Validity testing is a core element of the stated preference methodology. The basic elements are:

- Content validity—whether the study asks questions in a clear, understandable, unbiased and appropriate manner such that a ‘valid’ monetary valuation is estimated.
Construct validity—whether the study’s findings accord with expectations, based on comparison to similar studies and empirical results and expectations from economic theory.

5.1.9 Step 9: Reporting and peer review of results

Key findings, summary and main reports and detailed analytical annexes are produced as best practice. There will need to be some work at this stage also to ensure that the FSA teams are familiar with the new results and can use them in their analysis. Peer review is undertaken throughout the study at key milestones before significant amount of time and money is spent. This may include, for example, review of the focus group protocol, review of cognitive interview and pilot survey results, and recommendations for questionnaire design as well as review of data analysis.

5.2 Stated preference questionnaire sections

It is important that the stated preference questionnaire is designed so it collects all the data necessary to (a) set the context for the WTP questions; (b) estimate WTP and (c) explain the differences in WTP statements across different people and variations in the provision of the good that is valued. The latter is crucial to check that the answers given are thought through and valid11.

The following are the sections that appear in a typical stated preference study:

- Section A: Attitudes and opinions.
- Section B: Food consumption, preparation, eating habits.
- Section C: Experience with FBD (self and family / friends).
- Section D: Valuation scenario.
- Section E: Follow up questions.
- Section F: Socio-economic characteristics.

The rest of this section provides an overview of the purpose of each section and some example questions. The examples do not reflect the exact wording that would appear in the questionnaire (which would require qualitative research) but simply the type of questions that are relevant. The Public Attitudes Tracker and Food and You survey conducted for the FSA (FSA, 2013) would provide a useful source of information to inform the definition of questions included in Sections A, B and C of the questionnaire.

5.2.1 Section A: Attitudes and opinions

The purpose of this section is to ‘warm’ the respondents to the survey, and put food consumption and FBD (or allergens or radioactive and chemical contaminants) in the context of other, in particular, social issues that respondents may have preferences for.

The following are some examples of the type of questions that may appear in this section:

- What’s most / second most important public sector issue amongst these listed (the list to include education, crime, environmental quality, food hygiene, residues in food etc.).
- Which aspects of the food available for consumption are you satisfied with / you think needs improvement? (A list that would be tested in focus groups and cognitive interviews may include taste, price, freshness, hygiene, contaminants / residues etc.).
- Awareness and opinions about the FSA and its activities.

Questions like the above would allow us to test whether those who prioritise food hygiene issues over others and those who have a higher awareness about food hygiene issues are

11 ‘Validity’ has a specific meaning in economic valuation. WTP estimates can be said to be valid if, they confirm with the prior expectations based on other studies, empirical evidence and theory, or, any differences can be explained.
more likely to have a positive (and higher) WTP to avoid pain, grief and suffering, or vice versa.

5.2.2 Section B: Food consumption, preparation and eating habits
The purpose of this section is to explore individuals’ / households’ relationship with food and what they do / do not do to reduce risk of FBD and exposure to contaminants.

The following are some examples of the type of questions that may appear in this section:
- How often do you cook at home / eat out in a typical week?
- How do you choose where to eat / what to buy (a multiple choice answer that also includes factors that would reduce FBD risk such as checking the hygiene rating of a restaurant)?
- How do you prepare food?
- What kind of food you prefer eating?
- Are you a vegetarian, vegan or do you have any special dietary requirements?

There could also be some questions about aversive behaviour (actions taken by the individual to reduce FBD risk). For example, respondents could be asked to choose the option(s) that apply to them:
- Do not go to restaurants because I think they are dirty.
- Pay extra to make sure the food I buy is non-allergenic food e.g. nut or gluten free.
- Buy special vegetable washes and washers or other products to reduce dirt and contaminants.

5.2.3 Section C: Experience with FBD (self and family / friends)
The purpose of this section is to identify individuals who have experienced FBD, or known of someone close who has, and to identify those who have allergies (and if so if they have experienced any food related symptoms).

The following are some examples of the type of questions that may appear in this section:
- Do you consider yourself healthier than average population?
- Have you or someone in your family suffered from an FBD (e.g. to be provided in the question) in the last 12 months?
- Have you or that person needed medical treatment for FBD? If so, what?
- Have you or that person lost any work days as a result of FBD? If so, how many?

5.2.4 Section D: Valuation scenario
The purpose of this section is to ask the WTP question. For this to be credible, the following information also needs to be provided:
- An institutional setting that explains who is responsible for the current situation, who will instigate and implement the change, and who will receive the payment of the WTP if it was made in reality.

This is where the FSA’s purpose, remit and activities could be presented (in a couple of paragraphs and/or graphically). This is to make it clear to the respondents that the changes they will be asked to value are possible to link to the FSA activities (if not a one to one link, they should be within the realms of possibility). It is also to make it clear to them where their money would be spent and who will be responsible for achieving the changes they express preference for.

- The good to be valued, including its attributes for a choice modelling design or general definition of the good for a contingent valuation question (which may or may not use the structure of attributes).
The choice modelling exercise – show-cards displaying the policy choices (baseline and up to two alternatives) defined in terms of different levels of attributes (including the cost) and how the respondent is asked to choose their most preferred option (or ‘the least unacceptable’ option).

The contingent valuation question – a number of ‘elicitation formats’ can be tested here: open ended questions (what are you willing to pay); dichotomous choice (are you willing to pay £x? if yes, how about £y (where y>x)), if no, how about £z (where z<x)?), payment ladders (presenting a table of values and asking the respondents to put a tick against the figures they are certain they would pay, leave blank the figures they are uncertain, and put a cross against the figures they are certain they would not pay).

Payment vehicle – through which the WTP can actually be made. Payment vehicles should be incentive compatible. That is, they should encourage considering budget constraints, other things to spend money on, and are binding. For example, voluntary donations to a food safety fund would not be incentive compatible. The most likely payment vehicle is an increase in the (weekly) food bill, but the final decision can only be made after qualitative research.

5.2.5 Section E: Follow-up questions

The purpose of this section is to understand the reasons behind the answers in Section D. Thus, respondents are asked why they did / did not express a positive WTP. These questions are generally in multiple-choice format, where the choices are determined through qualitative research.

Some reasons are ‘valid’ according to economic theory, while others are ‘protests’. For example, some respondents may state zero WTP or always choose the current situation (with no additional cost) because they do not believe the survey / think industry or government or others should pay / oppose to the idea of paying more for food. People may give invalid reasons also because they pay for something bigger than what’s been asked to them (e.g. because it’ll be good for the environment, animal welfare will improve etc.). These responses are not true statements of what WTP is asked about and should be identified and not included in the analysis. Genuine zeros, e.g. because someone does not think they are at risk, or think the current level of risk is good enough, are included.

5.2.6 Section F: Socio-economic characteristics

The purpose of this section is twofold: to check that the sample is representative of the target population (in addition to the quotas that would be set at the start of the survey), and to use the information in data analysis.

Likely questions include gender, age, education, membership of consumer groups, household size, whether the respondent has children and whether they care for the elderly, income and so on.

With regards to validity analysis, we have some prior expectations for a few of these variables, e.g. those with children, those on higher incomes may have higher WTP, all else being equal. For other factors such as gender, age, there is no consistent relationship from the literature or theory and hence no prior expectations. But the results can be tested for reasonability.

5.3 Potential scale of future research options

Table 5.1 presents some illustrative options for future research to aid FSA consideration of next steps. The options are identified by reference to:

- Sample size, survey mode and design features. The output provided by each option.
- The pros and cons of each option.

Three packages are presented:
- High specification: choice experiment for microbiological pathogens FBD and separate surveys for chemical and radiological contaminants and allergens.

- Medium specification: choice experiment for microbiological pathogens FBD, boosted sample for allergens, and a WTP question for chemical and radiological contaminants added to the same survey.

- Low specification: choice experiment for microbiological pathogens FBD alone.

Qualitative research, main survey sample size and survey mode recommendations are approximate (it is not possible to be more specific at this point in the process). Cost estimates are therefore indicative.

**Table 5.1 Illustrative options for future research to determine consumer WTP for food safety health outcomes**

<table>
<thead>
<tr>
<th></th>
<th>High specification</th>
<th>Mid specification</th>
<th>Low specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative research</td>
<td>8 focus groups</td>
<td>6 focus groups</td>
<td>4 focus groups</td>
</tr>
<tr>
<td></td>
<td>15 cognitive interviews</td>
<td>10 cognitive interviews</td>
<td>10 cognitive interviews</td>
</tr>
<tr>
<td></td>
<td>100 pilot</td>
<td>75 pilot</td>
<td>50 pilot</td>
</tr>
<tr>
<td>Sample size – main survey</td>
<td>1500+</td>
<td>750</td>
<td>500</td>
</tr>
<tr>
<td>Survey mode</td>
<td>Mostly online</td>
<td>Online only</td>
<td>Online only</td>
</tr>
<tr>
<td></td>
<td>Some in-person interviews for testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design features</td>
<td>Choice modelling for microbiological pathogen FBD</td>
<td>Choice modelling for microbiological pathogen FBD (extra questions for allergens included)</td>
<td>Choice modelling for microbiological pathogen FBD</td>
</tr>
<tr>
<td></td>
<td>Separate surveys (with the same or different samples) for microbiological pathogens, chemical / radiological contaminants, and allergens</td>
<td>Some general WTP questions for chemical / radiological contaminants</td>
<td></td>
</tr>
<tr>
<td>Output – units</td>
<td>£/household (hh)/yr for 1 % in FBD for pain and suffering only</td>
<td>£/hh/yr for a unit change in each attribute (some attributes are on/off) Plus</td>
<td>£/hh/yr for a unit change in each attribute (some attributes are on/off) Plus</td>
</tr>
<tr>
<td></td>
<td>£/hh/yr for a unit change in each attribute (some attributes are on/off) Plus</td>
<td>How this WTP is scaled if FBD is for radioactive contaminants</td>
<td>How this WTP is scaled if FBD is for specific population groups</td>
</tr>
<tr>
<td>Output – look up table</td>
<td>Look up table for biological pathogen FBD and possibly other sources too</td>
<td>Look up table for biological pathogen FBD alone</td>
<td>There may not be sufficient observations (and variation within) to allow for look up tables to be calculated</td>
</tr>
</tbody>
</table>
Pros
All-encompassing valuation package. The larger sample is more advantageous in that more variation in the questionnaire can be covered and provides more statistical power. Allows for the WTP for most common FBD and/or food types to be scaled for different food / FBD / population types. The scaling info comes from the same sample who answered the WTP question so consistency is assured. Can focus on the most common FBD and/or food types to ensure new evidence is generated for the appraisal of the majority of the FSA’s activities, if not all.

Cons
The most expensive option but can be implemented in phases – e.g. break point after Step 5 to prioritise surveys. Not much saving from phasing qualitative research as there is economies of scale to commission these together, and cross-learning between the surveys is valuable. Online only may not suffice if risk information is found impossible to convey in this survey mode. Online only may not suffice if risk information is found impossible to convey in this survey mode.

5.4 Next steps: a summary
This study answers two research questions:
1. Is it possible to estimate WTP to avoid pain, grief and suffering due to FBD?
2. If so, what is the recommended approach?

5.4.1 Is it possible to estimate WTP to avoid pain, grief and suffering due to FBD?
In order to answer the first question we reviewed the FSA’s evidence needs, explored how such questions are addressed in three other countries and reviewed the economic valuation literature. A summary answer to the question is included in Table 5.2.

Table 5.2 Summary findings in relation to estimating WTP to avoid pain, grief and suffering due to FBD

<table>
<thead>
<tr>
<th>FBD caused by...</th>
<th>WTP to avoid pain, grief and suffering...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbiological pathogens</td>
<td>…can be estimated. There seems to be sufficient evidence on the impact pathways, symptoms, affected population and how risk and severity of FBD could change due to FSA activities.</td>
</tr>
<tr>
<td>Chemical and radiological contaminants</td>
<td>…cannot be estimated with the current knowledge and data on impact pathways, symptoms, and affected population to estimate the change in the risk of FBD. But it would be possible to estimate WTP to reduce these contaminants in food (as an overall WTP estimate rather than specifically for pain, grief and suffering).</td>
</tr>
<tr>
<td>Allergens</td>
<td>…can be estimated but this may not be as detailed as for microbiological pathogens as the information and data on impact pathways seems to be less certain – with a lot more individual related factors at play. It would also be possible to estimate WTP to reduce allergens in food (as an overall WTP estimate rather than specifically for pain, grief and suffering).</td>
</tr>
</tbody>
</table>
5.4.2 If so, what is the recommended approach?

When deciding which valuation method to use in a given study, it is best practice to first look at the market prices, then revealed preference and only if neither is appropriate to consider the stated preference method. Market and revealed preference data were reviewed and found to be inadequate (for the purposes of isolating WTP for pain, grief and suffering associated with FBD). The recommended approach is to design one or more stated preference studies.

The specific stated preference design would need to match the qualitative and quantitative information available FBD and how FDB is likely to change due to FSA activities (as summarised in Table 5.2). This informed the different design options recommended in Section 5.2.

It would be possible to take a phased approach to estimating WTP to avoid pain, grief and suffering associated with FBD. This would involve starting with the cheaper study related to FBD caused by microorganisms but including qualitative research to cover each of the contaminants associated with FBD. This would enable the FSA to test the feasibility of this reports recommendations, and if desirable, to implement subsequent studies for the other contaminants. Such a phased approach is common in similar large scale valuation exercises.
Annex 1 The FSA

This study is looking at a specific WTP issue for the FSA with a view to enhancing the FSA’s approach to valuing the benefits of its interventions. This annex provides contextual information on the FSA’s role and the type of measures whose appraisal might call for use of the WTP value(s).

A1.1 Strategic objectives and responsibilities of the FSA

The key strategic objectives of the FSA are (FSA, 2011c):

- Foods produced or sold in the UK are safe to eat.
- Imported food is safe to eat.
- Food producers and caterers give priority to consumer interests in relation to food.
- Consumers have the information and understanding they need to make informed choices about where and what they eat.
- Regulation is effective, risk-based and proportionate, is clear about the responsibilities of food business operators, and protects consumers and their interests from fraud and other risks.
- Enforcement is effective, consistent, risk-based and proportionate and is focused on improving public health.

The main responsibilities of the FSA, and other national and local bodies, with respect to the enforcement of food law are illustrated in the table below.

Table A1.1 Official controls - food law

<table>
<thead>
<tr>
<th>Central level</th>
<th>FSA</th>
<th>Animal Health and Veterinary Laboratories Agency and Scottish Government Rural Payments and Inspections Directorate (on behalf of the FSA)</th>
<th>Department of Agriculture and Rural Development for Northern Ireland (DARD) (on behalf of FSA)</th>
<th>Defra</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approval of fresh meat establishments.</td>
<td></td>
<td>Hygiene controls of fresh meat, milk production holdings/liquid milk establishments, egg production units / packing stations.</td>
<td>Overseeing system for certification of organic produce.</td>
</tr>
<tr>
<td></td>
<td>Classification and monitoring of shellfish harvesting areas.</td>
<td></td>
<td>Approval of liquid milk establishments and egg packers.</td>
<td>Policy on beef labelling system.</td>
</tr>
<tr>
<td></td>
<td>Hygiene controls - fresh meat.</td>
<td></td>
<td></td>
<td>Recognition in England of natural mineral waters from non-EEA</td>
</tr>
</tbody>
</table>
A1.2 The measures available to the FSA to address FBD

Food may be contaminated during primary production, for example if water used to irrigate fresh produce is contaminated with animal faeces or during processing and cooking. Raw food can contaminate cooked food in food service or domestic kitchens, for example. The way in which food is handled following contamination is also important. Many microbes need to multiply to large numbers before they will cause an illness, and multiplication often requires elevated temperatures. Incorrect storage of food can be an important causative factor in foodborne disease. High temperature kills most pathogenic microbes and neutralises many microbial toxins. The failure to properly heat food can cause foodborne disease.

There is no one-step prevention measure to ameliorate the risk of foodborne disease. Measures across the supply chain, from ‘farm to fork’, are necessary to prevent and limit risk of contamination. These include the application of good agricultural practice and manufacturing practices to prevent or limit the introduction of contaminants (e.g. following manufacturers’ guidelines for the application of plant protection products). Frequent review of production processes to identify contamination risks and hazards and to identify appropriate control points can help to prevent or limit contamination.

The FSA’s core remit covers food safety policy and enforcement from the moment foods exit the farm or are imported in the UK to the point of sale to the final consumer (FSA, 2011c). As part of this remit, the FSA is also responsible for the strategy for reducing microbiological foodborne diseases (FBD) and chemical and radiological safety. In this context, the key FSA objectives include (FSA, 2011a):

- Monitoring trends in foodborne illness.
- Promoting a hazard analysis-based approach to food safety management.
Promoting and providing guidance for producers, retailers, caterers and the general public.

To meet these objectives the FSA undertakes a range of regulation and enforcement activities:

- Approval and monitoring of food premises: the FSA is responsible for the approval and inspection of fresh meat premises and food irradiation facilities. The FSA is also responsible for monitoring, designation and classification of shellfish harvesting areas.

- Cooperation with local enforcement officers: the FSA has the key role of overseeing official feed and food controls undertaken by local authorities and to cooperate with them in order to ensure that the delivery of controls is effective, risk based, proportionate and consistent.
  - Local authority audits: the FSA is responsible of auditing local authorities’ delivery of official controls against the standards set by the FSA itself and associated guidance. Such audits cover all feed and food law enforcement activities put in place by local authorities, including food standards, food safety, animal feed and imported food. Audits are carried out as related to imported food and food that is produced, processed and manufactured in the UK.
  - Training and funding: the FSA provides training tools, seminars and funding in order to further develop local authorities’ enforcement services.
  - Provision of information: the FSA is the UK contact point for the Rapid Alert System for Food and Feed (RASFF), the EU system for notification and information exchange related to food safety. The FSA is also responsible for issuing information about product withdrawals and recalls targeted at consumers and local authorities.
  - Food hygiene ratings: The FSA supports a UK-wide food hygiene rating scheme, developed and operated in partnership with local authorities. The scheme designed to provide consumers with information about the results of food hygiene inspections carried out at food premises. Hygiene ratings are made publicly available on the FSA’s website, and may also be voluntarily displayed at the business establishment with the exception of Wales where a mandatory display of ratings is required as per the Food Hygiene Rating (Wales) Act 2013.

- Monitoring: monitoring of zoonosis and zoonotic agents is based on collaboration between the FSA and other authorities, including Defra, the Department of Health and the equivalent departments in the devolved administrations.

- Guidance and advice for industry: The FSA provides guidance on priorities on an annual basis to assist enforcement authorities in targeting their feed control activities. The FSA also issues guidance material targeted to businesses, food industry representatives and other organisations in order to help them understanding food safety issues often related to new legislation coming into force.

The FSA has specific responsibilities related to different stages of the food chain. These are described in Figure A1.1.
Figure A1.1  FSA responsibilities as related to different stages of the food chain

- **Imports**
  - Development of guidance
  - Monitor implementation of controls

- **Primary production**
  - Official controls – dairy hygiene
  - Approval and inspection – shellfish
  - Development of standards and guidance

- **Processing and manufacturing**
  - Approval of premises and official controls – meat hygiene
  - Approval of irradiation facilities

- **Wholesale, retail, food services**
  - Development of standards and guidance
  - Issuing of information on product recall and on food hygiene rating

- **Consumption**
  - Improve consumer awareness on food safety and hygiene
Annex 2  Foodborne diseases and food contaminants

This annex discusses the main microbiological contaminants, allergens, chemical contaminants and radiological contaminants of food in the UK. It includes the most common sources of contamination, the associated adverse health impacts and the implications for ‘at risk’ groups.

A2.1  Microbiological contaminants

The bacterial and virological pathogens representing the highest burden in the UK are (FSA, 2011a):
- Campylobacter.
- Listeria monocytogenes.
- Escherichia coli.
- Salmonella.
- Norovirus.
- Clostridium perfringens.

Each of these pathogens is discussed below.

A2.1.1  Campylobacter

Campylobacter is the most common bacterial cause of infectious intestinal disease in England and Wales. Compared to other foodborne pathogens, Campylobacter causes the greatest burden of disease in the UK due to very high case numbers and severity of illness (FSA, 2011a).

The primary source of illness is food and the most important food vehicle is undercooked poultry meat: between 60 and 80 per cent of cases are attributed to chicken (FSA, 2011). The FSA estimated that 65 per cent of chickens at retail sale in the UK are contaminated with Campylobacter (FSA, 2009). Other sources of transmission are milk, water, person to person contact and contact with animals, although less common.

Anyone can get campylobacteriosis, but young children, the elderly and people who work with farm animals or in the meat industry and travellers to developing countries are at greater risk (HPA, 2012). Most infected people recover without any treatment. Long term consequences are rare and include arthritis and a syndrome affecting the nerves called Guillain-Barré (CDC, 2010).

A2.1.2  Listeria monocytogenes

Compared to other foodborne diseases, listeriosis is rare but presents severe health impacts: a third of cases are estimated to result in death. Due to the severity of the illness, the burden linked to Listeria monocytogenes is very high and is considered as second to Campylobacter (FSA, 2011a). Most common health impacts are flu-like symptoms or gastroenteritis. Less common effects are severe blood poisoning (septicaemia) or meningitis.

Listeriosis is particularly dangerous for pregnant women, who are approximately 20 times more likely than other healthy adults to be infected. Although the illness is unlikely to be serious for the mother, it can cause miscarriage, premature delivery or life-long health problems for the child.

The major cause of infection is food consumption, while a minority of cases are due to person to person contact or contact with animals. Main food sources of infection are ready-to-eat refrigerated and processed foods such as pre-prepared cooked and chilled meals, soft cheeses, cold cuts of meat, pâtés and smoked fish (HPA, 2009).
A2.1.3 *E. coli* O157

Cases of *E. coli* outbreaks are less frequent than those linked to *Campylobacter* and *Salmonella*, but infections can result in serious conditions that may affect the blood, kidneys or nervous system and can be fatal: it can lead haemolytic uraemic syndrome (HUS), which is particularly dangerous for infants, young children and for the elderly. Primary sources of infection are contaminated foods, such as raw or undercooked meat, raw milk and contaminated raw vegetables and sprouts (WHO, 2011b).

A2.1.4 *Salmonella*

Over the period 2000-2010 cases of foodborne illness due to *Salmonella* in the UK have almost halved. However, case numbers are still high, and the disease represents a significant burden (FSA, 2011b).

Anyone can get salmonellosis, but young children, the elderly and people whose immune systems are not working properly have a greater risk of becoming severely ill. Symptoms include diarrhoea, stomach cramps, vomiting and fever and usually clear up without treatment. Serious illness may cause dehydration.

Transmission occurs by eating contaminated food, mainly of animal origin, or by faecal contamination from an infected person or animal (HPA, 2012b). Commercial chicken meat represents the most important food vehicle for *Salmonella* (FAO and WHO, 2009). FSA has found that close to 7 per cent of chicken at retail sale in the UK is contaminated with *Salmonella* (FSA, 2009).

A2.1.5 Norovirus

Norovirus is the most common cause of infectious gastroenteritis causing an estimated 200,000 yearly cases of infection in England and Wales (FSA, 2011a). Symptoms of infections are generally mild and last about 24 hours and no long-term effects are known.

Infections can occur at any age and at any time of year, although the disease is more common during the winter (HPA, 2011). The disease is most commonly transmitted person-to-person, but can also be due to consumption of contaminated raw shellfish, such as oysters.

A2.1.6 *Clostridium perfringens*

Common symptoms of infections are diarrhoea and abdominal pain, and illness generally lasts up 24 hours although elderly people may be more seriously affected. The burden is the lowest compared to the other pathogens described as the disease is less common and the symptoms are mild. *Clostridium perfringens* is the main cause of a rare but severe condition called ‘gas gangrene’ (tissue death) (FSA, n.d.b).

The primary cause of transmission is contaminated meat subject to poor temperature control and storage, both at food services premises and at household level.

A2.2 Allergens

A large number of allergens can cause food allergies and the dose necessary to trigger a reaction in allergic individuals is often very low. The most common allergens in Europe are regulated by EU legislation (Commission Directive 2007/68/EC), which requires mandatory labelling for the following foods:

- Cereals containing gluten.
- Crustaceans.
- Eggs.
- Fish.
- Peanuts.
- Soybeans.
- Milk (including lactose).
- Nuts.
**• Celery.**  
**• Mustard.**  
**• Sesame seeds.**  
**• Sulphur dioxide and sulphites.**  
**• Lupin.**  
**• Molluscs.**

Common features of the foods listed above are:

- They can cause adverse health effects, and in some cases can be lethal.
- They are generally resistant to food processing and can cause allergic reactions if they are added to foods in any form and at any stage of the production process.

The most common health effects due to food allergies include (EFSA, 2004):

- **Skin:** atopic dermatitis, urticaria, angio-oedema.
- **Gastrointestinal tract:** oral allergy syndrome, abdominal pain, colic, nausea, vomiting, diarrhoea, constipation, bloating, gastro-oesophageal reflux, enteropathies, failure to thrive.
- **Respiratory tract:** asthma, rhinitis.
- **Eyes:** conjunctivitis, watering eyes.
- **Central nervous system:** headache; abnormal behaviour (rare).

The described health consequences affect about 1-3 per cent of the population and about 4-6 per cent of children. The most severe reaction is anaphylaxis, representing a potentially life-threatening condition involving the cardiovascular system, the respiratory tract, the mouth and the pharynx and the skin, singly or in combination. In England and Wales about 20 people die annually for anaphylactic reactions, and about one third of these reactions are due to foods (EFSA, 2004).

**A2.3 Chemical contamination**

Chemical contaminants can affect food at different stages of the food chain, including farming, packaging, processing and storage. Chemical contaminants include:

- Process contaminants, such as acrylamide and furan.
- Naturally-occurring contaminants, such as mycotoxins and alkaloids.
- Man-made pollutants, such as dioxins and polychlorinated biphenyls (PCBs).

Some chemicals like metals fall in more than one category, as they may be found naturally in foods or added through processing. In the EU, chemical contaminants that represent the greatest concern either due to their toxicity or their potential prevalence in the food chain include (European Commission, 2008):

- **Acrylamide**
  Acrylamide is a highly toxic contaminant with genotoxic, carcinogenic and neurotoxic properties. Elevated levels of acrylamide are found in some foods processed at high temperatures, including French fries, potato crisps, soft bread, cereals and coffee (EFSA, 2012c).

- **Aflatoxins**
  They are the most toxic mycotoxins, and have been found to be genotoxic and carcinogen. They are most likely to contaminate dried food such as nuts and figs, spices, crude vegetable oils, cocoa beans and maize (EFSA, 2009).

- **Dioxins and PCBs**
  The risk to health due to consumption of food contaminated dioxins and PCBs include adverse effects on the nervous, immune and endocrine systems, damage to the reproductive function and cancer.
Dioxins and PCBs are found at low levels in many foods, and their consumption has no immediate effect. Negative health impacts are associated with the long-term consumption of highly contaminated food. The levels of exposure to those chemicals are therefore related to each individual’s diet.

Food represents the main source of human exposure. These chemicals mainly accumulate in animal fat, and the main food sources are (EFSA, 2012b):

- Milk and dairy products, particularly for infants and young children.
- Fish, seafood and meat for other age groups.

### Heavy metals

Metals can be present as residues in food because of their presence in the environment, as a result of human activities and as a consequence of food processing.

People can be exposed to metals from the environment or by ingesting contaminated food or water. Their accumulation in the body can lead to harmful effects over time.

At EU level, maximum levels are established for some metals in food, including the following (EFSA, 2012a):

- **Lead**: lead occurs both naturally and through human activities such as mining. According to EFSA, current dietary exposure to lead pose a low to negligible health risk for most adults in the EU, but may potentially affect the growth and development of the nervous system and of the brain in foetuses, infants and children. In Europe, foods that most contribute to human exposure to lead are cereals, vegetables and tap water.

- **Cadmium**: similarly to lead, current levels of human exposure to cadmium pose low health risk. However, possible kidney damage, lung damage ad skeletal changes might occur in the long term. The main source of exposure for non-smokers is food, and the main food sources are cereals and vegetables. Other main sources are smoke and workplace air. Higher exposure to the metal may occur in children, vegetarians and people living in highly contaminated areas.

- **Mercury**: the most common and toxic form of mercury is methylmercury. It can affect the development of the nervous system and of the brain in foetuses, and is mainly found in fish and seafood.

- **Inorganic tin**: tin is relatively less toxic than mercury, cadmium and lead. It may cause short term effects such gastrointestinal irritation. High levels of tin may be found in canned food in incorrectly manufactured tins.

### A2.4 Radiological contamination

Radioactivity is naturally present in food and the environment but this is generally considered to be an unavoidable exposure. Radiological protection is built on the principle of avoiding additional exposure caused by artificial sources of radioactivity, e.g. from energy generation or military activities, or artificially enhanced levels of natural radioactivity, e.g. from industrial processes. Radioactive contamination of food can occur from routine operations but this is controlled in order to minimise adverse health impacts. Accidental release of radioactive materials can contaminate food in the following ways:

- Fruit and vegetables can be contaminated by the atmospheric release of radionuclides following an accident.
- Contamination is transferred from animal feed into milk.
- Radioactivity can contaminate soil and water, and therefore affect fish and other seafood.

Exposure to radioactive contaminants increases the risk of cancer. Different kinds of radionuclides can contaminate food, and the type of cancers and organs affected depend on the specific type of radionuclides. In the case of nuclear accidents, two radionuclides in
particular are considered to be of major concern according to the World Health Organisation (INFOSAN, 2011):

- Radioactive iodine (iodine-131), which is rapidly transferred from contaminated feed into milk and tends to concentrate in the thyroid gland and increase the risk of thyroid cancer.
- Radioactive caesium (caesium-134 and caesium-137) which is also rapidly transferred from feed to milk but, compared to iodine-131, can remain in the environment for a longer time and affect human health for a longer term. If radioactive caesium enters the body, it is distributed uniformly throughout the body’s soft tissues and increases the risk of cancer.

Strontium and plutonium can also have potential long term health impacts, but they are both relatively immobile in the environment and therefore less likely to cause international food concerns. Other radionuclides are important in different scenarios such as:

- Improvised radiological devices (dirty bombs).
- Historic contamination from past industrial activities which enhance natural occurring radionuclides such as lead-210 and polonium-210 (e.g. phosphate processing).
- Historic contamination from manufacture and disposal of radium luminous dials etc.

Additional long-term risks due to exposure to radioactive contaminants include teratogenic mutations (i.e. mutations due to the exposure of foetuses) and genetic mutations (i.e. mutations that can be passed from parent to child) (EPA, 2012).

A2.5 Foodborne diseases

This section presents the main sources of foodborne diseases and food-contamination and describes the impact pathways for the most prevalent foodborne diseases in the UK. It is of contextual relevance to the study as it explains the ‘environment’ within which interventions that affect foodborne disease are being developed and applied.

A2.6 Sources of foodborne disease

Foodborne disease is any illness resulting from the consumption of contaminated food, pathogenic bacteria, viruses or parasites that contaminate food, as well as chemical or natural toxins. There are four main causes of foodborne disease:

- **Microbiological contaminants.** Pathogenic bacteria and viruses are the principal source of foodborne illness. Some at risk groups may be at higher risk of infection.
- **Food allergens.** Food allergens are natural substances which can cause adverse reactions in allergic individuals. Food allergens do not represent a concern for people that are not allergic.
- **Chemical contaminants.** These are substances which may be found naturally in foods or transferred to foods via processing or from the environment. Contaminated food can be highly toxic and have severe health impacts.
- **Radiological contaminants.** Radioactivity may occur naturally in foods or may be the result of human activity causing the release of radioactive material into the environment. A source of radiological contamination could be the subsequent consumption of food contaminated with radionuclides released during a nuclear accident.

A2.7 Sources of contamination

Foodborne disease associated with bacteria and viruses is commonly associated with a relatively limited number of food types:

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Raw foods of animal origin. These are the food types most likely to be contaminated with pathogenic bacteria or viruses. For example, raw meat and poultry, raw eggs, unpasteurised milk, and raw shellfish.

Shellfish, as they filter seawater and may harbour pathogens that are present in it.

Foods which mix the products of many individual animals, such as ground beef. A pathogen present in one of the animals may contaminate an entire batch of products.

Fruits and vegetables consumed raw. Fresh produce may be contaminated with pathogens during production.

Chemical contamination of food may affect any type of food. The Food Standards Agency has identified the following sources of chemical contamination:\(^{13}\):

- **Agricultural contaminants**: Chemicals used in the production of fresh produce, crops and animals. They include, for example, pesticides, fertilizers and veterinary drugs.

- **Environmental contaminants**: Chemicals which exist in the environment food is produced, processed, packed and consumed. Inorganic chemical contaminants may be present as a result of human activity or from natural sources. They include heavy metals such as lead, cadmium and mercury, and other chemical elements such as arsenic and iodine. There is also a large number of organic environmental contaminants (approximately 50,000) that may be present in food adventitiously as a result of human activity or from natural sources (e.g. polycyclic aromatic hydrocarbons, phthalates, brominated flame retardants and musks).

- **Food additives and flavourings**: In Europe food additives and flavourings must be assessed before they are permitted to be used in food products. They include antioxidants, colours, emulsifiers, stabilisers, gelling agents and thickeners, flavour enhancers, preservatives and sweeteners.

- **Food contact materials**: Chemicals which might transfer onto food from materials they come into contact with, for example, packaging and utensils.

- **Process contaminants**: Chemicals which can be formed in food by cooking or other forms of processing.

Food allergens are associated with a wide range of food types. Whether a food type is an allergen or not depends on the individual consuming the food. Known food allergens, such as peanuts or shellfish, are considered as contaminants when products are mislabelled as being free from such products.

Radioactivity exists naturally in the environment and is also created by human activity during energy production and military operations. Food is naturally radioactive but the levels are not generally considered to be significantly harmful to health. Food may also be artificially contaminated by discharge into the environment of radioactive material by civilian or military operations.

### A2.8 The disease-food impact pathway

The links between cause and effect in terms of contamination and foodborne disease are complex and depend on a variety of factors.

Certain food types are a more significant contributor to disease burdens than others. Raw chicken, for example, is more commonly associated with salmonella than red meat. Certain practices may be easier to control than others; it may be difficult to encourage consumers to handle and store raw food correctly, for example. In addition, the implications of contamination may be more significant for certain groups compared to others, for example infants or the elderly.

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Table A2.1 summarises potential microbiological contaminants, allergens, chemical contaminants and radiological contaminants of food in the UK. It includes sources of contamination, the associated adverse health impacts and the implications for ‘at risk’ groups.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Source of infection/exposure</th>
<th>Food type</th>
<th>Population at risk</th>
<th>Risk</th>
<th>Impact</th>
<th>Duration of illness</th>
<th>Treatment</th>
<th>Potential complications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microbiological contamination</strong></td>
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</tr>
<tr>
<td>Campylobacter</td>
<td>Eating raw or undercooked poultry meat</td>
<td>Chicken</td>
<td>All</td>
<td>UK laboratory confirmed cases in 2011: 72,150</td>
<td>Diarrhoea</td>
<td>One week</td>
<td>Most recover without treatment</td>
<td>Rare cases of long term consequences, including arthritis and ‘Guillain-Barré’ syndrome affecting the nerves</td>
</tr>
<tr>
<td></td>
<td>Contact with poultry packages</td>
<td>Other (cross-contamination)</td>
<td></td>
<td></td>
<td>Fever</td>
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<td></td>
<td>Unpasteurized milk or contaminated water</td>
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<td>Vomiting</td>
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<tr>
<td></td>
<td>Contact with animals</td>
<td></td>
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<td></td>
<td>Abdominal cramps</td>
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<tr>
<td></td>
<td>Person-to-person contact (rare)</td>
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<tr>
<td>Clostridium perfringens</td>
<td>Contaminated cooked meat and poultry dishes subjected to inadequate temperature control after cooking, during cooling, and storage</td>
<td>Meat</td>
<td>All</td>
<td>England and Wales, laboratory confirmed cases in 2011: 198</td>
<td>Diarrhoea</td>
<td>24 hours or less</td>
<td>No specific treatment</td>
<td>Rare: Tissue death (gangrene) - death</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poultry</td>
<td>Elderly, infants and young children</td>
<td></td>
<td>Abdominal cramps</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>E. coli O157</td>
<td>Raw or undercooked food</td>
<td>Meat</td>
<td>All</td>
<td>UK laboratory confirmed cases in 2011: 1,407</td>
<td>Diarrhoea</td>
<td>Up to ten days</td>
<td>No specific treatment</td>
<td>Life-threatening diseases such as haemolytic uraemic syndrome (HUS).</td>
</tr>
<tr>
<td></td>
<td>Contaminated water</td>
<td>Milk and dairy products</td>
<td></td>
<td></td>
<td>Fever</td>
<td></td>
<td></td>
<td>Up to 10% of patients with Enterohaemorrhagic Escherichia coli (EHEC) infection may develop HUS, with a case-fatality</td>
</tr>
<tr>
<td></td>
<td>Person-to-person contact</td>
<td>Fruit and vegetables</td>
<td></td>
<td></td>
<td>Vomiting</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Direct contact with farm animals</td>
<td>Other (cross-contamination)</td>
<td></td>
<td></td>
<td>Abdominal cramps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>Source of infection/exposure</td>
<td>Food type</td>
<td>Population at risk</td>
<td>Risk</td>
<td>Impact</td>
<td>Duration of illness</td>
<td>Treatment</td>
<td>Potential complications</td>
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<tr>
<td>Listeria monocytogenes</td>
<td>Main source: food</td>
<td>Pre-prepared cooked and chilled meals</td>
<td>All Unborn infants, neonates, immunocompromised individuals, pregnant women and the elderly are at high risk</td>
<td>UK laboratory confirmed cases in 2011: 164</td>
<td>Fever, Stiff neck, Vomiting, Diarrhoea, Meningo-encephalitis, Septicaemia, Spontaneous abortion</td>
<td>Days to weeks</td>
<td>Antibiotics</td>
<td>Infected newborns may develop serious health problems, such as: Mental retardation, Paralysis, Seizures, Blindness, Impairments of the brain, heart, or kidney&lt;sup&gt;14&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Some cases by direct contact with animals</td>
<td>Soft cheeses, Cold cuts of meat, Pâtés and smoked fish</td>
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<td></td>
<td>Mother to foetus in utero or during birth or via person to person spread between infants shortly after delivery</td>
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<tr>
<td>Norovirus</td>
<td>Main source: person-to-person contact</td>
<td>Shellfish</td>
<td>All Unborn infants, neonates, immunocompromised</td>
<td>England and Wales, laboratory confirmed</td>
<td>Diarrhoea, Fever, Vomiting</td>
<td>48 hours</td>
<td>Rehydration therapy, Antiemetic drugs and</td>
<td>None identified</td>
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<td></td>
<td>Environmental contamination</td>
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<tr>
<th>Disease</th>
<th>Source of infection/exposure</th>
<th>Food type</th>
<th>Population at risk</th>
<th>Risk</th>
<th>Impact</th>
<th>Duration of illness</th>
<th>Treatment</th>
<th>Potential complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella</td>
<td>Raw or undercooked food&lt;br&gt;Poor kitchen hygiene&lt;br&gt;Excretions from sick / infected people&lt;br&gt;Polluted surface water and standing water&lt;br&gt;Unhygienically thawed fowl&lt;br&gt;Associated with (pet) reptiles</td>
<td>Chicken&lt;br&gt;Eggs&lt;br&gt;Pork&lt;br&gt;Other (cross-contamination)</td>
<td>All&lt;br&gt;Children and young children much more susceptible to infection&lt;br&gt;Elderly at higher risk of adverse health impacts&lt;br&gt;HIV patients and those with suppressed immunity at risk of serious illness</td>
<td>UK laboratory confirmed cases in 2011: 9,455</td>
<td>Diarrhoea&lt;br&gt;Fever&lt;br&gt;Vomiting&lt;br&gt;Abdominal cramps&lt;br&gt;Sepsis</td>
<td>4 to 7 days</td>
<td>Most recover without treatment&lt;br&gt;Antibiotics may be necessary for vulnerable groups</td>
<td>Dehydration from severe diarrhoea&lt;br&gt;Death&lt;br&gt;Reactive arthritis which can last for months / years (rare)</td>
</tr>
</tbody>
</table>

**Allergens**

<p>| Allergens | Contact, inhalation or ingestion of food | Cereals containing gluten, Crustaceans&lt;br&gt;Eggs&lt;br&gt;Fish&lt;br&gt;Peanuts&lt;br&gt;Soybeans&lt;br&gt;Milk (including) | Allergic consumers&lt;br&gt;Health impacts more frequent in children&lt;br&gt;Differences of food allergy due to ethnicity | Skin: Atopic dermatitis, Urticaria, Anglo-oedema&lt;br&gt;Gastrointestinal tract: Oral allergy syndrome, Abdominal pain, Colic, nausea, Vomiting, Diarrhoea Constipation&lt;br&gt;Bloating Gastro-oesophageal reflux (heart burn) Enteropathies&lt;br&gt;Respiratory tract: Asthma, | Hours to days | Antihistamines&lt;br&gt;Adrenaline | Anaphylaxis’ complications: Airway blockage, Cardiac arrest, Respiratory arrest, Shock |</p>
<table>
<thead>
<tr>
<th>Disease</th>
<th>Source of infection/exposure</th>
<th>Food type</th>
<th>Population at risk</th>
<th>Risk</th>
<th>Impact</th>
<th>Duration of illness</th>
<th>Treatment</th>
<th>Potential complications</th>
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</thead>
<tbody>
<tr>
<td>Lactose</td>
<td>Nuts, Celery, Mustard, Sesame seeds, Sulphur dioxide and sulphites, Lupin, Molluscs</td>
<td>Rhinitis, Eyes: Conjunctivitis, Watering eyes, Central nervous system: Headache; Abnormal behaviour (rare), Generalised: Anaphylaxis</td>
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<tr>
<td>Chemical contamination</td>
<td>Acrylamide</td>
<td>Food processed at high temperatures</td>
<td>Wide range of foods such as French fries, cereals, biscuits</td>
<td>All</td>
<td>No immediate health impact. Adverse health impacts associated with long-term repeated exposure.</td>
<td>N/A</td>
<td>None identified</td>
<td>Damage to DNA and cancer; neurotoxic properties in high doses</td>
</tr>
<tr>
<td>Aflatoxin</td>
<td>Food and non-food sources</td>
<td>Dried foods, spices and crude vegetable oils, and cocoa beans, Milk from animals fed with contaminated feed</td>
<td>All</td>
<td>No immediate health impact. Adverse health impacts associated with long-term repeated exposure.</td>
<td>N/A</td>
<td>None identified</td>
<td>Damage to DNA (genotoxicity) and liver cancer</td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>Source of infection/exposure</td>
<td>Food type</td>
<td>Population at risk</td>
<td>Risk</td>
<td>Impact</td>
<td>Duration of illness</td>
<td>Treatment</td>
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<tr>
<td>Dioxins and PCBs</td>
<td>Food</td>
<td>Milk and dairy products</td>
<td>All</td>
<td></td>
<td>No immediate health impact. Adverse health impacts associated with long-term repeated exposure.</td>
<td>N/A</td>
<td>None identified</td>
<td>Adverse effects on the nervous, immune and endocrine systems, damage to the reproductive function and cancer</td>
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<td></td>
<td></td>
<td>Fish</td>
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<td></td>
<td></td>
<td>Meat</td>
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<tr>
<td>Heavy metals</td>
<td>Environment, food, water,</td>
<td>Lead: cereals, vegetables</td>
<td>All</td>
<td></td>
<td>No immediate health impact. Adverse health impacts associated with long-term repeated exposure.</td>
<td>Days</td>
<td>None identified</td>
<td>Tin: diarrhoea, vomiting, abdominal cramps</td>
</tr>
<tr>
<td></td>
<td>smoke</td>
<td>and tap water</td>
<td>Foetuses, infants, children</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lead: affects growth and development of the nervous system and of the brain in foetuses, infants and children</td>
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<td>Cadmium: cereals and</td>
<td></td>
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<td></td>
<td></td>
<td>Cadmium: kidney damage, lung damage and skeletal changes</td>
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<tr>
<td></td>
<td></td>
<td>vegetables</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>Mercury: fish and seafood</td>
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<td></td>
<td></td>
<td></td>
<td>Mercury: affects the development of the nervous system and of the foetal brain</td>
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<td></td>
<td></td>
<td>Inorganic tin: canned</td>
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<td></td>
<td>food</td>
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</tr>
<tr>
<td>Radiological contamination</td>
<td>Radioactive iodine</td>
<td>Food</td>
<td>All</td>
<td></td>
<td>No immediate health impact (except in very high exposures which are unlikely from food consumption). Adverse health impacts associated with long-term repeated exposure.</td>
<td>N/A</td>
<td>Ingestion of potassium iodide prophylaxis to prevent accumulation of radioactive iodine (most likely to be used for</td>
<td>Increased risk of cancer, particularly thyroid cancer</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>All</td>
<td>Infants, (including breastfeeding infants) and foetuses are more sensitive to radioactive contaminants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Teratogenic and genetic mutations</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>All</td>
<td>Foetuses, new-born, children and young</td>
<td></td>
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<td></td>
<td>Man-made activities</td>
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<tr>
<td></td>
<td>Nuclear accidents</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Disease</th>
<th>Source of infection/exposure</th>
<th>Food type</th>
<th>Population at risk</th>
<th>Risk</th>
<th>Impact</th>
<th>Duration of illness</th>
<th>Treatment</th>
<th>Potential complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive caesium</td>
<td>Food</td>
<td>All</td>
<td>Adults at higher risk of thyroid cancer</td>
<td></td>
<td>No immediate health impact (except in very high exposures which are unlikely from food consumption). Adverse health impacts associated with long-term repeated exposure.</td>
<td>N/A</td>
<td>None identified</td>
<td>Increased risk of cancer, Teratogenic and genetic mutations</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>All</td>
<td>Infants, (including breastfeeding infants and foetuses are more sensitive to radioactive contaminants</td>
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</tr>
<tr>
<td></td>
<td>Environment</td>
<td>All</td>
<td>Infants, (including breastfeeding infants and foetuses are more sensitive to radioactive contaminants</td>
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</tr>
<tr>
<td></td>
<td>Man-made activities</td>
<td>All</td>
<td>Infants, (including breastfeeding infants and foetuses are more sensitive to radioactive contaminants</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nuclear accidents</td>
<td>All</td>
<td>Infants, (including breastfeeding infants and foetuses are more sensitive to radioactive contaminants</td>
<td></td>
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</tbody>
</table>

populations at risk of high dose from inhalation rather than food consumption)
A2.9 Foodborne disease negatively affect human health and have adverse economic impacts

In most cases, symptoms in healthy adults are mild and only last for a few days without the need of specific treatments. For example, norovirus causes up to one third of foodborne illness and symptoms only last for about 24 hours. However, in some cases contaminants and allergens can lead to severe health consequences. Some types of foodborne disease may have a more severe impact on particular groups, such as children, pregnant women and the elderly. The risk of illness or of severe and long term consequences may be higher for these groups. Listeriosis, for example, is more likely to affect people over sixty years of age.

Gastrointestinal symptoms are generally linked to diseases caused by virus and bacteria. Chicken meat is the most common food vehicle for these pathogens, in particular for *Salmonella*, *Campylobacter* and *Clostridium perfringens*. Contamination may occur at any stage of the food chain, but the large majority of outbreaks are linked to the food service sector and the main causes are inadequate cooking and poor storage.

Food allergies represent another relevant health concern. Allergic reactions may affect several organs and cause a range of clinical features, including gastrointestinal symptoms similar to those caused by bacteria. Severe reactions to several allergens are more common in children. Common food allergens include a wide variety of foods, and food processing may increase or decrease the risk of adverse reaction.

Chemical and radiological food contaminants do not typically cause immediate symptoms, but cumulative exposure can result severe impacts in the long term, for example cancer and brain damage.

Allergens and food contaminated with pathogenic bacteria or viruses typically have immediate and short term health impacts. The adverse health impacts associated with chemical contaminants and elevated levels of radioactivity are often apparent only after many years of prolonged exposure at low levels.
Annex 3  Process of how we developed the recommended economic valuation approach

This Annex provides some supporting information on the concept of economic valuation (Section A4.1) and presents the process of thinking this study went through to result in the recommended approach:

A3.1  Total Economic Value

Understanding the factors that motivate individuals to have a positive WTP to avoid FBD is required to decide what type of data to collect through a valuation study so that the differences in consumer behaviour displayed and in stated WTP can be explained. The motivations are given by the Total Economic Value (TEV) framework (Figure A3.1) and econometric analysis (based on demand theory) is used to understand the direction and scale of the impacts of these different motivations.

Figure A3.1  Total Economic Value (TEV)

Source: etec (2010)

In the context of food safety, TEV is made up of the following types of value (or motivations to hold economic value). The ‘total’ in TEV refers to the sum of these motivations, not an absolute value of the good. There may also be other social, cultural, individual reasons why a good is valued by an individual but there are the motivations that economic analysis can cover:

- **Use value:**
  - **Direct uses** where individuals derive value from consuming safer food.
  - **Indirect uses** where individuals can derive value without directly using it, as such providing food for animals. Indirect use value is generally associated with the life support services provided by the environment that benefit all but not directly consumed by any (for example, aesthetic beauty, soil stabilisation, carbon sequestration, water regulation etc.).
  - **Option value** the value that individuals place on having the option to consume safe food in the future even if they are not current users, e.g. being able to consume a specific type of food in the future knowing it will be safe(r) to do so.

- **Non-use value:**
Bequest value where individuals attach value to the fact that safe(r) food (for example, avoided impacts that contaminants may have) will be passed on to (benefit) future generations.

Altruistic value where individuals attach values to the availability of safe(r) food to others in the current generation (e.g. children, family, friends).

Existence value derived from the existence of safe(r) food, even though an individual has no actual or planned use of it for self, for others, now or in the future.

A3.2 The good to be valued

The overall good could be described as safer food. The FSA’s activities can influence the following attributes of safer food:

- Risk of getting FBD.
- Severity of symptoms.
- Duration of symptoms.

Individuals are likely to think about the following attributes at the same time as the above:

- Who is more at risk of FBD?
- Food type.

Although these attributes are not directly affected by the FSA’s activities, they may affect the choices people make about food consumption and hence should be considered for inclusion in a valuation questionnaire. This is subject to the early qualitative research work.

Policy and public interventions are likely to affect risk of FBD more often than severity and duration. There are two ways to incorporate the change in the risk into decision-making: (a) incorporate it into the valuation exercise and (b) incorporate it into appraisal process alone.

In the first option, the difficulty of communicating risk is undeniable as reported in Section 3 and Annex 3. However, there have been significant developments in communicating the risk information in the recent literature (food and other contexts), including visual presentation of risk and designing games for respondents to understand how to trade off risk. Thus this task is no longer as difficult as it may once have been (e.g. Packham, 2004).

In the second option, the valuation study would elicit WTP for pain and suffering for a certain case of FBD. This is equivalent to asking about individual symptoms. In this case the risk information can be applied in the appraisal (WTP value for a certain case multiplied with risk reduction will give the benefit). However, this assumes that people have linear preferences, i.e. 1% reduction in risk is valued the same whether it is 1% reduction between 100% and 99% and between 2% to 1%. This is very unlikely to be the case in reality – people would be willing to pay more for reductions in higher risks. Whether it is within the WTP question, or elsewhere in the survey, individuals’ priorities for risk reduction need to be elicited. Revealed preference studies can also theoretically produce this information but in practice, this depends on availability of data which is not promising.

The FBDs that are relevant and their outcomes also need to be explained in as clear a way as possible. The literature shows that duration and severity of the symptoms are two characteristics that individuals would like to learn about.

It would be efficient to choose either (a) a food and FBD combination that is most common (e.g. poultry consumption and campylobacteriosis) or (b) a food and FBD combination that may be rarer but has a more significant impact (e.g. cooked-sliced meats or sandwiches that contain Listeria monocytogenes). From the discussions with the FSA, the focus for the study is morbidity rather than mortality. However it may be possible to include it in one survey.

Table A3.1 presents the type of hazard, mechanisms through which they can be contracted and information on incidence and severity.
Table A3.1  Hazard and risk

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Campylobacter</strong></td>
<td>UK laboratory confirmed cases in 2011: 72,150. Total incidence thought to be much higher.</td>
</tr>
<tr>
<td><strong>Clostridium perfringens</strong></td>
<td>England and Wales, laboratory confirmed cases in 2011: 198</td>
</tr>
<tr>
<td><strong>E. coli O157</strong></td>
<td>UK laboratory confirmed cases in 2011: 1,407</td>
</tr>
<tr>
<td><strong>Listeria monocytogenes</strong></td>
<td>UK laboratory confirmed cases in 2011: 164</td>
</tr>
<tr>
<td>Norovirus</td>
<td>England and Wales, laboratory confirmed cases in 2011: 8548; in 2012: 10,845</td>
</tr>
<tr>
<td><strong>Salmonella</strong></td>
<td>UK laboratory confirmed cases in 2011: 9,455</td>
</tr>
<tr>
<td>Allergens</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Chemicals</td>
<td></td>
</tr>
<tr>
<td>Acrylamide</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Aflatoxin</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Dioxins and PCBs</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Heavy metals</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Radiological contamination</td>
<td></td>
</tr>
<tr>
<td>Radioactive iodine</td>
<td>Number of cases of associated illness not available</td>
</tr>
<tr>
<td>Radioactive caesium</td>
<td>Number of cases of associated illness not available</td>
</tr>
</tbody>
</table>

A3.3  The change to be valued

As discussed above, risk is likely to be the key indicator that can be affected by policy. Therefore, all likely levels of risks and risk reduction should ideally be covered in a valuation study. This does not require knowing a priori all future policies and interventions. It just requires identification of what the current risks are and a minimum and maximum likely risk reduction ‘bracket’.

For the severity and duration aspects of the change (even if these are not changed by all or any FSA activity), focusing the study on a given type of food, severity, duration is that the results may not be transferable to other contexts. The transferability issue needs further qualitative research on how people think of different foods, different FBD and so on.

Food related studies have tended to change one or more of the above parameters, either in general terms or for specific FBD from general food consumption or for specific FBD from specific foods. For example:

- Scharff (2011) uses an enhanced COI approach to value pain and suffering per type of FBD factoring in changes in QALY (i.e. changes in severity and duration).
- Brown, J.; Cranfield, J.A.; and Henson, S. (2005) developed a WTP for food safety risk reductions related to exposure to Campylobacter after consuming a breaded chicken sandwich.

When describing the mechanism through which change will be delivered studies tend to use general descriptions like “government will improve food safety in production, processing and preparation stages”, “there will be better labelling of the content and production process of food” and so on.

A3.4 Defining the target populations for valuation studies

Individuals may have different WTP to avoid FBD risk for different groups. Food and non-food related literature shows that health impacts affecting children tend to attract higher WTP due to altruistic motivations, as to be expected. This does not necessarily mean there needs to be a different survey for children or other specific groups, just that if there is a statistically significantly different risk for these groups, this information should be reflected in the design of any study.

For policy actions that target a specific group, FSA may need to know the WTP of that group (e.g. those allergic to given types of food). As these are likely to be a small proportion of the general population, a sampling process that aims to be representative across the population will not pick up sufficient number of individuals to estimate group specific WTP.

Therefore, ‘booster samples’ — sampling extra individuals from the target groups — will be needed. This does not change the design of a survey, but affects the sampling method and costs, and it may also mean fieldwork takes longer if it’s more difficult to access members of target groups.

In this section, we discuss the approaches to understanding the motivations behind customer behaviour and stated WTP, defining the sample population and sampling methods.

A3.4.1 Defining the sample population

Through our understanding of TEV it is possible to hypothesise that WTP may differ across the population for some of the following reasons:

■ Direct users of food:
  – Given the association of FBD with meat in the UK, meat eaters may be willing to pay more for safer meat than vegetarians.
  – Those who have specific food allergies could have a higher WTP for policies targeted at allergens (e.g. for better labelling and awareness) than those who do not have such allergies.
  – Those that “eat out” and therefore have less control over some risks (e.g. food preparation and how well cooked the food is) may have a higher WTP than those eat “at home” more and own more of the risks associated with eating safe food.
  – Those that buy food more frequently might have a different WTP for safer food as they regularly make choices over food (e.g. quality of food), type of food (e.g. processed vs. fresh) compared to those that don’t buy food often and so make less much decisions concerning food.
  – Those who believe the risk is not sufficiently high or those who believe they already take sufficient precautions might have no / low WTP for public safer food policy measures.
  – Socio-economic factors are important. Economic theory and empirical evidence shows that, all else being equal, higher income and education levels usually mean higher WTP.

■ Non-use factors:
  – Those with more vulnerable dependents (e.g. children, elderly, pregnant partner) might have a higher WTP to pay for safer food despite not consuming the food themselves.
Those individuals who have experienced FBD may have a higher WTP to avoid further FBD risk.

Those individuals who know of others that might be at risk (e.g. allergic to a type of food) may have a higher WTP even if they themselves do not benefit (i.e. not allergic).

The likely influence of use and non-use factors mean that results could be biased if the sample focuses on individuals more directly affected, however it is not clear that selecting a sample representative of the wider population would be more appropriate.

### A3.4.2 Sampling methods

Sampling methods are the process by a representative sample of the affected population is selected.

If market prices are used, the sample will include all purchases of the types of food that’s of interest, or the types of actions people themselves can take to reduce the risk of FBD.

There are two specific methods that could be used for stated preference methods using questionnaires:

- **Probabilistic sampling:** each member of the population has the same probability of being selected for the sample. Designs include:
  - Simple random samplings, for example where people are interviewed at the exit of a shopping centre are selected randomly.
  - Systematic sampling, for example every 3rd person exiting a shopping centre is interviewed.
  - Stratified sampling, the population is divided into strata and quotas are set for each strata (or group) to meet the survey needs.
  - Cluster sampling, the population is divided into strata but only a random selection of the strata is included.

- **Non-probabilistic sampling:** the sampling procedure relies on the personal judgement of the researcher. Quota sampling is the most popular sampling method, which is used in opinion polls and market research. The selection of respondents is controlled to ensure that the samples contain given proportions (or quotas) of various types of respondents, designed to reflect the population of interest. The most common quotas are set for socio-economic characteristics (e.g. gender, income and/or education level representative of the Census data). For example, the survey may have conditions such as requiring X number of female responses and Y male responses.

It is important to distinguish between factors that are likely to affect individuals’ values and those that define separate groups. For example, food habits, whether the person suffered an FBD before, age, gender, income levels and other similar socio-economic characteristics are more likely to affect individuals’ preferences and hence their WTP. But these characteristics do not create groups whose separate WTP needs to be known by the FSA for economic analysis. For example, WTP of females and WTP of males need not be known separately. Other characteristics, most prominently, whether those with food allergies, may need to be treated as separate groups – since the FSA’s activities targeting the risk to this group may require separate analysis. This is when ‘booster samples’ need to be considered as mentioned above.

### A3.5 Valuation method

#### A3.5.1 Type of value data

When deciding which valuation method to use in a given study, it is best practice to first look at the market prices, then revealed preference and only when neither of these is appropriate to consider stated preference. Below we present the types of market price and revealed and stated preference data that can be used to estimate WTP to avoid FBD:
■ **Market price and consumption data** collected on how people behave as consumers. Two types of market price data can be used here:

- **Spending on safer food**: premium paid for safer food or places that process and sell safer food. Here safer food includes that with a decreased risk of FBD contamination and those allowing for decreased pesticide/GM consumption.

- **Spending on FBD**: expenditure on medication, but also money / productivity loss if FBD means not being able to work. This is also known as ‘cost of illness’.

■ **Revealed preference data**: collected on how people behave in markets that are not the market for the good we value but are related to it. Such so-called ‘surrogate markets’ include travel market (how much people spend to go to a recreational site is an indication of how much they value recreation at that site) and property market (how much people pay for properties in cleaner, more beautiful areas with better schools etc.). These two methods are not appropriate to valuing pain, grief and suffering. But the third type of revealed preference method, i.e. aversive expenditure, can help here:

- **Spending (money) to avoid risk of FBD**: market data on products that reduce contamination or pesticide levels (e.g. vegetable ‘wash’, ‘Salmonella-killing’ cleaning products).

- **Spending (time) to avoid risk of FBD**: It is also possible to use time as the unit of measure then infer the value using value of time. For example, we could elicit how much extra time people spend on cleaning and preparing food at home to reduce the risk of FBD, then value this extra time using average national income.

■ **Stated preference data**: collected by asking a sample of respondents who are representative of the affected population, a series of specially designed questions about their attitudes towards / preparation and consumption of food, health and socio-economic characteristics, the change ‘scenario’ presented to them, their willingness to pay responses and follow up questions to test the validity of these answers. There are two variations to stated preference methods that differ in the way the valuation scenario, in particular the definition of the good, is presented:

- **In contingent valuation**, respondents are asked to value of the bundle of attributes of the good, e.g. risk of a given FBD from a given type of food. Respondents’ WTP are asked directly (e.g. ‘are you willing to pay £x to reduce this risk?’ ‘please choose the amount you are willing to pay from this list’ and so forth).

- **In choice modelling**, the good is defined in terms of its attributes and each valued separately as well as a bundle. For example, the good ‘safer food’ would be defined in terms of food types, level of risk (% or number of cases a year), preparation time and cost. Respondents are given several scenarios consisting of different levels of each attribute and asked to choose their most preferred. WTP is, thus, not asked directly but inferred from the choices made across the scenarios.

Table **A3.2** summarises how different methods and types of data can be utilised for morbidity and mortality effects of FBD.

**Table A3.2  Types of data need to value the reduction in the risk of FBD**

<table>
<thead>
<tr>
<th>Type of health impact</th>
<th>Morbidity</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative data needed</td>
<td>Food – disease link</td>
<td>Who is at risk?</td>
</tr>
<tr>
<td></td>
<td>Type of disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Who is at risk</td>
<td></td>
</tr>
<tr>
<td>Quantitative data needed</td>
<td>Risk of disease and symptoms (number of days ill etc.)</td>
<td>Change in risk</td>
</tr>
<tr>
<td></td>
<td>QUALYs</td>
<td>Life years lost</td>
</tr>
<tr>
<td></td>
<td>DALYs</td>
<td></td>
</tr>
<tr>
<td>Type of health impact</td>
<td>Morbidity</td>
<td>Mortality</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>At risk population</td>
<td></td>
</tr>
<tr>
<td>Valuation method</td>
<td>cost of illness</td>
<td>Cost of illness</td>
</tr>
<tr>
<td></td>
<td>lost productivity</td>
<td>Lost productivity</td>
</tr>
<tr>
<td></td>
<td>aversive expenditure</td>
<td>Stated preference</td>
</tr>
<tr>
<td></td>
<td>Stated preference</td>
<td></td>
</tr>
<tr>
<td>Type of data</td>
<td>Price premium for safer food</td>
<td>WTP to reduce the risk of mortality or life years lost</td>
</tr>
<tr>
<td></td>
<td>Time spent for safer preparation</td>
<td>WTP to avoid pain, grief and suffering alone</td>
</tr>
<tr>
<td></td>
<td>Market data on medical expenditure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Market data on products that reduce contamination or pesticide levels (i.e. vegetable 'wash,' 'Salmonella-killing' cleaning products)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Market value of labour (average national income)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WTP to avoid risk of FBD to avoid all costs associated with FBD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WTP to avoid pain, grief and suffering alone</td>
<td></td>
</tr>
</tbody>
</table>
Annex 4  Existing economic value evidence for foodborne illnesses

This annex summarises the review of the economic valuation literature (academic and grey literature), how this evidence is used in economic appraisal by other organisations responsible for food safety a number of countries and presents conclusions which have informed the approach described in Section 4.

A4.1  Economic value evidence

29 economic valuation studies have been reviewed from the UK and elsewhere. The key purpose of the review was to learn lessons from the literature to judge whether it would be possible to estimate WTP to avoid pain, grief and suffering associated with FBD and if so what design features could be transferred. These lessons are summarised in this section and in Section 3.3. Finding actual estimates that could be transferred for use by the FSA was not expected and such transferrable estimates were not found.

A4.1.1  The good and change being valued

Existing economic valuation studies have estimated:

- Willingness to pay (WTP) for food free of contaminants (or ‘more free' of contaminants) and allergens (or ‘more free’ of allergens).
- WTP for food that is ‘Certified Residue Free' (or contains less pesticide residue).
- WTP for food that is FBD free (or less likely to contain FBD).
- WTP to reduce the FBD risk presented as pathogen-specific.
- WTP to reduce the FBD risk from certain foods.

These sought to value a reduction in risk of getting a FBD rather than explicitly trying to isolate the value of pain, suffering and suffering associated with having a FBD.

All have shown that it is difficult to find the right way to express the change in risk being valued. It has been suggested that questions which ask people to make direct trade-offs between their own wealth and (very small) changes in (unfamiliar) risks are unlikely to produce meaningful results (Covey, 1999). Subsequent studies have attributed this to respondents having a poor understanding of risk reductions and related numeracy (i.e. percentages, proportions) and, as a result, developed easier to understand visual tools to explain such risk (Buzby & Roberts, 2009; Covey, 1999; Hammitt & Haninger, 2007, Alberini 2006). The studies also had ‘practice questions' where participants practice making (monetary) trade-offs between foods and risk levels.

A4.1.2  Whose preferences were elicited

In most of the studies reviewed, including those interested in a specific consumer group (that is, members of a particular university community, customers at a particular shop, etc.), the sample was structured so as to be representative of the larger population being studied (or to which the results would be applied). This is in line with best practice.

Most WTP studies have determined what their affected population is by using census data to compile a demographically similar sample based on age, gender, education level, income, and household size.

Surveys reviewed were usually aimed at meat consumers, mainly because of the significance of FBDs associated with the consumption of meat pathogens and the propensity for meat consumption in the populations studied.

Overwhelmingly these studies have been interested in individual responses, rather than those of households or businesses, thereby acknowledging that individual preferences are unique and that individual demands for risk reduction vary.

Within this general population, studies have tended to engage with those individuals who:
Conduct the majority of household food shopping as these are the consumers who are faced with making regular choices between income and foodborne illness risk avoidance.

Prepare the majority of meals due to a similar rationale; that food preparers can chose to adopt, or not adopt, certain food hygiene practices that would reduce risk of contamination, and so can make an exchange between behaviour and associated foodborne illness risk levels more frequently.

Eat out often. Typically, a question is asked about the average number of times a respondent eats out within a week or month so as to gauge whether prevalence of eating out is correlated with risk perception and risky behaviour, and if so, how it is correlated with these topics. Existing studies seem to indicate that people who eat out more are less risk averse.

Have children vs. households that do not have children to see if there were any differences in their decisions and how much they were WTP.

Studies commonly map respondents’ risk perceptions, awareness, and their capacity for understanding changes in risk levels. For example, questions were asked regarding how often they purchased organic produce, with the aim of examining what existing consumer preferences can be inferred about their risk perception and spending habits. This approach is one where revealed preference data are collected through surveys and used to try to help explain why WTP values may vary between respondents (i.e. is a given factor an important explanatory variable), where those that already spend money to reduce risks, may have a different WTP compared to those that don’t purchase these types of products. In most of the studies reviewed so far, these behavioural variables have been shown to significantly impact consumers’ WTP.

### A4.1.3 The use of economic valuation methods

The literature is dominated by stated preference studies. The review confirms that the definition of the good and changes to the good are key aspects in designing these. For instance, the focus of a given study on measuring WTP for reductions in risk, number, severity or duration of FBDs\(^\text{15}\) (see: Roberts, 2007; Abelson, 2006) was decided upon at the preliminary design stages. Similarly, early decisions on how the outcome would be reported (QALYs, VSL, or VSC) as well as what sample population to consider determined the direction of the study.

The way in which evidence is gathered is also an important concern. This included determination of whether researchers wanted to collect evidence by observing premiums paid for categorized food products (e.g. “organic”, “certified residue free”, or “no additives”) (revealed preference) as a measure of risk avoidance, or by eliciting the premiums that respondents would pay for a measured reduction of risk of illness (stated preference).

Some studies were interested in WTP variations in relation to the method by which food risks were realised (i.e. through irradiation or increased quality control measures/inspections).

Furthermore, the type of risk, in terms of morbidity risk or mortality risk and in terms of type of food (product) risk versus type of pathogen risk,\(^\text{16}\) and the scale of risk reductions to be measured are thoroughly addressed at the preliminary planning stages.

Historically, research on the valuation of health risk has been dominated by the study of mortality risk. Foodborne disease in the UK and other OECD countries is in most cases non-fatal and certain studies (see: Hammit, 2002; Andersson et.al, 2011) have therefore opted to focus on individuals’ preferences for reducing morbidity risk related to food consumption instead.

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\(^{15}\) Studies examined that attempted to value FBDs in general applied estimated WTP from previous studies that were based on a specific FBD.

\(^{16}\) Although certain food products are linked to certain FBDs, risk reductions can be pathogen-specific, food product specific, or presented as a general change in likelihood of contracting a FBD.
Most studies assessed were similar in method and execution. They used one or more ways of framing the questionnaire in terms of (i) WTP for risk reduction; and (ii) health indicators like QALYs.

A4.1.3.1 Market price and revealed preference

There are data on consumer spending for organic and GMO-free food. The premium paid for these is likely to relate to perceived ‘safer food’ characteristics of these production processes. However, it’s not possible to separate from this spending data WTP specifically for pain, grief and suffering. Therefore market price data are not appropriate for the purposes of this study.

Revealed preference data on surrogate markets have also been investigated. The only surrogate market directly related to FBD is home fruit and vegetable wash products. This is a so-called ‘aversive expenditure’ that is undertaken by individuals with the intention of eliminating or minimising FBD risk. While such data can be collected, WTP specifically for pain, grief and suffering cannot be isolated.

A4.1.3.2 Stated preference studies – WTP for risk reduction

Where studies focused on valuing changes in the risk of getting a FBD, the general approach included:

- Asking respondents about food that they would purchase for consumption and preparation at home:
  - Chicken is most often used\(^{17}\) mainly because it is a familiar product and also because it is the cause of most foodborne illness-related deaths. Other food types used are eggs (Covey, et. al., 1998), beef (Radam & Yacob, 2010), and produce (Burton & Rigby, 2001; Huang & Kan, 2000).

- Asking respondents’ WTP a premium for a product with a set (less than current) risk of FBD:
  - One such study used a per cent increase in weekly food bill (Burton & Rigby, 2001).
  - WTP premiums can also be discussed in terms of auction-based surveys or (most often) as yes or no responses to different premium vs. risk reduction scenarios.

- Using realistic risk levels and potential reductions, in order to provide less hypothetical bias and more valid results.

- Presenting a number of factors in order to determine WTP such as risk of illness, its duration, its severity, and conditional probability of mortality, in addition to socio-economic factors (see Andersson et. al, 2011; Antle, 1999; Covey et. al, 1999; Haninger & Hammit, 2007 and 2011; Roberts, 2007 and others).

- Asking respondents own and family’s experience with FBD and their perception of how common it is compared with other health and safety risks to determine their awareness of risks in general.

- Could be giving a tutorial to help respondents practise making trade-offs between the price and safety of food, or a tutorial to help them understand changes in risks.

When this was not a feature of the survey, researchers would often include questions within the survey to determine how well a respondent understood risks.

A4.1.3.3 Health indicators

A US study by Scharff (2011) sets out an approach to valuing FBD using an ‘enhanced’ cost of illness (COI) model. The original COI model included economic estimates for medical

\(^{17}\) Responses from consumers who did not eat the food assessed were often not included in the analysis. However, in certain cases, if respondents did not eat the food, another food option was presented (as in Hammit & Hanninger, 2007).
costs, productivity losses, and illness-related mortality (death) based on hedonic value-of-
statistical-life studies.

The enhanced model replaced the productivity loss component within existing COI models
with a more inclusive component that included pain, suffering, and a functional disability
measure by replacing hedonic VSL estimates with monetised QALY estimates.

The study claims that the addition of updated cost data enhanced the performance of each
existing economic model, as FBD costs were estimated for each pathogen and a broader
class of unknown pathogens by multiplying the effect of illness on QALYs, and then applying
this to EQ-5D EuroQol\textsuperscript{18} weightings. This method could also be adapted to allow for the
inclusion and calculation of an elicited QALY value (i.e. through WTP survey). For example,
a WTP survey could be constructed to estimate the value of avoiding a FBD of varying
severity and duration. The value from this could then be used to estimate QALYs (see:
Haninger & Hammitt (2011), which can then be applied to EuroQol weighting to achieve a
more accurate measurement of COI. A national study in Denmark (Gyrd-Hansen, 2003)
elicted such a QALY value from its population in order to achieve just this.

In the UK, the National Institute for Health and Care Excellence (NICE) recommends that
“the value of changes in patients’ health related quality of life (HRQL) should be based on
public preferences using a choice-based method [and] the EQ-5D is the preferred measure
of HRQL in adults (Gyrd-Hansen, 2003).” Due to this fact, utilising QALY measurements
along with EQ-5D weightings for COI estimations seems to be of particular use. However,
without linking these measures to a monetary expression of preferences, it’s not clear how
they can be used in the economic appraisal of FSA initiatives.

In conclusion, QALYs / DALYs can be used to explain different severity and duration of FBD
but are not sufficient on their own to generate monetary WTP. Whether these should be
used in a questionnaire needs to be tested through qualitative research.

A4.2 Conclusions relevant to this study

A4.2.1 How can the existing WTP studies be improved upon

The review shows that there are several academic and government studies that have valued
the impacts of FBD. They have used a variety of different methods. The survey based
studies using risk information have improved over time, providing clearer presentation of this
information to respondents.

The following areas remain to be improved and any future valuation study should be
designed with these in mind:

- As most studies involve meat consumption (in particular chicken), they can be seen as
  excluding non-meat eaters.
- More studies should involve other food as new studies have shown that leafy green
  vegetables can be a significant cause of FBDs (CDC, 2013).
- Estimates are sensitive to the study populations, type of risk, and level of risk so results
  are often not transferable to different decision contexts. So, a new (more transferable)
  study should estimate WTP for FBD in as general terms as possible (e.g. number of FBD
  incidence from a typical weekly food basket) and collect data on respondents’ relative
  scores about different duration and severity of FBD and type of food.

\textsuperscript{18} The EuroQol Group is a network of international multidisciplinary researchers devoted to the measurement of
health status. They developed EQ-5D as a standardised measure of health status in order to provide a simple
generic measure of health for clinical and economic appraisal. It can be applied to a wide range of health
conditions and treatments and provides a simple descriptive profile and a single index value for health status that
can be used in the clinical and economic evaluation of health care as well as in population health surveys
(EuroQol Group, 2009).
Some measurement issues, especially for non-fatal outcomes (Buzby & Roberts, 2009) needs continued attention. In particular communication of risk, and very small changes in already small risks, is a notoriously difficult task (Covey, 1999).

Unexpected results regarding duration and severity of illness (mild discomfort to hospitalisation) are observed (Andersson et al, 2011; Hammit & Haninger, 2007; Covey, et. al.,1998; and more to be added later). For example, Andersson et.al (2011) found a strong relationship between WTP and the size of the QALY change related to non-fatal outcomes, but no statistically significant relationship between WTP and change in QALYs related to mortality risk. This may seem contrary to expectations but could be a result of the very small mortality risk presented to the respondents, per 100 million, or that the cognitive task of evaluating both a morbidity and mortality risk was too cumbersome for the respondents.

Estimates have proved sensitive to the characteristics of the study population, the level of risk, the type of risk (as expected).

The studies reviewed often assume away the importance of personal preferences within their decisions to purchase certain items (Kuchler & Golan, 1999), but these preferences (i.e. tastes, brand loyalty, simplicity, familiarity) should be kept in mind during analysis.

A4.2.2 Transferability of the evidence

Most of the existing valuation studies have been designed with a very narrow focus (e.g. one food product, one FBD, a small number of possible changes in the risk of FBD). Therefore, in most cases these cannot be transferred to appraise other food products, FBDs or a greater set of risk changes.

As for all other valuation contexts, studies from outside the UK (but from countries sufficiently similar to the UK) can be transferable only as an indication of the kind of values that may be estimated in the UK. They are not advisable to use for policy appraisal.

Studies to date (regardless of their focus and location) are useful in understanding the relative merits to different valuation designs. Such methodological advancements have underpinned the approaches suggested further on in this note.

A4.2.3 Conclusions

We can conclude that the valuation studies reviewed show that:

- It is possible to produce a valuation of pain, grief and suffering, lost leisure time, and other costs that cannot be estimated through market prices or revealed preference (e.g. basic cost of illness approach).
- Most have determined what their affected population is by using census data to compile a demographically similar sample based on age, gender, education level, income, and household size.
- Most have valued a change in risk but some have sought to value the severity of a FBD in terms of its pain, grief and suffering through the use of QALYs. The QALYs can then be valued using existing valuations or could potentially be used to quantify the change valued in a new WTP study.
- Individual preferences for risk reductions vary. This variation has been explained by socio-economic characteristics like income, age, health states and previous experience of FBD, whether the household has children and whether they prepare most of their food at home.
- The term ‘consumer’ can be broad (i.e. general population) without making a distinction between households and businesses.
- Surveys have limitations in how information on disease incidence is presented. More detailed and realistic data on the health consequences of FBD should be presented for more detailed WTP estimates.
- WTP can be estimated despite the randomness of foodborne illness cases (i.e. no one can predict exactly who will suffer from the hazard).
- There seems to be differences between WTP estimates from elderly (lower WTP for FBD avoided) and for FBD affecting children (higher WTP for FBD avoided).
- Statistically more robust results can be produced if a real and binding payment mechanism can be used (e.g. increase in general taxation, cost of weekly food shopping).

The evidence base raises questions, but also provides some signposts, about how far values can be regarded as generally applicable or case-specific, and how the complexity of disease, impact, population variation can be managed.

**A4.3 Market price evidence**

Two specific food markets are relevant to food safety as detailed below. Neither of these, however, could generate data that can be readily disaggregated to estimate WTP for pain, grief and suffering.

- **Organic food markets** - Organic foods are anywhere between 5% and 40% more expensive than conventional foods in the UK. This is mainly due to the use of the standards and processes applied for its farming. Within organic farming the use of synthetic chemicals or other processing standards are not acceptable (or limited) and so some of the price premium can be viewed as being realised through the preference for reduced chemical or pesticide consumption. Padel and Foster (2005) found personal health was a particularly strong driver among UK consumers of organic foods and related it to an absence of residues and increased food safety. Food safety represents consumers’ concern of residues in food resulting from chemical sprays, fertilizers, artificial additives, and preservatives often linked to farming methods. There is further evidence that also suggests that consumers believe organically grown produce poses fewer FBD risks than conventional food products (see: Williams & Hammit, 2000; Schifferstein & Ophius 1998; Yee et. Al, 2005).

- **Certified GMO free** - The use of GMOs in food products appears to cause anxiety and mistrust among some consumers in the UK (Burton et. al, 2001). Studies have shown that, in particular, concerns for food safety impact the apparent premium that UK consumers are willing to pay to avoid consumption of GMOs by way of purchasing food products that have GM-free labels or subject to retailers’ GM-free sourcing commitments. Currently, no GM crops are being grown commercially in the UK, but imported GM commodities, especially soya, are being used mainly for animal feed, and to a lesser extent in some food products.

- **UK disinfectants market** - Consumer fears over FBDs and increasing health consciousness and hygiene awareness worldwide are key factors fuelling growth of the global market for disinfectants. For the purposes of this study the focus would be on the UK market for kitchen disinfectants, which can help to infer a value that consumers place on reducing FBD risk.

**A4.4 Revealed preference evidence**

The advantage, of this approach is that it is based on observed behaviour involving a real choice. Cost of Illness (COI) uses a form of actual expenditure and revealed preference data. The cost of a health impact (from any source) includes medical expenditure, loss of income, loss in productivity and potentially WTP to avoid pain, grief and suffering (Antle, 1999). IID 119 and IID 220 carried out an epidemiology study of foodborne disease and included some COI estimates but not the pain, grief and suffering component.

We have looked at what surrogate markets there are for people to make purchases in that reflect their preferences for safer food. Organic and GMO-free food markets are detailed above. There is also a category of ‘aversive expenditure’ that could have potential, which is the home fruit and vegetable washes. The use of home fruit and vegetable wash products is increasing. These washers are natural cleaners that are safe to use on fresh produce to effectively remove all traces of dirt, fertilizer, pesticides, and other contaminants that may be harmful if eaten. Thus, by spending more on these, customers express their preferences for eliminating or at least minimising FBD risk.

While all of the above data reveal preferences for ‘safer food’, it’s not possible to separate from such data the WTP component for pain, grief and suffering alone. If such separate is not possible, we’d be valuing all motivations for such spending which are likely to include cost of illness, pain, grief and suffering, taste and convenience, perceived differences in nutritional value of food, ethical considerations about the environment and so on.

A4.5 Stated preference evidence

There are a large number of studies that cover economic burden from illness and pain and suffering in the context of air and water pollution, traffic deaths, and occupational deaths. However, there are markedly fewer that specifically target pain and suffering (and corresponding QALY, or similar measurements) from FBDs. In addition, most studies that are relevant to this topic were found to have been conducted in the USA. And so, in order to compile our literature review we utilised the Environmental Valuation Resource Inventory (EVRI) in addition to consulting valuation experts in the field of agriculture and food safety.

In searching the literature, it became apparent that the largest volume of studies dealing with WTP for FBD risk, symptoms, and general food safety regulation were studies that examine WTP for risk reductions (or WTP a premium for “safer food”) in order to estimate QALYs, VSLs, and VSCs. These studies also provide important information regarding the relationship between human behaviour and perceived exposure to FBDs in addition to perceptions about food safety and socio-economic factors which impact WTP. In particular, studies evaluating the WTP a premium for “safer” foods (i.e. organic, Certified Residue Free (CRF)) are valuable in providing estimates of consumer WTP for avoiding health deterioration through exposure to FBDs and chemical and radiological contamination from food or food related products as well as focusing on how food contamination concerns can correspond to behavioural changes. Studies examined on this topic have consistently found that these consumers are more knowledgeable about FBD risks and symptoms, the food system, and HRQL. These studies have therefore been included in the literature review in addition to studies concerning measuring health and well-being in relation to severity and duration of illness and/or QALY and VSL estimation.

The literature review included 27 empirical studies on topics ranging from consumer food risk perceptions and food safety policy, to subjective well-being and quality adjusted life years in the context of FDBs. A breakdown of the literature is provided below:

- Eleven studies were from the USA, nine studies were UK-based, one study was conducted in Canada, one study was from Asia (Malaysia), and a further five were mainland Europe-based (Sweden, Denmark, France (2), and Italy).
- Four studies used WTP for reduction in risk of FBD as a proxy for VSL and QALY estimates.
- Five studies analysed WTP a premium for non GMO, organic, or CRF products as an (possible) indication of WTP to avoid symptoms of FBDs and increased food safety.

http://www.food.gov.uk/science/research/foodborneillness/foodborne disease research/b14 programme/b14 proj list/b18021/
- Seven studies were based on measuring human health (pain and suffering) and well-being and/or subjective well-being and acceptable practices.
- Four studies analysed WTP for reductions in risk of FBDs (one of which, Mukhopadhaya et. al, 2007, examined WTP for zero FBD risk).
- Three studies analysed food safety perceptions and FBD risk awareness (this topic is also included as part of most WTP FBD studies assessed).
- And a further four studies analysed either WTP methods or methods for evaluating differing levels of health (one being the construction of EQ-5D values in America.
## Table A4.1  Summary table of valuation studies reviewed for this study

<table>
<thead>
<tr>
<th>ID</th>
<th>Title of literature reviewed</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Benefits and costs of food safety regulation</td>
<td>Antle, J. (1999), Benefits and costs of food safety regulation, Food Policy volume 24, no. 6, and p.605-623</td>
</tr>
<tr>
<td>ID</td>
<td>Title of literature reviewed</td>
<td>Reference</td>
</tr>
<tr>
<td>----</td>
<td>-------------------------------</td>
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</tr>
<tr>
<td>12</td>
<td>Consumer Willingness to pay to reduce GMO’s in food and increase the robustness of GM labelling</td>
<td>Rigby D., Young T., Burton M., (2004) Consumer Willingness to pay to reduce GMO’s in food and increase the robustness of GM labelling. Draft Report to Department of the Environment, Food and Rural Affairs.</td>
</tr>
<tr>
<td>ID</td>
<td>Title of literature reviewed</td>
<td>Reference</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>20</td>
<td>The public's valuation of food safety: can it contribute to policy?</td>
<td>Packham, C.M. (2004). The public's valuation of food safety: can it contribute to policy?. Ph.D University of Newcastle</td>
</tr>
</tbody>
</table>
### Title

**Diminishing Willingness to Pay per Quality-Adjusted Life Year: Valuing Acute Foodborne Illness**

### Reference


### Type

Empirical study on food safety, WTP

### High Level Description

Survey to assess WTP to reduce foodborne risk of acute illness and to test whether WTP is proportional to the corresponding gain in expected quality-adjusted life years (QALYs). Expected gain in QALYs is calculated using respondent-assessed decrements in health related quality of life if ill, combined with the duration of illness and reduction in probability specified in the survey. It finds sharply diminishing marginal WTP for severity and duration of illness prevented. Finds that estimates of WTP to avoid non-fatal health risk based on multiplying the corresponding loss in QALYs by a constant monetary value per QALY is not valid. Results suggest that while WTP to reduce morbidity risk is an increasing function of severity and duration of the illness to be prevented, WTP is more sensitive to severity than to duration, and so WTP cannot be represented as a univariate function of expected QALYs gained.

### Location, Country

USA

### Scale

National

### Valuation Approach

Stated preference

### Definition of the Good

Reduction in risk of foodborne illness of varying severity and duration

### Definition & Measurement of the Change

WTP for reduction in risk of foodborne illness of varying severity and duration

### Sample Size

2858

### Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP is modelled as a function of the severity and duration of</td>
<td>average WTP ($) per</td>
<td>Average WTP per QALY ranges from $150,000 to $5.6 million. VSC estimates</td>
<td>2011</td>
</tr>
<tr>
<td>Comments on Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>There is insensitivity of the contingent valuation (CV) method to the scope of the good being valued or genuine preferences (i.e., many studies find less-than-proportional relationship between WTP and risk reduction). This result suggests inadequate sensitivity to scope, perhaps due to difficulties in communicating the magnitude of risk reduction to survey respondents or to respondents valuing the risk reduction formed by combining their prior estimates of the risk reduction with the value stated in the survey through a Bayesian updating process.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Transferability to the UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods transferrable to UK, however quantitative data not transferrable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
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<tbody>
<tr>
<td>Willingness to pay and QALYs: What can we learn about valuing foodborne risk?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
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<table>
<thead>
<tr>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical study on food safety, WTP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Level Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study examines the value of reducing foodborne risk by focusing on an individuals’ preference for reducing morbidity risk related to food consumption. It obtains estimates of the value of a statistical case (VSC) for morbidity risk and the value of a statistical life (VSL) for mortality risk. It also examines whether WTP is proportional to the expected change in QALYs and estimates a WTP per QALY. It finds that WTP increases with but is not proportional to the change in QALYs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location, Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
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</table>

<table>
<thead>
<tr>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stated preference</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition of the Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in risk of <em>Salmonella</em> bacteria in a chicken filet</td>
</tr>
</tbody>
</table>
Definition & Measurement of the Change

WTP for reduction in morbidity risk and mortality risk of getting salmonellosis as a consequence of chicken consumption.

Sample Size

920

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP is modelled as a function of the change in risk of morbidity, change in the risk of mortality, other risk attributes, and respondent characteristics.</td>
<td>average WTP per QALY</td>
<td>Willing to pay a premium of between $2-$6 for a chicken product that reduces the risk of getting salmonellosis by between 1 and 3 in 10,000. This translates to (preferred) VSC estimates of $17,400 – $23,300 and a VSL estimate of $2.1 million.</td>
<td>2011</td>
</tr>
</tbody>
</table>

Comments on Method

Weak relationships found b/w WTP & morbidity risk reduction could be due to a too low variation in the risk levels/too low a variation in the differences in risk changes between the scenarios. Choosing realistic risk levels at the time of the survey may have increased realism, but may have increased the difficulty for respondents to distinguish the difference between them. We found a strong relationship between WTP and the size of the QALY change related to a non-fatal outcome. No statistically significant relationship between WTP and a change in QALYs related to mortality risk found. This is contrary to expectations and could be a result of the very small mortality risk presented to the respondents, per 100 million, or that the cognitive task of evaluating both a morbidity and mortality risk was too cumbersome for the respondents.

Transferability to the UK

Methods transferrable to the UK, quantitative data not transferrable.
<table>
<thead>
<tr>
<th>Title</th>
<th>Benefits and costs of food safety regulation</th>
</tr>
</thead>
</table>

| Reference | Antle, J. (1999), Benefits and costs of food safety regulation, Food Policy volume 24, no. 6, and p.605-623 |

| Type | Analytical study on costs/benefits of food safety regulation |

| High Level Description | Reviews the concepts and methods that can be used to quantify the benefits and costs of food safety regulations. Discusses the use and limitations of currently available benefit and cost information for quantitative regulatory impact assessment, using the assessment of the mandatory HACCP and pathogen reduction regulations in the United States as an example. WTP methods and costs of regulatory designs and performance standards are also discussed. |

| Location, Country | n/a |
| Scale | n/a |

| Valuation Approach | n/a |

| Definition of the Good | n/a |

| Definition & Measurement of the Change | n/a |

| Sample Size | n/a |

| Valuation Results | |
|------------------|------------------|------------------|------------------|
| Description | Unit of Measurement | Quantitative Estimates | Year of data |
| n/a | n/a | n/a | n/a |

| Comments on Method | Using cost of illness as a lower-bound of WTP. Explains how WTP for reduced risk of morbidity and mortality can |
be separated into four components: 1) the cost of treating the illness, 2) forgone income lost from work, 3) costs of averting illness, 4) and the disutility of illness.

Transferability to the UK

Methods for quantifying benefits from food safety regimes transferrable, but (slightly) dated.

Title

Consumer attitudes to genetically modified organisms in food in the UK

Reference


Type

Empirical study on food safety, WTP

High Level Description

Sets out to measure the extent to which UK consumer attitudes toward GM technology by assessing their WTP to avoid GMOs in food products. Choice modelling was used to map responses in the form of a preferred/optimal food bill for differing food baskets (i.e. some containing GM plants, some containing GM plants modified by the use of both plant and animal genes, or organic food) and their corresponding prices.

Location, Country

Manchester, UK

Scale

site specific

Valuation Approach

Stated preference

Definition of the Good

Reduction in GMO exposure

Definition & Measurement of the Change

Change in weekly food bill (as percentage of current level) in response to the introduction of GM foods.

Sample Size

228

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of</th>
<th>Quantitative Estimates</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>of data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WTP as a function of preference for organic food (either infrequent purchaser, occasional purchaser, or committed purchaser), preference for chemical use reduction, preference for local food, and socio-economic factors.</td>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% increase in weekly food bill to avoid animal and plant GM products.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The results suggest that infrequent consumers of organic food would be willing to increase their food bill by 26% (males) and 49% (females). The implied increases in occasional and committed organic consumers’ food bill for a GM-free diet suggest that they would never choose a basket with GM food.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments on Method

Respondents are not explicitly asking to value GM foods, but their valuation is inferred through analysis of their attitudes to the organisation of the food production system. Because of this, only very broad inferences could be made.

Transferability to the UK

Methods are transferrable. Qualitative data can be used as a proxy for UK consumer behaviour & attitudes concerning GMO's, quantitative data should not be transferred in a policy context.

Title

Valuing the prevention of foodborne illness: some limitations of consumers’ ‘willingness to pay.’

Reference


Type

Empirical study on food safety, WTP

High Level Description

WTP study analysing the value to consumers of small hypothetical risk reductions of foodborne illness from egg consumption. Annual expenditure on eggs was calculated for each respondent, and attached to a series of scenarios in which they were asked how much more they would be willing to pay for different egg brands in which the risks of illness (of varying severity and duration) were reduced. Three responses were recorded: the largest amount the respondent definitely would pay; the smallest amount that the respondent definitely would not pay; and the amount between the two where they found it most difficult to decide whether or not they would pay said amount.

Location, Country

Newcastle and York, UK

Scale

site specific
### Valuation Approach

Stated preference

### Definition of the Good

Reduction in risk of foodborne illness of varying severity and duration

### Definition & Measurement of the Change

WTP for changes in risk of illness of varying severity.

### Sample Size

69

### Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP as a function of risk of illness severity and duration, risk of death, and socio-economic factors.</td>
<td>WTP for varying reductions in risk of illness, illness duration, and illness severity</td>
<td>Depending on illness severity and duration, respondents were WTP (on average) between 5p and 20p per box of eggs for varying levels of risk reduction.</td>
<td>1998</td>
</tr>
</tbody>
</table>

### Comments on Method

WTP per box of eggs instead of WTP per year gave more understandable results to respondents. The structure of the study built upon previous studies on WTP for reductions in risk, but still found inconsistencies between results and economic theory. It is suggested that questions which ask people to make direct trade-offs between their own wealth and (very small) changes in (unfamiliar) risks are unlikely to produce meaningful results. There are indications that this study's respondents were confused about risk reduction and illness severity.

### Transferability to the UK

Methods are transferrable, qualitative & quantitative data are site-specific (no random sampling), can only make inferences a/b the small, sampled population; should not be used in a policy context.

### Title

Willingness to pay for food safety: Sensitivity to duration and severity of Illness

### Reference


### Type

Empirical study on food safety, WTP
High Level Description

Study estimating WTP for reduction in the risk of foodborne illness of specified severity and duration. The study found that the VSC avoided is higher for risk to children than to adults and that WTP was insensitive to duration (one to seven days) and severity (mild discomfort to hospitalisation).

Location, Country

USA

Scale

National

Valuation Approach

Stated Preference

Definition of the Good

Reduction in risk of foodborne illness of varying severity and duration

Definition & Measurement of the Change

WTP for food safety risk reductions

Sample Size

3766

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP is modelled as a function of the severity and duration of illness, reduction in its probability, other risk attributes, and respondent characteristics.</td>
<td>WTP per statistical case avoided</td>
<td>WTP to reduce risk of short-term morbidity from foodborne illness estimated at $1000 per statistical case avoided, and double that for child cases avoided. WTP is 35% and 47% larger for moderate and severe than for mild symptoms. Implied VSL of $9-$25million.</td>
<td>2004</td>
</tr>
</tbody>
</table>

Comments on Method

Respondents first completed a tutorial in which they practiced making trade-offs between food price and safety.

Transferability to the UK

Methods are transferrable. Data should only be used for USA-related inferences.

Title
Joint Estimation of Consumer Preferences and Willingness-to-pay for food safety.

Reference


<table>
<thead>
<tr>
<th>Type</th>
<th>Qualitative Choice Model, WTP</th>
</tr>
</thead>
</table>

High Level Description

Both a joint probit and ordered probit model used to analyse consumer preference and WTP for certified residue free (CRF) produce. This study assumes that a respondent actually has two joint simultaneous decisions to make: 1) whether or not to pay more and 2) how much more to pay. Only have information on the range of percentages of a price premium that a respondent is willing to pay for CRF produce. The results show that married households and higher income households are more likely than their counterparts to pay a premium for CRF produce. It is interesting to note that while income is not a significant factor that affects the probability of willingness to pay it does have a positive and significant effect on the amount of premium that a respondent is willing to pay.

Location, Country

GA, USA

Scale

State

Valuation Approach

Stated Preference

Definition of the Good

A reduction in pesticide consumption.

Definition & Measurement of the Change

WTP, in range of percentages of a price premium for reduction in pesticide through purchase of Certified Residue Free (CRF) produce.

Sample Size

381

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP determined by choice model</td>
<td>WTP premium (as a range of percentages)</td>
<td>Results indicate a moderate level of willingness to pay for CRF produce at 5% or 10% more than prevalent market price.</td>
<td>1989</td>
</tr>
</tbody>
</table>
Comments on Method

Statistical results of joint and separate estimation of willingness to pay more and how much more to pay equations. It has been suggested that whether there were children in the household might be a better variable than the marital status in explaining how much price premium that a consumer is willing to pay for CRF produce.

Transferability to the UK

Methods are transferrable. Qualitative data can be used as a proxy for UK consumer behaviour & attitudes concerning CRF foods, quantitative data should not be transferred in a policy context.

Title

Consumers’ Willingness to Pay for Food Safety: A Pathogen Specific Analysis

Reference


Type

Empirical study on food safety, WTP

High Level Description

Estimated consumers’ willingness to pay for a hypothetical vaccine that would deliver a 1-year, 5-years, 10-years, or lifetime protection against Salmonella, E. Coli, or Listeria. The dependent variable in the logit model is yes or no responses to WTP a given bid amount. A series of dummy variables for the type of pathogen, duration of prevention that the vaccine provides, and the bid level offered to the respondent are included as independent variables, also socioeconomic factors were included.

Location, Country

USA

Scale

National (nine Emerging Infections Program sites from nine states)

Valuation Approach

Stated preference

Definition of the Good

Hypothetical vaccine delivering 1 yr., 5 yr., or lifetime protection against E.coli, Salmonella, Listeria.

Definition & Measurement of the Change

WTP based on answer to yes or no questions concerning prices for hypothetical vaccines for different durations.
### Sample Size

5293

### Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP for protection against pathogen as a function of pathogen type, duration of protection, and socioeconomic factors.</td>
<td>WTP a set price, for set duration of protection against one of three common FBD.</td>
<td>WTP $104 for lifetime protection against <em>Salmonella</em>, $10 more for protection against <em>E. Coli</em>, $41 less for one-year prevention, $16 less if aged 65 years and above, $32 more on behalf of children less than five years of age. WTP (truncated mean) is $134 while the untruncated mean or median estimate is $125. On average, 68%, 56%, 50%, and 45% of respondents were willing to pay $25, $50, $75, and $100, respectively, for a hypothetical vaccine to protect them against one of the foodborne pathogens.</td>
<td>2002</td>
</tr>
</tbody>
</table>

### Comments on Method

There are obvious problems with offering a hypothetical good. Yes or no responses were translated into estimates of mean or median WTP measures. Duration of protection may not be relevant in a policy context, however pathogen specific data could be very useful.

### Transferability to the UK

Methods should be transferrable. Data can be used as a proxy for USA residents only.

### Title

Consumer Attitudes Toward Food Safety and Willingness to Accept Selected Bacterial Control Measures for Fresh Chicken

### Reference


### Type

Empirical study on food safety, WTA

### High Level Description

Telephone survey was conducted in order to gather information regarding consumer awareness and attitudes toward food safety, and their willingness to buy and pay for chicken made safer by better inspection, chemical bath, or irradiation. Questions about a respondent’s willingness to increase their own food preparation time (to ensure food safety) were also addressed. Nearly 85% of respondents were willing to buy safe chicken treated by...
chemical baths or irradiation.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>National</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>Stated preference</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>Reduction in risk of foodborne illness from chicken consumption</td>
</tr>
<tr>
<td>Definition &amp; Measurement of the Change</td>
<td>WTP for safer chicken treated through bacterial control measures (inspection, chemical bath, or irradiation).</td>
</tr>
<tr>
<td>Sample Size</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Results</th>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WTP for reduced foodborne illness risk from chicken consumption as a function of safety measurement, food safety concerns and practices, and socio-economic factors.</td>
<td>WTP (premium) per pound of treated chicken.</td>
<td>WTP $.16/lb. for inspected chicken, $.15/lb. if chemically treated and $.12/lb. if irradiated.</td>
<td>1988</td>
</tr>
</tbody>
</table>

| Comments on Method | Gathering more information about topics such as food safety concerns, food-borne illness risk awareness, etc., enabled this study to provide a clear picture of what type of people, with differing levels of concern, prefer which type of safety measurements. |

| Transferability to the UK | Methods should be transferrable. Quantitative data is based on the purchasing of a hypothetical good; can be used as a proxy for USA residents only. |

<table>
<thead>
<tr>
<th>Title</th>
<th>Relating Consumer Willingness-to-Pay for Food Safety to Risk Tolerance: An Experimental Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Empirical study on food safety, WTP</th>
</tr>
</thead>
</table>

**High Level Description**

The objective of this study was to investigate the relationship b/w food safety related risk tolerance and WTP for food safety risk reductions. Non-hypothetical experimental auctions were used to elicit consumer valuations of food safety improvement. To identify the relationship between food safety concern and risk-reduction valuations, individual risk perception scores were constructed based on survey responses. Results show WTP for improved food safety tends to decrease as individuals become more risk tolerant. Differences in bids across uninformed and informed rounds of bidding tend to become smaller with risk tolerance for individuals who initially overestimated the food safety risk.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>Canada</th>
</tr>
</thead>
</table>

**Scale**

site specific (university community members)

**Valuation Approach**

Hypothetical auction

**Definition of the Good**

Risk reduction related to exposure to Campylobacter after consuming a breaded chicken sandwich.

**Definition & Measurement of the Change**

WTP for food safety risk reductions

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>146</th>
</tr>
</thead>
</table>

**Valuation Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP for food safety risk reductions as a function of risk tolerance</td>
<td>WTP for food safety risk reductions as impacted by unit changes in risk tolerance</td>
<td>A one unit increase in the risk tolerance factor score brings about a 0.76% reduction in the willingness-to-pay for improved food safety.</td>
<td>2005</td>
</tr>
</tbody>
</table>

**Comments on Method**

The use of a high-risk FBD (individual chance of infection of Campylobacteriosis is 1 in 90 annually. Of those individuals who become ill, one individual in 1,000 will die annually) that is relatively unknown, could allow for respondents to more easily comprehend
changes in risk and protection. However, it may also lead to exaggeration of WTP.

**Transferability to the UK**

Methods are transferrable. Quantitative data can be used as a proxy for Canadian residents only.

**Title**

Consumers’ Perceptions, Attitudes and Willingness to Pay towards Food Products with “No Added MSG” labelling

**Reference**


**Type**

Empirical study on food safety, WTP

**High Level Description**

This research was carried out in order to determine consumers’ perceptions, attitudes and willingness-to-pay (WTP) towards food products with “No Added MSG” labelling by determining a consumer’s WTP for the consumption of safer beef. A logit model was used to estimate the premium that consumers are willing to pay for food products with “No Added MSG” labelling.

**Location, Country**

Malaysia

**Scale**

Regional

**Valuation Approach**

Stated preference

**Definition of the Good**

WTP for reduced risk of illness due to MSG consumption

**Definition & Measurement of the Change**

WTP a premium for food products with "No added MSG" labelling.

**Sample Size**

200

**Valuation Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of</th>
<th>Quantitative Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

79
<table>
<thead>
<tr>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP for beef with &quot;No MSG&quot; labelling</td>
</tr>
<tr>
<td>The average mean premium WTP is about RM0.43, which indicated that respondents are willing to pay a premium of about RM 0.43 (~£.10) for food products with “No added MSG” labelling.</td>
</tr>
</tbody>
</table>

**Comments on Method**

The actual survey conducted was of very poor design to reveal an unbiased measurement of willingness to pay. However, it was able to capture the demand for the labelling of MSG vs. non-MSG food, and the level of concern that consumers have toward MSG.

**Transferability to the UK**

Methods are transferrable, but assumptions based upon results provided within this study should not be transferred.

**Title**

Consumer Willingness to pay to reduce GMOs in food and increase the robustness of GM labelling

**Reference**

Rigby D., Young T., Burton M., (2004) Consumer Willingness to pay to reduce GMOs in food and increase the robustness of GM labelling, Draft Report to Department of the Environment, Food and Rural Affairs.

**Type**

Empirical study on food labelling, WTP

**High Level Description**

This study assessed the consumer benefits associated with forthcoming changes in the EU regulations regarding the labelling regime for GMOs in food and feed. Namely, estimating the benefits of a reduction in GM labelling threshold levels and estimating the benefits of increasing the robustness of the labelling regime. Also, analysed consumer reactions to changes in the proportion of their food items containing GM ingredients. This was analysed using choice sets including different bread options which included distinctions between GM, GM-derived and non-GM ingredients.
**Definition of the Good**

WTP to reduce GMO exposure

**Definition & Measurement of the Change**

WTP (in percentage) in increase in price from their usual bread price for less GM ingredients, and for more robust GM labelling.

**Sample Size**

608

**Valuation Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP for GM avoidance and more robust GM labelling as a factor of current consumption, socio-economic factors, and attitudes towards GMOs.</td>
<td>WTP (in percentage) in increase in price from their usual bread price for less GM ingredients, and for more robust GM labelling.</td>
<td>The median WTP for the sample is 79%, which may be interpreted as the discount required to induce purchase of a GM product, or the premium consumers will pay to avoid the GM product.</td>
<td>2003</td>
</tr>
</tbody>
</table>

**Comments on Method**

Motivations of purchases could be important, for example, some may make purchases because they know that it contains no GM ingredients, others may do so because they like the taste or other qualities of the bread and may be prepared to purchase the same bread if GM or GM-derived ingredients were used.

**Transferability to the UK**

Methods are transferable, data should not be transferred.
This study aims to give a value to food safety relative to the practice of sewage sludge disposal on agricultural soils by examining WTP for risks linked to one heavy metal (cadmium). These risks are supposed to be very low and can be difficult to assess because of the uncertainties involved in the food chain process, but using the responses, ‘tolerable weekly doses’ for the most dangerous heavy metals are estimated. In order to remedy this, another objective was to compare the willingness to pay obtained in a hypothetical risky situation and in one where risks were uncertain.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>site specific</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>Stated preference</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>WTP for reduction in risk of illness from consumption of ‘sewer sludge’ foods as translated to a premium for vegetables not grown with sludge that will reduce intake of ‘weekly tolerable doses’ of cadmium.</td>
</tr>
<tr>
<td>Definition &amp; Measurement of the Change</td>
<td>WTP a premium for vegetables that have not been grown in sludge.</td>
</tr>
<tr>
<td>Sample Size</td>
<td>64</td>
</tr>
<tr>
<td>Valuation Results</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Unit of Measurement</td>
</tr>
<tr>
<td>WTP for reduced risk of foodborne illness due to higher levels of cadmium through consumption of sludge-grown vegetables.</td>
<td>WTP (premium) francs/week to avoid sludge-grown vegetables and to reduce the probability of coming closer to the weekly tolerable dose of cadmium.</td>
</tr>
<tr>
<td>Comments on Method</td>
<td>Respondents state preferences for “uncertain risks” leaves results which are difficult to interpret.</td>
</tr>
<tr>
<td>Transferability to the UK</td>
<td>Methods are transferrable. Data should only be used for France-related inferences.</td>
</tr>
</tbody>
</table>
**Title**

Willingness to Pay for Food Safety: Costs and Benefits of Accurate Measures

**Reference**


**Type**

Discussion of WTP and FBD risk

**High Level Description**

This paper discusses things such as the use of WTP to determine consumer welfare, the subsequent pros and cons, and variables that systematically influence WTP. Also includes suggestions for construction of a WTP survey and how to interpret results.

**Location, Country**

USA

**Scale**

n/a

**Valuation Approach**

n/a

**Definition of the Good**

n/a

**Definition & Measurement of the Change**

n/a

**Sample Size**

n/a

**Valuation Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td></td>
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</tbody>
</table>

**Comments on Method**

Developing foodborne illness specific WTP estimates is preferable to using standard amounts. Standard VSL estimates are most likely poor measures of WTP for reducing foodborne illness fatalities, as there is more risk of morbidity related to these illnesses.
Transferability to the UK

Methods of assessing costs and benefits of determining consumer welfare trade-offs are transferrable.

Title

Organic Food Product Purchase Behaviour: a pilot study for urban Consumers in the South of Italy

Reference


Type

Empirical study on food purchasing behaviour

High Level Description

This paper aims to explain factors that influence organic food purchases of urban consumers in the South of Italy. It finds that attitudes towards health and environmental benefits provided by organic foods are the most important factors explaining, both, the intention to purchase and the final decision. Also, income and organic knowledge positively influences the final decision to buy organic food products. Suggests that the most appropriate strategy to enhance organic food consumption is to design communication campaigns highlighting the benefits of organic food products for the whole society, through environmental protection and health benefits.

Location, Country

Italy

Scale

Regional

Valuation Approach

Stated preference

Definition of the Good

n/a

Definition & Measurement of the Change

n/a

Sample Size

200

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of MEASUREMENT</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments on Method</td>
<td>n/a</td>
<td>n/a</td>
<td>2003</td>
</tr>
<tr>
<td>-------------------</td>
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<tr>
<td>Transferability to the UK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methods are transferrable. Data should only be used for Italian consumer-related inferences.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Title**

The Effect of Risk Presentations on Choices and WTP Estimates

**Reference**


**Type**

Empirical Study on Food Safety (WTP) and Study on risk and choice behaviour

**High Level Description**

This study examines, discusses, and compares the effects of different presentations of risk changes on a consumer's choice behaviour and their valuation of product attributes. Mainly, the focus is on the use of visual 'risk grids' to accompany probabilities of risk (i.e. 1 in 10,000) within discrete choice experiment surveys, compared to surveys supplying risk information without a visual aid. Respondents chose between two identical whole chickens (in terms of taste, appearance, texture) that differed in price, level of food risk, presence of nano-sensors, and level of animal welfare. The study does not conclude that the use of risk grids has reduced task complexity and hence error variance, but finds increased sensitivity to risk changes when grids are present in the sets and hence increased valuations of risk reductions. And so, results seems to indicate that consumers are WTP more to lower their risk of food poisoning when their preferences are elicited using risk grids as a visual aid within the choice surveys.

**Location, Country**

UK

**Scale**

National

**Valuation Approach**

Stated preference

**Definition of the Good**

Reduction in level of food poisoning risk

**Definition & Measurement of the Change**
WTP a premium (above given baseline prices) for reduction in level of food poisoning risk related to the purchase/consumption of a whole chicken

Sample Size

449

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP premium for reductions in food poisoning risk (through use of nano-sensor technology), and changes in animal welfare</td>
<td>£ (premium)/per chicken</td>
<td>On average, consumers prefer chickens with a lower risk of food poisoning, better animal welfare, and lower prices. Also, consumers shown a risk grids were willing to pay £0.72 more than the non-grid sample per whole chicken to halve the food poisoning risk from 80 (baseline) to 40 per 10,000.</td>
<td>2010</td>
</tr>
</tbody>
</table>

Comments on Method

Conducted a split sample DCE survey in which respondents chose between risk reducing food products. In the first split risks are conveyed in absolute terms (e.g., 10 in 10,000) while in the 2nd split this information is presented with risk grids. Analysis of the pooled data focuses on the impact of inclusion of the risk grids on marginal utilities of, and WTP for, risk reductions, changes in the probability of selecting the SQ option, and error variance. Does not/cannot provide information regarding whether value of risk reduction would be different if achieved by means other than nanotechnology. Possible distrust of nanotechnology not addressed.

Transferability to the UK

Methods are transferrable. Quantitative data should not be directly transferred within a policy context, but can be used as proxy for consumer attitudes and behaviours in relation to the good specified.

Title

Using a Discrete Choice Experiment to Elicit Consumers’ WTP for Health Risk Reductions Achieved By Nanotechnology in the UK

Reference


Type

Empirical Study on Food Safety (WTP) and Study on risk and choice behaviour

High Level Description

This study looks at consumer’s WTP for reductions in the level of foodborne health risks and addresses how such valuations are affected by the means in which the risk reduction is delivered and the methods of risk presentations used in choice tasks. In particular, consumers are faced with choices between risk reduction achieved by an improvement in the food system in general (e.g. more strict regulations/inspection) versus risk
reductions realised by innovations within food packaging, mainly nano-sensors that reveal a colour change on the packaging material if contamination is present. Also, respondents were grouped as either standard (those who regularly buy non-organic/non-free range chicken) consumers or non-standard consumers. The effects of nano-sensors and risk grids on consumers' choices are not strong across the models. The valuations of health risk reductions show some variations across the models in both treatment groups.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>National</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>Stated preference</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>Reduction in level of food poisoning risk</td>
</tr>
<tr>
<td>Definition &amp; Measurement of the Change</td>
<td>WTP a premium (above given baseline prices) for reduction in level of food poisoning risk related to the purchase/consumption of a whole chicken</td>
</tr>
<tr>
<td>Sample Size</td>
<td>449</td>
</tr>
</tbody>
</table>

### Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP premium for reductions in food poisoning risk through two different treatments: an improvement in the food system, or nano-sensors. The second part of the research examines the effects of different risk presentations on WTP values for the health risk reductions offered using two different risk presentations: absolute numbers with and without visual grids, to communicate changes in the level of food poisoning level attributable to chicken.</td>
<td>£ (premium)/per chicken</td>
<td>On average, standard consumers are willing to pay the same amount for a unit decrease in food risk in no-nano sample. The use of grids has an effect on standard consumers’ valuations of health risk reductions (standard chicken consumers are willing to pay more to prevent food risks when risk grids are used in the surveys), but not on consumers who buy niche, higher welfare chickens.</td>
<td>2010</td>
</tr>
</tbody>
</table>
This is a continuation of a previous study (the one above) that also takes into account consumer preference for different types of foodborne illness risk reduction techniques, mainly nano-sensors versus food system improvement (i.e. More strict regulations/inspections). The analysis results from the first part showed that the inclusion of nano-sensors in packaging does not affect consumers’ preferences for raw, whole chickens.

Transferability to the UK

Methods are transferrable. Quantitative data should not be directly transferred within a policy context, but can be used as proxy for consumer attitudes and behaviours in relation to the good specified.

Title

A Means to an End? The Value of Health Risk Reductions Achieved via Nanotechnology.

Reference


Type

Empirical Study on Food Safety (WTP) for risk reductions achieved via nanotechnology

High Level Description

This study examines and compares consumers’ valuations of food risk reductions and how this is affected by the means by which it reductions are achieved, and in particular the impact on the value if the risk reduction is delivered through nanotechnology. The research further investigates how people’s valuations vary with varying risk amounts and presentations, and their underlying attitudes to nanotechnology and levels of trust in different institutions and agents associated with food safety. It also discusses the factors affecting the public's view of nanotechnology.

Location, Country

UK

Scale

National

Valuation Approach

Stated preference

Definition of the Good

Reduction in level of food poisoning risk

Definition & Measurement of the Change

WTP a premium (above given baseline prices) for reduction in level of food poisoning risk related to the purchase/consumption of a whole chicken
Sample Size
449

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTA compensation for increases in food poisoning risk through two different treatments: an improvement in the food system, or nano-sensors. The second part of the research examines the effects of different risk presentations on WTA values for the health risk reductions offered using two different risk presentations: absolute numbers with and without visual grids, to communicate changes in the level of food poisoning level attributable to chicken.</td>
<td>£ (premium)/per chicken</td>
<td>Standard chicken consumers are WTA a decrease in price of £0.32 less for a 1 unit increase in FP risk (e.g. from 1/1,000 to 2/1,000). Non-standard chicken consumers have different WTPs for changes in risks if the package includes a nano-sensor. In nano-case, they are willing to pay £0.46 less for a 1-unit increase in FP risk level (i.e. 1/1,000 to 2/1,000). If there is no nano-sensor in the packaging, they are willing to pay £0.58 less for a 1 unit increase in the level of FP risks (there is implicit WTP to avoid nanotechnology).</td>
<td>2010</td>
</tr>
</tbody>
</table>

Comments on Method

This study lays the groundwork for two consequent studies (the two above). It finds similar results and uses similar methods of survey/model design, and finds that for those buying niche, higher welfare chickens, there exists a disutility associated with the nanotechnology.

Transferability to the UK

Methods are transferrable. Quantitative data should not be directly transferred within a policy context, but can be used as proxy for consumer attitudes and behaviours in relation to the good specified.

Title

Economic Burden from Health Losses Due to Foodborne Illness in the United States

Reference


Type

Empirical study on COI

High Level Description

This study aims to provide improved and updated estimates of the cost of foodborne illness by adding new (2011) FBD statistics from the CDC to the CDC’s existing cost-of-illness model which includes estimates for medical
costs, productivity losses, and illness-related mortality (based on hedonic VSL studies). The new COI model replaces productivity loss estimates with a more inclusive pain, suffering, and functional disability measure based on monetized QALY estimates. Costs are estimated for each pathogen and a broader class of unknown pathogens. The study claims that the addition of updated cost data enhanced the performance of each existing economic model. To calculate effect of illness on QALY, they suggest a loss of 0.492 per day for cases with a hospitalization, and a loss of 0.311 per day for all other cases.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>National</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>COI</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>n/a (no survey used)</td>
</tr>
<tr>
<td>Definition &amp; Measurement of the Change</td>
<td>n/a (no survey used)</td>
</tr>
<tr>
<td>Sample Size</td>
<td>n/a</td>
</tr>
<tr>
<td>Valuation Results</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Unit of Measurement</td>
</tr>
<tr>
<td>Cost per case of FBD by pathogen using EQ-5D QALY values</td>
<td>cost per case of FBD by pathogen</td>
</tr>
</tbody>
</table>

Comments on Method

The difference between the old and new models is that the new model includes a measure for lost quality of life (QALY) but no measure for own-illness productivity loss (due to its inclusion in QALY measurements). The study claims that the addition of updated cost data enhanced the performance of each existing economic model.

Transferability to the UK

Methods are transferrable; data should not be used in a policy context other than in the USA.
Title
The public’s valuation of food safety: can it contribute to policy?

Reference
Packham, C.M. (2004). The public’s valuation of food safety: can it contribute to policy? Ph.D University of Newcastle

Type
Empirical study on food safety

High Level Description
The thesis uses a stated preference technique, contingent valuation, to try and estimate the demand, and so the willingness to pay for the food safety public good. Three specific market failures are identified and discussed; these are risk perception, information asymmetry, and social costs and benefits. It is suggested that the government needs to intervene to correct these market failures, and the core issue of the extent to which government intervention is demanded by the public is discussed.

Location, Country
Tyneside, UK

Scale
National

Valuation Approach
Stated preference

Definition of the Good
increased food safety

Definition & Measurement of the Change
WTP for increased food hygiene

Sample Size
312

Valuation Results
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP (as a set of given choices) for increased</td>
<td>WTP extra amount</td>
<td>The open-ended survey produced average WTP values of £8 a week. The closed-ended survey</td>
<td>2004</td>
</tr>
<tr>
<td>food hygiene consistency</td>
<td>on top of yearly</td>
<td>produced a WTP value of between £400 and £450 a year. The median WTP was £250 per year.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>food spend</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Comments on Method**

The study is very broad (i.e. Asking respondents whether they would pay a given set of prices for more consistent food hygiene) however, asked a lot of questions which give qualitative results.

**Transferability to the UK**

Methods and some qualitative data are transferrable. However, methods have improved since this application and hence valuation questionnaire should include these improvements.

<table>
<thead>
<tr>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living Healthy and Living Long: Valuing the Non-Pecuniary Loss from Disability and Death</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical study on measuring pain and suffering and well-being</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Level Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study aimed to estimate the non-pecuniary cost associated with disability late in life by collecting data using an iterative computerized questionnaire. The interviews, conducted in 1998, used a sample consisting of clients at rehabilitation clinics and orthopaedic clinics in NC, USA and assessed WTP as a function of experience with disability, whether respondent ever had a cognitive disability, whether avoiding a disability was extremely important, demographic characteristics, and initial cost of living differential between two communities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location, Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC, USA</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Scale</th>
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<tbody>
<tr>
<td>age-specific</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stated preference</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition of the Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>prolonged quality of life</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Definition &amp; Measurement of the Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>disability and accidental death avoidance</td>
</tr>
</tbody>
</table>

| Sample Size |
Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP as a function of experience with disability, whether respondent ever had a cognitive disability, whether avoiding a disability was extremely important, demographic characteristics, and initial cost of living differential between two communities.</td>
<td>WTP to avoid disability/accidental death</td>
<td>Willingness to pay functions estimated values for intangible losses ranging from $0.39 million (1998 United States Dollars) to $3.21 million (1998 United States Dollars). The study shows that for most people, disability beginning in the sixth decade of life is not worse than death even though it does impose a tremendous loss on individuals.</td>
<td>1998</td>
</tr>
</tbody>
</table>

Comments on Method

This study focused on responses from an elderly population to assess potential differences in values (compared to other studies & generally used values) for quality and longevity of life.

Transferability to the UK

Methods are transferrable; data should not be used in a policy context other than in the USA.

Title

The Value of Health and Longevity

Reference


Type

Empirical study on human health and life expectancy

High Level Description

This study aims to develop and apply an economic framework for valuing improvements in health and longevity, based on individuals WTP by assuming that WTP is determined by the expected discounted PV of lifetime utility. Since cumulative gains in life expectancy over the 20th century were worth over $1.2 million per person for both men and women, b/w 1970 and 2000 increased longevity added about $3.2 trillion per year to national wealth, and reduced mortality from heart disease alone has increased the value of life by about $1.5 trillion per year since 1970. Potential gains from future innovations in health care (1% reduction in cancer mortality worth nearly $500 billion), while a cure (if one is feasible) would be worth about $50 trillion.
USA
Scale
National

Valuation Approach
Stated preference

Definition of the Good

health improvements

Definition & Measurement of the Change

gains in life expectancy

Sample Size

Various studies assessed

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP is determined by the expected discounted present value of lifetime utility</td>
<td>WTP for improvements in health</td>
<td>Cumulative gains in life expectancy over the 20th century were worth over $1.2 million per person for both men and women.</td>
<td>2000</td>
</tr>
</tbody>
</table>

Comments on Method

This study develops an economic model for valuing improvements in health and life expectancy which builds on life cycle theories. The model uses estimates of the VSL taken from the literature on WTP for reductions in risks of accidental death. The calibration of the model involves use of estimates of the VSL taken from literature on willingness to pay for reductions in risks of accidental death. It is also assumed that advances in longevity and quality of life are related. Their equation incorporates estimates of the value of non-market time and the value of improvements to health while living in assessing the value of health improvements.

Transferability to the UK

Methods are transferrable; data should not be used in a policy context other than in the USA.

Title

Willingness to Pay for a QALY

Reference


Type
Empirical study on WTP for QALY

High Level Description

The WTP per QALY estimate presented here differs considerably from that implied in contingent valuation studies, suggesting that WTP for reducing risk of death is based on other preference structures than is ex post WTP for improvements in quality of life. Results further suggest that different preference structures may exist when respondents are faced with WTP questions in which case elimination of minor health problems are associated with negligible utility. After choosing the worst health state, the respondent was asked the willingness to pay (WTP) for going from the worst to the other health state. The bidding was closed ended; the monthly costs were allocated at random to the respondent, ranging from 8.50 to 10000 DKK. The payment vehicle was out-of-pocket, in monthly costs for medicines. The values were adjusted with two different QALY tariffs, Danish and UK.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>Denmark</th>
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</thead>
<tbody>
<tr>
<td>Scale</td>
<td>National</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>Stated preference</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>health improvements</td>
</tr>
<tr>
<td>Definition &amp; Measurement of the Change</td>
<td>gain in quality of life/health</td>
</tr>
<tr>
<td>Sample Size</td>
<td>3201</td>
</tr>
<tr>
<td>Valuation Results</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Unit of Measurement</td>
</tr>
<tr>
<td>WTP for medical treatment that brings them from one (worse) health state (defined by EuroQol, EQ 5D) to another (better) health state</td>
<td>WTP for improvements in health</td>
</tr>
</tbody>
</table>

Comments on Method

The WTP per QALY estimate presented here differs considerably from that implied in contingent valuation studies, suggesting that WTP for reducing mortality risk is based on other preference structures than is ex post WTP for improvements in quality of life. Results further suggest that different preference structures may exist when respondents are faced with WTP questions in which case elimination of minor health problems are associated with negligible utility.

Transferability to the UK
Methods transferrable, data should only be used in Denmark.

<table>
<thead>
<tr>
<th>Title</th>
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<tbody>
<tr>
<td>Valuing Health: A Brief Report on Subjective Well-Being versus Preferences</td>
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<table>
<thead>
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<th>Reference</th>
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<table>
<thead>
<tr>
<th>Type</th>
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<tbody>
<tr>
<td>Well-being Study</td>
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</table>

<table>
<thead>
<tr>
<th>High Level Description</th>
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<tbody>
<tr>
<td>In the UK, the National Institute for Health and Clinical Excellence (NICE) recommends that “the value of changes in patients’ HRQL should be based on public preferences using a choice-based method [and] the EQ-5D is the preferred measure of HRQL in adults.” This study uses Shaw et. al's (2007) EQ5D to analyse the impact on SWB (in the same way that Shaw and others analyse its impact on preferences) by creating a dummy variable for each level of each dimension in a regression model with SWB as the dependent variable and the dummies for the EQ5D as independent variables.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Location, Country</th>
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<tbody>
<tr>
<td>UK</td>
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<table>
<thead>
<tr>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>national &amp; international techniques discussed</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
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</table>

<table>
<thead>
<tr>
<th>Definition of the Good</th>
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<tbody>
<tr>
<td>increased quality of life and/or longevity</td>
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</table>

<table>
<thead>
<tr>
<th>Definition &amp; Measurement of the Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>avoiding ailments</td>
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<table>
<thead>
<tr>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1173</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
</tr>
</tbody>
</table>

96
Percentage impact of each level of each dimension based on people’s TTO preferences (using the Shaw et al data) or their SWB (new data on life satisfaction and day affect found by this study).

| % of life expectancy willing to give up to avoid specific ailments | The general public is willing to give up between 14.6% & 17.5% of their life expectancy to avoid any one (and only one) of the “some problems” proposed. Moderate anxiety/depression is associated with broadly comparable drops in SWB; 15.1% for life satisfaction and 21.8% for day affect. | 2012 |

Comments on Method

Methodology has some problems (which are discussed throughout the text), most notably the fact that circumstances often affect individuals quite differently from how they imagine them, and views of symptoms and illness may differ largely from person to person.

Transferability to the UK

Methods transferrable, data is taken from Shaw et al EQ 5D and SWB data derived from this study.

Title

US valuation of the EQ-5D health states: development and testing of the D1 valuation model.

Reference


Type

Empirical study valuing differing levels of health and well-being

High Level Description

This study elicited US population values for the EQSD from 3773 respondents using the TTO method. The EQ-5D TM defines health in terms of 1 of 3 levels of severity (broadly, no problems, some problems, and extreme problems) associated with each of 5 dimensions; mobility, self-care, usual activities, pain/discomfort, anxiety/depression. Each of the 243 health states are represented by a 5-digit code, ranging from 11111 for full health to 33333 for extreme problems on all 5 dimensions. Values are derived from answers from members of the public asked for their time trade off (TTO) preferences relating to how many years of life in 11111 they consider to be equivalent to a longer period of time in one of the remaining 242 poor health states.

Location, Country

USA

Scale

National

Valuation Approach

Stated preference
Definition of the Good

quality of life

Definition & Measurement of the Change

increase/decrease in quality of life and health

Sample Size

3773

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time trade off (TTO) preferences relating to how many years of life in 11111 they consider to be equivalent to a longer period of time in one of the remaining 242 poor health states.</td>
<td>TTO</td>
<td>the conceptually based D1 model yielded the best fit for the observed TTO data, with an MAE of 0.025 and only 7 prediction errors exceeding 0.05 in absolute magnitude</td>
<td>2005</td>
</tr>
</tbody>
</table>

Comments on Method

Using a large, representative sample of the general adult US population, the study generated a preference-weighting system for the EQ-5D health states. This scoring function can be used to generate preference weights that may be incorporated into QALYs and CUAs. It is suggested that multinational studies will need to conduct sensitivity analyses to evaluate the impact of differences between countries in the methodology used to generate preference weights for the EQ-5D health states.

Transferability to the UK

Methods are transferrable; data should be used in US context only.

Title

Consumers' willingness to pay for food safety: the case of mycotoxins in milk

Reference


Type

Empirical study on WTP for decreased risk of exposure to contaminant

High Level Description

The objective of this paper is to evaluate Italian consumers’ perception of the mycotoxins’ risk and their WTP to reduce such risk. A web-based stated choice (SC) experiment with a representative sample of 973 Italian consumers was carried out involving a hypothetical bottle of milk obtained by cows in which the feed ration...
contains maize certified for the ‘good practices’. WTP has been measured using the panel data version of a Random Parameters Logit (RPL) model. The results show that Italian consumers are willing to pay a rather high average price premium for “reduced-mycotoxin” milk. This premium becomes even higher for female, middle-aged, and low-education consumers.

<table>
<thead>
<tr>
<th>Location, Country</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>National</td>
</tr>
<tr>
<td>Valuation Approach</td>
<td>Stated preference (stated choice)</td>
</tr>
<tr>
<td>Definition of the Good</td>
<td>Reduction in risk of mycotoxin exposure</td>
</tr>
<tr>
<td>Sample Size</td>
<td>973</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valuation Results</th>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WTP as a function of socio-economic factors, frequency of food shopping, frequency of milk purchase, attitude toward mycotoxin labelling, type of milk preferred (fat content, heating treatment (i.e. pasteurisation, UHT), price, and certification of production process (either ‘good practices’ or ‘conventional practices’).</td>
<td>WTP to avoid exposure to mycotoxins</td>
<td>The study finds that the price premium that consumers are WTP to obtain a product with a reduced mycotoxins’ risk is, on average, 0.64 €/l, which is 41.5% of the average milk price (1.54 €/l).</td>
<td>2009</td>
</tr>
</tbody>
</table>

Comments on Method

The survey started with a statement describing mycotoxins, their potential health impacts, and the role of some ‘good practices’ in reducing the risk of their presence in milk. Consumers were then asked to choose bottles of milk that differed in fat content, heating treatment (pasteurisation, UHT, etc.), and prices. Hypothetical milk products claiming to be made with ‘good practices’ were also included. WTP for this study is likely to be slightly over exaggerated, as it is commonly found that informed consumers (i.e. survey respondents due to the inclusion of mycotoxin information) exhibit stronger preferences for lower exposure risks.

Transferability to the UK

Methods are transferrable; data is only representative of the Italian national population and so should not be directly transferred.
The Perception of Risks Associated With Food-Related Hazards and the Perceived Reliability of Sources of Information.

Reference


Type

Empirical study on risk perception and ‘trustworthiness’ of sources of food risk information

**High Level Description**

This study aimed to explore public perception of risks associated with different food-related hazards and perception of reliability of various sources providing information on these risks. Consumers compared six food-related hazards in terms of perceived personal risk and their knowledge of potential food risks. The results showed that consumers were more worried about those food hazards that were well known to them (the highest levels of perceived risk being from respondents were pesticide residue, bacterial contamination, and mad cow disease (BSE)), and consequently, less worried about food hazards that were less known. It also indicates that perceived personal risk and the individual’s own knowledge of potential food risks were two distinct dimensions of food risk perception. It also found that the reliability of knowledge held by agencies about risks associated with food-related hazards to human health and the trustworthiness of the sources (consumer and environmental sources were most trusted) of information were two important factors of consumer trust.

**Location, Country**

Italy

**Scale**

National

Valuation Approach

n/a

Definition of the Good

n/a

Definition & Measurement of the Change

n/a

Sample Size

unknown

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>2004</td>
</tr>
</tbody>
</table>
### Comments on Method

Consumers were asked to which extent they used and trusted information sources related to fish. Use and trust were measured on seven-point interval scales, ranging from “never” (1) to “very often” (7), and from “completely distrust” (1) to “completely trust” (7), respectively. The sample was representative of the Italian national population.

### Transferability to the UK

Methods are transferrable; data is only representative of the Italian national population and so should not be directly transferred.

### Title

**Willingness to pay for food safety: an experimental investigation of quality certification on bidding behaviour**

### Reference


### Type

Empirical study on WTP for decreased risk of exposure to heavy metal contaminant

### High Level Description

This study aims to examine the impact of new information about food safety on a subject’s WTP for food products in an experimental setting. Prices were elicited using either a second price auction or the Becker-DeGroot-Marschak procedure. There were three stages in the bidding process: in the first stage subjects bid for products without any information; in the second stage public information about the health impacts were provided; and in the third stage new certified products become available, and the subjects bid then for non-certified and certified products. The introduction of certified products was found to induce an asymmetric updating of initial bids, bids for non-certified products are lowered, but bids for certified products remain equal to the initial bids.

### Location, Country

France

### Scale

Regional

### Valuation Approach

Stated preference, WTP (second price auction)

### Definition of the Good

Either non-certified (assumed higher concentration of heavy metals) or certified (assumed less concentration of heavy metals) consumer products

### Definition & Measurement of the Change

Decrease in consumption of contaminants
Sample Size

120

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP as a function of new product contamination information</td>
<td>WTP (as a bid) for products certified as having safe levels of heavy metals</td>
<td>None disclosed</td>
<td>2003</td>
</tr>
</tbody>
</table>

Comments on Method

Respondents had to be involved in regular food shopping for their household and were between 20 and 65 years of age. Sample size (120) is too small to represent entire national population, and in the BDM treatment 85% of respondents were female. There is relatively little discussion of other possible explanatory variables for observed differences between first price round and second price round bids.

Transferability to the UK

Methods are transferrable; however sample size too small to represent French national population.

Title

Does taste beat food safety? Evidence from the “Pera Rocha” case in Portugal

Reference


Type

Empirical study on WTP for decreased risk of exposure to contaminant

High Level Description

In this study, an experimental auction was used to investigate how quality attributes information affects consumers’ WTP for different types of pears, particularly, the Portuguese "Rocha" pear variety (a Protected Designation of Origin product since 1993). The BDM auction mechanism was combined with sensory analyses to evaluate product attributes. The results show that information on the products’ characteristics related to food safety influences consumers’ WTP. However, it appears that sensory intrinsic attributes related to taste beats the guarantee of food safety in driving the buying behaviour.

Location, Country

Portugal

Scale

Regional (Oeiras)
Valuation Approach

Stated preference, WTP (experimental auction)

Definition of the Good

Certification based on origin (increased taste) and/or decreased exposure to food contaminants

Definition & Measurement of the Change

Premium paid for either a certification based on product origin or based on retailer’s ‘high quality’ certification

Sample Size

74

Valuation Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit of Measurement</th>
<th>Quantitative Estimates</th>
<th>Year of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP as a function of product labelling</td>
<td>WTP (as a bid) for products certified as having either ‘high quality’ or being certified in terms of origin as ‘Rocha de Oeste’ pear.</td>
<td>When consumers are informed on the absence of safety guarantee, the mean WTP decreases from €0.91 to €0.56. The trend is reversed when participants can taste the pears again and the WTP then grows from €0.55 to €0.78 (P &lt; 0.0001)</td>
<td>2007</td>
</tr>
</tbody>
</table>

Comments on Method

Individuals were contacted by phone and selected if they ate at least 3 pears per week, regularly participated in their food purchasing, and if they ate “Rocha” pears. These criteria indicate a chance for bias within the results. The addition of allowing consumers to taste the pears, and the impact this has on their WTP even in the presence of risk, provides an interesting method with interesting results.

Transferability to the UK

Methods are transferrable, however data are not.

A4.6 Experience of other countries with economic analysis of FBD related policies

A4.6.1 The United States

The Economic Research Service of the U.S. Department of Agriculture has undertaken several studies related to the costs of foodborne disease. Two methodologies have been established to determine the costs of adverse health outcomes to cost factors (Kuchler and Golan, 1999):

1. The cost of illness.
2. Consumer willingness to pay.

The cost of illness (COI) approach sums total dollars spent on medical expenses and forgone earnings due to illnesses, accidents or premature deaths. COI estimates have been
used to measure the monetary benefits of government programmes to promote health and reduce the number of premature deaths, illnesses, or injuries. That is, to calculate the total economic benefit resulting from programmes to improve public health. ERS researchers apply the COI approach for non-fatal illnesses and have also used it to calculate the cost of premature deaths.

The utility of the COI approach is considered to be limited as it does not adequately account for the severity of the illness. Variables, such as the characteristics of the institutions through which medical services are supplied, or the income of the affected individual / group, influence COI measures. This reduces the usefulness of COI estimates as measures of social welfare.

Due to the limitations described above, the ERS uses consumer willingness to pay (WTP) estimates for reductions in health risk or improvements in health. WTP methods are applied to address the specific shortcomings of COI approaches; to value non-market goods such as pain and suffering. The ERS suggests that WTP should be applied in the ex-ante evaluation of health and safety programmes as it measures what individuals would be willing to pay for a reduction in the probability of encountering a hazard which could negatively impact their health.

The US Food and Drug Administration is required to conduct regulatory impact analysis (RIA) for new regulations. A recent RIA (US FDA, 2013) included a calculation of the economic impact of illness due to the consumption of FDA-regulated foods. The calculation included an estimation of WTP to reduce the risk of foodborne illness. Due to the limited amount of stated preference studies related to foodborne illness, the FDA use indirect estimates of WTP based on values of risk reduction estimated for other hazards (benefits transfer). This method involved combining estimated values of statistical lives and life years with the estimated losses of life-years and quality-adjusted life years associated with FBDs.

The steps taken in the calculation are summarised below.

1. Establish the consequence of FBDs.

   FBDs are characterised in terms of medical outcomes, for example, gastroenteritis, duration of conditions acquired due to illness, and the probability of occurrence for each condition with a specific level of severity (non-hospitalised or hospitalised). The percentages of cases by severity are defined based on relevant medical literature and databases.

   FBDs are categorised into illnesses which are not severe (non-hospitalised) and those which are severe enough to require hospitalisation. This is done to reveal which FBDs are likely to have higher and lower costs associated with them.

   To reflect the fact that most acute symptoms of foodborne illness last from a few hours to a few days to several weeks, the method applied by the FDA makes a distinction between long-term complications associated with some FBDs. The secondary conditions associated with each FBD are defined and categorised in terms of duration (days / rest of life) and the per cent of cases associated with long-term complications.

2. Measure the loss of well-being suffered due to a disease / condition.

   The next step undertaken is to estimate health benefits by applying the quality adjusted life years (QALYs) associated with each FBD. QALYs for acute and chronic conditions associated with each FBD are obtained from relevant medical literature.

   QALYs range from 0 to 1, where 0 is equivalent to death and 1 is equivalent to perfect health for one year. As most FBDs last for days or weeks rather than years, the value between 0 and 1 of a QALY is expressed as a daily health state, or quality adjusted life day (QALD). The FDA apply a starting QALD value of 0.87 to represent the average health score based on the U.S. population, and apply a published method (Shaw et al. 2005) to estimate QALDs for each FBD based on the profile of each illness.

3. Calculate the value of the burden of a case of food-related illness.
The dollar loss per FBD is calculated by multiplying the probability of getting an illness of a particular severity by the health loss plus the medical costs per case.

The type and severity of ailments for each FBD, for example, hospitalised, non-hospitalised, death and various long-term conditions, is assigned a per cent of case breakdown (the per cent of FBD incidences which result in each ailment). Each ailment is assigned a QALD. The next step is to calculate the health cost of each case, by ailment. The value of a QALD is multiplied by the actual number of QALDs lost and discounted where appropriate (i.e. for long-term conditions). The value of a QALD is determined based on the value of statistical life (VSL); the corresponding value of statistical life year (VSLY) is used to derive the daily QALD value. The QALD value used is $586 per QALD at a discount rate of 3 per cent. The medical costs per case are estimated based on the costs of hospitalisation and visits to the emergency room.

4. Estimate total benefits of eliminating FBDs from FDA regulated products.

To estimate the total benefits of eliminating foodborne illness from FDA-regulated products is calculated by multiplying the estimated annual number of illness per pathogen by the estimated costs per case.

A4.6.2 Australia

The most recent estimate of the costs of FBD in Australia (Applied Economics Pty, 2006) includes the use of WTP estimates. Costs are based on the estimated incidence of FBDs and the associated ailment; gastroenteritis; non-gastroenteritis illnesses (invasive listeriosis, toxoplasmosis, hepatitis A); and, sequelae (haemolytic uraemic syndrome, irritable bowel syndrome, Guillain-Barré syndrome and reactive arthritis).

Costs are calculated for:

■ Health care services.
■ Foodborne disease surveillance and control units.
■ Lost productivity borne by businesses.
■ Lost productivity, lifestyle and mortality costs borne by individuals, inclusive of the costs of caring for ill family members.
■ Business disruption associated with food recalls.

WTP estimates are used to calculate the cost of pain and suffering associated with ailments caused by FBDs. The WTP estimates specifically exclude loss of workplace productivity, loss of household productivity and disrupted household activities, and cost of carers.

WTP values are calculated based on the severity of ailment(s) associated with an FBD (severity weight, SW), the number of days an ailment persists for (D) and the value of a day of good health (VDH). This is can be represented in the equation below, where subscript ‘a’ denotes the type of ailment.

\[
WTP_a = SW_a \times D \times VDH
\]

The severity weight is a measure of the loss of quality of life, calculated using disability adjusted life years (DALYs)\(^{21}\). DALYs for each ailment associated with an FBD are obtained from relevant medical literature. Each ailment is categorised in terms of severity depending on whether hospitalisation is required or not. The number of days associated with each ailment is also obtained from relevant medical literature.

The value of a day of good health is based on the value of a year in good health divided by 365 days. The study uses a value of $2.5 million per annum obtained from a literature review, and assumes that 40 years of life are forgone and that an individual’s real rate of time discount is 3 per cent. This results in a figure of $108,000 per annum, or $296 per day.

\(^{21}\) DALYs are the utility lost for a year not lived in perfect health.
An example is useful to demonstrate how the method is applied. Assuming a case of gastroenteritis with medium severity (for example, requires a visit to a GP) is 0.094 SW, and that symptoms persist for 4 days, then a consumer’s WTP to avoid the gastroenteritis is $111 (0.094 \times 4 \times $296 = $111).

**A4.6.3 New Zealand**

The approach followed in New Zealand is practically identical to that followed in Australia (the same author has prepared recent reports to estimate the costs of FBDs in both countries). It is described in a guide to estimating the cost of FBD prepared for Food Standards Australia New Zealand (Applied Economics Pty, 2010a), and applied in a study to estimate the cost of FBDs in New Zealand (Applied Economics Pty, 2010b). The authors of the guide note that the application of WTP methods based on amounts consumers are willing to give up rather than bear an illness are constrained by a lack of robust research and measurements (Applied Economics Pty, 2010a). This lack of data necessitates the use of WTP values based on a day in good health.

The guide states that estimates should be established for the following factors:

- The number of cases avoided (or incurred).
- The disability weight of the illness.
- The average days of illness.
- The WTP value of a day in good health (the value of a life year divided by 365).

The first three points provide an estimate of the total burden of disease in terms of equivalent full days of illness. This is multiplied by the WTP value of a day in good health to provide the amount that society is willing to pay to avoid the illness(es).
Annex 5 Focus Group Protocol

This annex contains some initial pointers as to the kind of questions that could be raised during the initial focus groups. Subsequent groups would build on the earlier ones, with less time spent on general discussion on food, and more time on specific WTP question design. The protocol requires more work before it can be used in a group and hence should not be used in its current state.

The tracker surveys conducted by FSA will provide a lot of information in terms of the type of food-related issues and preferences. Ensuring consistency between the valuation study and the tracker surveys will lead to efficiency in study design and discussions at the focus group and also comparability between the opinion and behaviour related data collected by the tracker surveys and the economic valuation study(ies).

Introduction:
(To introduce the research, warm up participants and understand spontaneous views of food related issues).

- Moderator, outline aims of research and background to the project.
- Remind participants to be open and honest with their feedback. Stress confidentiality and seek permission to record.
- The research is being conducted in accordance with the Code of Conduct of the Market Research Society (MRS) and also with the Data Protection Act. This means that everything you say here this evening is confidential and will not be attributed to you personally.
- The discussion is also being [viewed only: videoed and] tape-recorded. This is standard market research procedure and is to ensure accuracy – so I do not have to try to remember what you have said – and for analysis purposes only. The recordings will not be passed to any third party not associated with the research project, and I assure you that none of your comments will be attributed to you by name.
- The discussion will last around one and a half hours.
- Can I stress that we are looking for your views. There are no right or wrong answers. I hope you will all contribute to the discussion.

Discussion about food:
- Dietary preferences / habits.
- Preparatory habits for consumption at home.
- Eating out habits.

Discussion about food safety:
- What kind of safety concerns do you have?
- What kind of FBD (without calling it FBD)?
- What do you think are the main causes of FBD (or repeat the kind of symptoms participants mention)?

Discussion about FSA:
- What do participants know about what it is, what it does, the level of trust?

What’s important when thinking about FBD:
- Open discussion first to note what the participants come up with and how this compares to the list of potential attributes.
- If not revealed unprompted, moderator should prompt discussion on the following:
  - Risk.
- Severity.
- Duration.
- Symptoms.
- Different groups of affected populations.

**Risk communication exercise:**
- Different ways of explaining small risks and small changes (e.g. 1%) in current risk.

**WTP scenario:**
- Idea of trading off – less risk with higher cost.
- How to isolate WTP to avoid pain, grief and suffering from other FBD costs (medical costs, loss of income) and from other food related issues (e.g. taste and nutrition) to avoid double counting.

**Summary**
*(To obtain an overview of the main issues raised during the focus group).*
- In your view, what are the most important things we have discussed tonight?
- Has anything surprised you during the discussion?
  - Yes / no.
- Thank and Close.
Annex 6 References


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