RANKING FOOD SAFETY RISKS
A PROTOTYPE METHODOLOGY
(REVISED OCTOBER 2004)

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by

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SUMMARY

This project is intended to develop a prototype risk ranking methodology (including risk categories and criteria) suitable for food safety issues appropriate to the NZFSA.

A risk ranking process includes the following steps:

- Define and categorise the risk to be ranked;
- Identify the risk attributes (criteria) that should be considered;
- Describe the risks in terms of the attributes in risk summary sheets;
- Select participants and perform the risk ranking; and,
- Describe the issues identified and the resulting rankings.

The categorisation of risks is covered by the food/hazard combinations used for Risk Profiles.

The proposed criteria for ranking include:

- Criteria associated with public health (incidence of illness apportioned to the food of interest);
- Criteria associated with severity (morbidity, mortality);
- Criteria associated with uncertainty about the risk (quality of data);

A suggested risk ranking process involves the convening of a group of interested parties from consumer groups, the food industry, technical experts and relevant government agencies. This group would meet to discuss and agree the risk ranking process and initial rankings.

Risk summary sheets are included in Appendix 3. The material for these is taken from completed Risk Profiles, as well as additional data compiled for this project.

1   INTRODUCTION

1.1   The NZFSA's Risk Management Framework for Food Safety

The New Zealand Food Safety Authority (NZFSA) has adopted a structured approach to food safety risk management. Details of the generic approach have been published in the document "Food Administration in New Zealand: A Risk Management Framework for Food Safety" (Ministry of Health/Ministry of Agriculture and Forestry, 2000). The NZFSA's risk management framework adopts the following definitions:

- A **hazard** is a biological, chemical or physical agent in food that has the potential to cause an adverse health effect in consumers.
- **Risk** is a function of the probability of adverse health effects and the severity of those effects in the population consuming that food.
- **Risk management** is the process, distinct from risk assessment, of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant to health protection of consumers and promotion of fair trade practices, and, if needed, selecting appropriate prevention and control options.

The four-step framework for food safety risk management is shown in Figure 1.

Figure 1:   Risk Management Framework
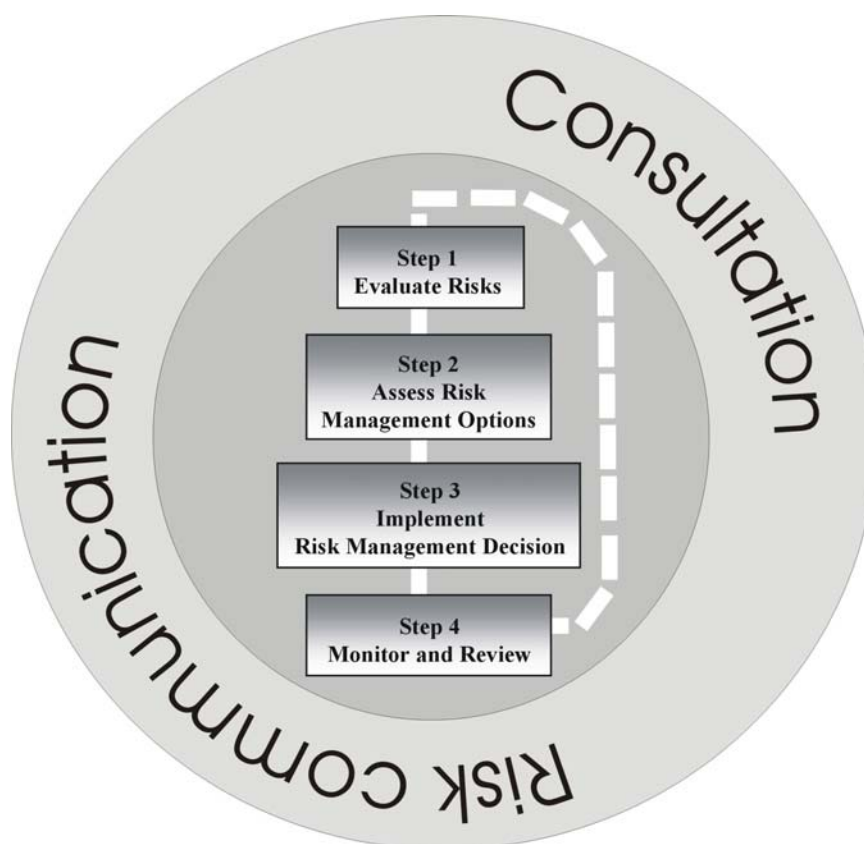
Figure reproduced from "Food Administration in New Zealand. A risk management framework for food safety" (Ministry of Health/Ministry of Agriculture and Forestry, 2000).

In more detail, the four-step process is:

1. Preliminary risk management activity

- identification of the food safety issue
- establishment of a risk profile
- **ranking of the food safety issue for risk management**
- establishment of risk assessment policy
- commissioning of a risk assessment
- consideration of the results of risk assessment

2. Risk management option assessment
- identification of available risk management options
- selection of preferred risk management option
- final risk management decision

3. Implementation of the risk management decision

4. Monitoring and review.

Since 2000 ESR has produced Risk Profiles for microbiological hazards in particular foods ('food safety issues') as part of Step 1 above. This process is now well established and attention moves to the next step in the process – the ranking of the food safety issue for risk management.

While this process is being developed, the NZFSA has chosen five interim priority areas (or "silos") for risk management focus:

- *Campylobacter* in poultry;
- *Salmonella* in poultry;
- Norovirus (previously known as Norwalk-like virus);
- Shiga-like toxin producing *Escherichia coli* (STEC) in red meat;
- *Listeria monocytogenes* in ready-to-eat foods.

1.2   The Current Project

During 2002-2003 a discussion document was prepared to consider issues and review existing approaches to the ranking of food safety risks (Cressey and Lake, 2003). While a number of similar discussion documents have been produced by other organisations, particularly related to environmental risks, there are far fewer examples of cases where theoretical risk ranking methodologies have been applied to actual risk scenarios.

During 2003-2004 the risk ranking project aimed to:

- Develop a prototype risk ranking methodology (including risk categories and criteria) suitable for food safety issues appropriate to the NZFSA.
- Develop risk summary sheets based on existing food/(microbiological) hazard Risk Profiles and demonstrate their use to create a risk ranking using the methodology.

- Make suggestions on how the methodology could be extended to cover non-microbiological risks.
- Make suggestions for a communication process to achieve stakeholder acceptance of the risk ranking methodology.
- Supply the methodology, microbiological risk ranking, and communication suggestions to NZFSA in the form of a draft risk ranking policy.
- Provide risk communication material for use in stakeholder consultations with respect to microbiological risk ranking.

A report from the 2003-2004 project addressing these issues was provided to NZFSA in March 2004 (Cressey and Lake, 2004). This document was then used as the subject of a stakeholder consultation meeting in July 2004, including representatives from NZFSA, ESR, consumers, the food industry, Ministry of Health, and the Ministry of Agriculture and Forestry. A number of revisions to the risk ranking process were decided at this meeting, principally:

- Restricting criteria to severity and incidence measures;

- Convening an expert consultation to address the difficult question of attribution of disease incidence to foodborne transmission, in general, and to the foods that have been the subjects of Risk Profiles, in particular.

This October 2004 report represents a revision of the March 2004 document, to incorporate the changes decided by the stakeholder meeting. A substantial part of the background material in the March 2004 report has been retained, to provide context for how the risk ranking methodology has been developed. This report concludes with a statement of the overall process as currently formulated, and is intended to be the subject of a wider consultation in early 2005.

1.3   Objectives of Risk Ranking

Risk ranking or comparative risk analysis (CRA) is driven by the premise that if the relative risks of a range of problems can be established, then risk reduction efforts can be directed at the worst problems first. CRA has been applied mainly to environmental problems and has been used at national and sub-national levels overseas to inform environmental policy development. CRAs conducted to date have four main objectives (Konisky, 1999):

1. Involve the public in priority setting and identify and incorporate their concerns;
2. Identify the greatest (environmental) threats and rank them accordingly;
3. Establish (environmental) priorities; and,
4. Develop action plans/strategies to reduce risks.

While risk ranking and CRA are often regarded as synonymous, the objectives outlined by Konisky go beyond the ranking of risks and incorporate the subsequent risk management activities of risk prioritisation and the development of risk reduction strategies. The approach taken in this document restricts the objectives of risk ranking to the first two of Konisky above.

These two objectives are well aligned with the conditions for risk decision-making proposed by Webler *et al*. (1995):

- Decisions should be based on the best available scientific knowledge; and,
- Groups with an interest in the situation should have some say in the decision.

The "best" decision has been described as the one that is both scientifically competent and democratically accepted (Webler *et al*., 1995).

These ideas are most suited to a general public consultation exercise. For the NZFSA risk ranking is part of a process to allocate resources, and that process will involve other considerations, as discussed in Section 4.1.1.

2 THE RISK RANKING PROCESS

A risk ranking exercise has three main components (Konisky, 1999):

- Problem list
- Criteria for evaluating problems. Criteria must consider the types of risks analysed (human health, quality-of-life, economic), the scope of the risks considered (inherent, residual) and the participants conducting the ranking (public, expert). Criteria may be a mixture of quantitative and qualitative descriptors.
- Ranking. Process of sorting data and drawing conclusions on relative severity of problems. This inevitably involves comparing problems against several criteria at once.

These components have been incorporated into a five-step risk ranking method that was developed in a project undertaken for the US EPA (Florig *et al.*, 2001). The process is summarised in Figure 2.

Step A and Step B are intended to be iterative before proceeding to Step C. Step B implies decisions about the criteria to be used.

This model only specifies stakeholder involvement in the ranking process, but decisions as to the criteria (risk attributes) will also require stakeholder input. Nevertheless this model will serve to structure this discussion document.

Figure 2:   EPA five-step risk ranking process

**Step A:
Define and categorise the risks to
be ranked**

**Step B:
Identify the risk attributes that
should be considered**

**Step C:
Describe the risks in terms of the
attributes in risk summary sheets**

**Step D:
Select participants and perform
the risk rankings**

**Step E:
Describe the issues identified and
the resulting rankings**
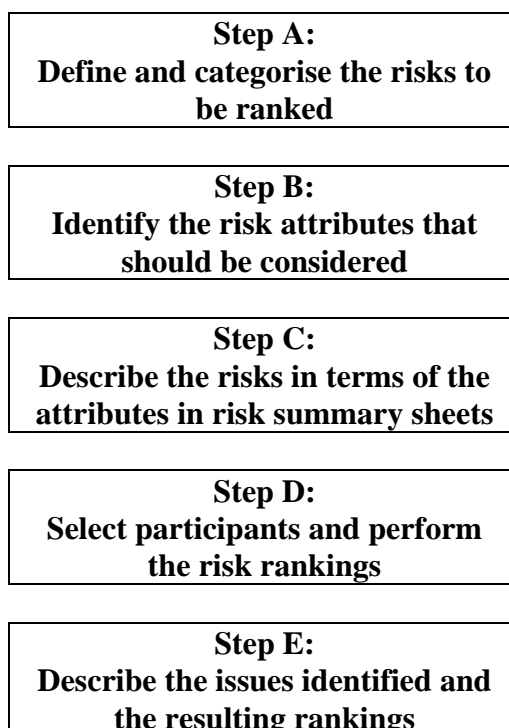
While variations in risk ranking methodologies have been suggested by various proponents, the EPA five-step process addresses the three fundamental requirements for a risk ranking process (the list of problems, criteria for assessment and a ranking step), includes a useful

format for presenting risk information (summary sheets), addresses the issue of who should carry out the ranking and provides a platform for the communication of the process outputs. This process will be adopted as a prototype for the ranking of food safety risks of concern to the New Zealand Food Safety Authority.

3 DEFINITIONS AND CATEGORIES OF RISK (STEP A)

Risks can be defined in many ways, including:

- by hazard (e.g. *Campylobacter, Salmonella)*,
- by source (e.g. farm derived, processing derived),
- by pathway (e.g. chicken, cheese, environmental), or
- by target group (e.g. whole population, young children).

Choosing the category by which risks are defined requires value choices and can have important implications for the resultant rankings. Development of an explicit basis for choosing a risk-categorisation scheme is seen as crucial if an agency wishes to use the results of a risk ranking project as an input into risk management (Morgan *et al.*, 2000).

While the huge diversity of hazards involved in an environmental CRA mean that categorisation is not only important, but necessary, it appears to be less crucial when considering the relatively narrow topic of microbiological food contaminants or even the wider topic of all food contaminants. However, categorisation should be considered as part of the ranking exercise, as it may offer opportunities to group risks in useful ways.

The current approach to the development of Risk Profiles for the foods New Zealanders eat (see http://www.nzfsa.govt.nz/science-technology/risk-profiles/index.htm for electronic version of Risk Profiles published to date) uses a consistent approach to the definition of problems ("specific food safety problems"; Ministry of Health/Ministry of Agriculture and Forestry, 2000). Each problem is consistently defined in terms of a specific hazard or related group of hazards (e.g. shiga toxin-producing *Escherichia coli*) in a particular food or related group of foods.

Risk ranking exercises carried out in the environmental arena have generally aimed to define a 'comprehensive' set of problems. The limited number of examples of risk ranking of food safety issues have tended to take a narrower view and considered only a segment of the food safety spectrum. Petersen *et al*. (1996) considered '25 infectious agents transmissible to man through consumption of undercooked beef', while Sumner and Ross (2002) considered '10 seafood hazard/product combinations'. The Risk Profiling work performed by ESR for the NZFSA has similarly considered a narrow segment of the possible food safety risks, based on a strength-of-evidence selection process for the contribution of the food/hazard combination to foodborne disease in New Zealand (Lake *et al*., 2000). The Risk Profiles initiated by NZFSA-ESR to date and their current (March 2004) status are given in Table 1 below.

Table 1:   Status of Risk Profiles commissioned by the NZFSA

Hazard	Food	Status of risk profile
Bacillus spp	Rice	Complete
Campylobacter jejuni/coli	Poultry (whole and pieces)	Complete
Campylobacter jejuni/coli	Mammalian and poultry offals	In progress
Campylobacter jejuni/coli	Red meat	In progress
Listeria monocytogenes	Processed ready-to-eat meats	Complete
Listeria monocytogenes	Ice cream	Complete
Listeria monocytogenes	Soft cheeses	Review stage
Listeria monocytogenes	Ready-to-eat salads	Review stage
Listeria monocytogenes	Low moisture cheeses	Review stage
Mycobacterium bovis	Milk	Complete
Mycobacterium bovis	Red meat	Review stage
Norwalk-like virus	Mollusca (raw)	Complete
Salmonella (non-typhoid)	Poultry (whole and pieces)	Complete
Salmonella (non-typhoid)	Eggs (in and on)	Review stage
STEC	Red meat and meat products	Complete
STEC	Uncooked comminuted fermented meat products	Complete
STEC	Leafy vegetables	In progress
STEC	Raw milk	In progress
STEC	Boutique cheeses	In progress
Toxoplasma gondii	Red meat and meat products	Complete
Vibrio parahaemolyticus	Seafood	Complete
Yersinia enterocolitica	Pork	Complete

STEC = shiga toxin-producing *Escherichia coli*

The risk ranking prototype process for the 2003-2004 year should include all food/hazard combinations for which Risk Profiles are complete.

4 CRITERIA FOR EVALUATION OF RISK: RISK ATTRIBUTES (STEP B)

4.1 Introduction

The ranking of risks by the NZFSA is a tool for decision-making by the Authority for allocation of resources, rather than an opinion poll exercise. The environment for decision-making by the NZFSA is influenced by four major components:

- The legislative mandate under which the NZFSA operates, and the associated objectives and priority areas;
- The interests and concerns of consumers (or the public) as a key stakeholder group;
- The interests and concerns of the food industry as a key stakeholder group
- Scientific information on the relevant food safety issues.

4.1.1 NZFSA

The NZFSA has published objectives and goals in its "Strategic Direction" and "Profile". High-level goals include:

- A food regulatory programme that protects and promotes the health of consumers;
- A food regulatory programme that facilitates and enhances New Zealand's trade in food and food related products.

Published objectives include:

- Protect consumers from risks that may arise in connection with the consumption of food, and otherwise protect the interests of consumers in relation to food through effective enforcement and monitoring.

These points indicate that NZFSA criteria for risk ranking will focus on public health issues, particularly the burden of foodborne diseases and the contribution of various foods to the causation of foodborne diseases. The risks are to consumers, primarily in New Zealand, but also conceivably to overseas consumers through food exported by New Zealand.

The resource allocation process for NZFSA has three components:

1. Risk ranking according to scientific criteria (as in Step 1 of the Risk Management Framework);
2. Risk management option assessment (as in Step 2 of the Risk Management Framework); and,
3. Prioritisation of work associated with other responsibilities of the NZFSA e.g. international treaty obligations linked to facilitating and enhancing trade.

Only the first of these is covered by this document. The second component is likely to require additional research and data gathering, and decision making at this stage will involve expert judgment by NZFSA staff.

4.1.2 Public/consumers

Risk is a multi-attribute concept. People are concerned about a large number of attributes, but high correlations amongst risk attributes in general allow the variation amongst risks to be captured by three independent factors (Slovic, 1987; Florig *et al*., 2001):

- unknown risk;
- dread risk;
- societal and personal exposure.

Although this analytical framework was not originally developed for assessing public perception of food associated risks, it has been found to explain most of the variance in public perception of such risks (Sparks and Shepherd, 1994).

Unknown risk

This component concerns whether the risks are known to the people exposed, known to science, or are accurately assessed. This suggests that uncertainty about foodborne disease risk is relevant.

Dread risk

This component has also been described as "concern" or "severity". This suggests that the severity of the health consequences of food-associated risks would be relevant.

Societal and personal exposure

This component of risk perception is related to the voluntary or involuntary nature of the exposure, and the degree of control by society or the individual over that exposure.

4.1.3 Food industry

The food industry will have the same public health concerns as the NZFSA and consumers, but particular sectors are likely to be focused on their own food safety issues and especially the degree to which the burden of foodborne disease may be apportioned to the foods within their industry sector. "Apportionment" is the proportion of transmission of a hazard that can be attributed to food in general, or particular foods, amongst the entirety of potential transmission pathways. While all stakeholders will have an interest in apportionment, it is likely to be an issue of intense interest for the food industry.

It has been pointed out that society can place value on food safety in market terms (Golan *et al*., 2004). The ability of a food safety (regulatory) system to reduce disruption in domestic and international markets is reflected in access to markets and increased consumer confidence (thus reducing market volatility in reaction to food scares). A food/hazard combination may rank low on public health scale, but have immense potential for affecting the food supply and market (BSE is an obvious example). Short term high profile issues may occasionally drive risk management activities, but this does not appear to be consistent with the longer-term view and science-based approach to risk ranking being advocated in the current document.

Although risk management option consideration is to be a separate process, the current state of risk management of a food/hazard combination may be useful background information for a risk ranking exercise. The current status of risk management (both by the food industry and regulators) for food/hazard combinations is described in each Risk Profile.

4.2 Selection of Criteria Associated with Societal and Personal Exposure

Virtually any quantitative or qualitative criteria can be applied to risk ranking, although these criteria should relate to the metrics of the risks being ranked. Risk is generally defined as a function of the probability of a particular adverse outcome and the severity of that outcome in the exposed population. In the case of environmental (including food) hazards the risk will be a function of:

- Level of exposure or dose. For foodborne hazards, this in turn will be a function of the frequency of consumption of the foods, the quantity of food consumed, the frequency of contamination of the food and the level of contamination.
- The potency of the hazard. Related factors are the dimensions of the dose-response relationship and the severity (or perceived severity) of health outcomes.
- The exposed population, including particular sensitivities of sectors of the population.

Incidence of illness is a useful metric as it integrates effects of exposure, potency and population. However, in many cases it is not possible to ascribe the incidence of a particular adverse outcome to a particular exposure route. For example, while the incidence of campylobacteriosis in New Zealand is a very good indicator of the total risk associated with *Campylobacter* exposure in New Zealand, it is extremely difficult to apportion this total risk to individual risk factors. There will be a high degree of uncertainty associated with any such apportionment.

4.3 Criteria Included in Current NZFSA/ESR Risk Profiling

Risk profiles completed for the NZFSA by ESR have classified the risks associated with hazard-food combination on the basis of four criteria or attributes:

- Severity of outcomes associated with the hazard. The hazard is classified in terms of the percentage of cases that result in severe outcomes (death or hospitalisation).
- Incidence of illness associated with the hazard. The incidence level classified here is usually an estimate of the proportion of the incidence due to the food in question, based on invariably very limited data.
- Trade importance. This is generally a yes/no criterion indicating whether the presence of the hazard in the particular food is a current criteria for the food in international trade, and whether the food in question is an export commodity for New Zealand.
- Other considerations. This criterion allows for the inclusion of any prevailing societal attitudes or other qualitative considerations relevant to the hazard-food combination.

Severity and incidence levels are assigned on the basis of broad classifications described in an Appendix to each Risk Profile.

4.4   Additional Criteria Proposed by the NZFSA Consumer Forum

The topic of risk ranking was presented to the NZFSA Consumer Forum in November 2002. While there was general support for the approach being taken with the Risk Profile project, it was felt that a wider range of assessment criteria were desirable for the classification of hazard-food combinations. Suggestions included:

- Food consumption. This criterion would apply a greater weighting to foods which are more commonly consumed.
- Manageability of the hazard in the food. This criterion was proposed to give greater weighting to situations where there was a good expectation that management of the hazard would affect a change.

It should be noted that food consumption will be related to the incidence of illness, as it is a major driver for the assessment of exposure, along with the frequency and level of contamination of the food by the causative agent and the virulence of the organism, as expressed by the dose-response relationship. However, as discussed previously, food consumption can be targeted to a particular area of risk quite accurately, while incidence can not generally be apportioned with any accuracy to the various components of the total risk.

Manageability will be a key consideration for the prioritisation of risks for risk management activity, however, it is questionable whether this should be included as a risk ranking criteria. As already mentioned the assessment of risk management options will be a separate process and require additional research to provide data for the process.

4.5   Combined Criteria

As criteria for risk ranking, severity and incidence of disease may provide conflicting or difficult to resolve priorities (rare but severe diseases versus common, but mild diseases). One solution to this is to combine these criteria into a single measure. As described in the previous report from this project (Cressey and Lake, 2003), several such metrics have been used, including economic burden, quality adjusted life years (QALYs) and disability adjusted life years (DALYs). While such analyses can be useful, they often include implicit assumptions about the value of certain events (health outcomes) which may pre-empt risk ranking decisions around incidence and severity.

4.6   Comparison of Published Criteria for Assessing Microbiological Risks Associated with Foods

For the literature review conducted in 2002-2003 only two reports were found that compared the risks associated with different microbiological food safety issues (Petersen *et al*., 1996; Ross and Sumner, 2002). Table 2 summarises the criteria used in these two studies.

Table 2 demonstrates a reasonable degree of correlation between the criteria used by Petersen *et al.* (1996), Ross and Sumner (2002) and the criteria used in Risk Profiles currently produced for NZFSA by ESR.

Table 2:   **Comparison of criteria used for microbiological risk ranking**

General category	Petersen *et al.* (1996)	Ross and Sumner (2002)
Disease characteristics -population affected	Extent of affected population • Population most likely affected • Cases per year	Susceptibility of the consumer
Disease characteristics -outcomes	Seriousness • urgency • percent case specific mortality • usual duration of illness • intensity/discomfit of symptoms	Hazard severity
Exposure to organism -food consumption		• Frequency of consumption • Proportion of population consuming • Size of population of interest
Exposure to organism -food contamination	Exposure • Rate of detection by current inspection procedures • Ability to multiply in food • Infectious dose for general population Percent prevalence in/on final product	• Proportion of product contaminated • Effect of process • Potential for recontamination • Increase required to reach infectious dose • Effect of post-processing controls • Effect of meal preparation

4.7   Proposed Criteria for the NZFSA Risk Ranking Process

The preceding discussion has identified a number of possible criteria for ranking food associated microbiological risks. These include (in no particular order):

- Criteria associated with public health (incidence of illness apportioned to the food of interest);
- Criteria associated with severity (morbidity, mortality);
- Criteria associated with exposure (food consumption, hazard prevalence)
- Criteria associated with uncertainty about the risk (quality of data);
- Criteria associated with topicality (short term high profile issues).

The first three of these are most amenable to quantitative assessment, while the others are likely to be expressed qualitatively.

The use of all these criteria were discussed in the previous report from this project (Cressey and Lake, 2004), and further considered at the consultation meeting in July 2004. The consultation meeting decided to simplify the criteria to just two: incidence and severity, with an associated consideration of uncertainty.

Incidence:

- Total disease incidence (notified cases/100,000/year adjusted for unreported cases), with estimates for the incidence of non-notifiable diseases;
- Apportionment of the total disease burden to foodborne transmission;
- Apportionment of the total disease burden to transmission by the food of interest.

Explicit information on these three measures will rarely be available and criteria describing apportionment may include elements of three sources of information; expert opinion, exposure assessment, and surveillance information (outbreak analysis and epidemiological investigations). Following consultation, it has been decided that apportionment will be determined primarily by expert opinion, informed by information on exposure, outbreaks and epidemiological investigations.

Severity:

- Total disease severity (case specific mortality, hospitalisation, long term sequelae, duration of morbidity, at risk populations). This may also include information on affected sub-populations – are the risks associated with the food/hazard combination equal across the population or are they borne by specific sub-populations?

Uncertainty:

- Qualitative criterion, assessing the uncertainty/quality of available data and hence the uncertainty associated with any risk assessment. This criterion may also signal the need for further research to fill data gaps.

In considering criteria to be applied to the ranking of microbiological food safety risks in New Zealand the value of combined criteria (economic burden, QALYs, DALYs) was

considered. These measures are derived by applying economic or quality of life values to specific disease data (incidence, hospitalisation, mortality). Estimates of the economic burden of foodborne disease in New Zealand have been generated (Scott *et al.*, 2000). However, it was felt that these combined (and more complex) criteria would only add value if the assumptions and equivalences used in their derivation were widely accepted by stakeholders.

The consultation meeting also made the following points:

- Incidence measures should focus on broad bands only, to avoid disagreements about details;
- A simple matrix style presentation should be developed.

The assessment of food/hazard combinations against the proposed criteria will be dependent on two main inputs:

- Quantitative data on the incidence and severity of infectious intestinal diseases in New Zealand, and
- The elicitation of expert opinion on the apportionment of disease incidence amongst foods.

A discussion of disease incidence and severity data sources can be found in Appendix 1, while Appendix 2 introduces methodologies for the elicitation of expert opinion.

# 5	PREPARATION OF SUMMARY SHEETS (STEP C)

This step in the process seems trivial but involves some important considerations. The material to be presented to any risk ranking process will be based on decisions in Steps A and B. The process of assembling information into standard format summary sheets will promote the consistency of comparisons between risks.

Appendix 3 contains Risk Summary Sheets for all food/hazard combinations for which finalized Risk Profiles have been published. These summary sheets have been partly based on those developed for the Centreville Middle School risk ranking exercise (Florig *et al*., 2001). They include both quantitative information, as available, as well as some background text providing qualitative information about the importance of the food as a transmission vehicle for the hazard.

The information in these summary sheets has been subjected to a review following the July 2004 consultation meeting, and the sheets are different to those included in the previous report from this project. The consistent basis for selection of data, and presentation of the information are described at the start of Appendix 1.

6   PARTICIPANTS AND THE RISK RANKING PROCESS (STEP D)

6.1   Participants

While no reports have been located concerning involvement of stakeholders in priority-setting for food safety issues, there is literature on the involvement of the general public in setting health care priorities and environmental issues. Review of some of this literature, in the previous report from this project (Cressey and Lake, 2003), defined some questions to be considered before proceeding with the risk ranking consultation process:

- Which stakeholder groups should be involved?
- To what degree should stakeholder groups influence the final decisions?

Stakeholder groups will include:

- NZFSA;
- Technical support (ESR, other CRIs, academics);
- Consumers;
- Food industry; and,
- Other responsible regulatory agencies (e.g. Ministry of Health, Food Standards Australia New Zealand).

These participants will consider the overall risk ranking process. The Expert Consultation to consider apportionment will comprise a smaller group invited by NZFSA.

The purpose of the risk ranking exercise is to be part of the resource allocation process by the NZFSA. As described in Section 4.1.1, this process will have three components. It is appropriate that stakeholders have the opportunity to contribute to the ranking exercise, but final decision-making must remain with the NZFSA.

7 RISK COMMUNICATION: DESCRIBING THE ISSUES INVOLVED AND THE RESULTING RANKINGS (STEP E)

The risk ranking exercise will need to be documented as fully as possible, to capture participant's views and also to describe the process for the rankings chosen and the uncertainties involved.

Feedback of this material will be an important part of the consultation process.

The MfE scoping study identified the following aspects which should be communicated at the conclusion of the ranking exercise (MfE, 1996). It was envisaged that this would be in the form of a report:

- Offer an explicit description of analytical and ranking methods.
- List the group(s) involved in the process.
- List data sources and assumptions.
- Show techniques and assumptions used for future estimations of risk.
- Show risk rankings.
- Explain how the risk rankings of different groups differed and why.
- List risk reduction options for each problem area with a summary of the risk reduction potential for each specific option.
- List the environmental priorities identified by the exercise and explain how the potential priorities for action relate back to the original environmental vision and its associated goals.

As discussed previously, the MfE scoping study went beyond risk ranking to consider risk management options and priority setting. The current report does not consider these aspects and, consequently, the last two aspects of risk communication listed by MfE would not be relevant.

Feedback mechanisms would include the normal print and internet communication channels of the NZFSA, as well as presentations to groups such as the Consumer Forum.

8   APPLICATION OF THE PROPOSED APPROACH TO THE RANKING OF NON-MICROBIOLOGICAL RISKS

A hazard is a biological, chemical or physical agent in food that has the potential to cause an adverse health effect in consumers. While the current methodology considers the ranking of microbiological food/hazard combinations, chemical and physical agents in the food supply must also be managed. It would be useful if a consistent approach could be applied to all of these hazards, to obtain a consistent approach to ranking.

The ranking criteria used in this methodology are disease prevalence, apportioned by expert opinion to food in general and the food of interest in particular, and disease severity.

Information on disease severity will be similar for chemical and physical hazards to microbiological hazards, where a specific endpoint disease state can be identified. For many chemicals disease states are identified either from animal toxicological experiments or from studies of human occupational exposure, at doses considerably higher than those encountered due to dietary exposure.

Information on specific incidence of adverse health effects will rarely be available for chemical and physical contaminants of the food supply. For physical contaminants it is often the impact of the contaminant on the wholesomeness of the food, rather than its causation of a particular health effect that is the concern. For chemicals, potential disease outcomes are often chronic in nature and the disease states have multiple aetiological factors, such that the contribution of a particular food contaminant to the overall disease burden cannot be determined. It is probable that ranking of food/chemical hazard combinations will depend on toxicological indices to indicate the potential for disease causation. Such indices may include, carcinogenic potency factors (the slope of the carcinogenic dose-response curve), benchmark doses, endpoint classification, etc. Approaches to ranking of chemical hazards have been explored in another project conducted by ESR for the NZFSA (Cressey, 2004).

9   CONCLUSIONS

The material in this report offers the current development of a policy and process for a risk ranking exercise by the NZFSA. To our knowledge, this exercise will be a first attempt at such a ranking for any group of risks within New Zealand. It would be valuable to document the process as much as possible, if it is to be of value for future rankings by the NZFSA, and for similar processes for other types of risk.

Thus far, the process has identified risk categories (food/hazard combinations) and criteria (severity, incidence). Preliminary data towards ranking the risks against these criteria have been assembled into summary sheets in Appendix 3. To properly rank the risks using the chosen criteria these data will need to be considered by an expert consultation, to produce estimates of severity and incidence. Following the production of these measures for each food/hazard combination, the ranking process should be relatively straightforward.

This current document is another interim step in the process towards a risk ranking policy and process. Following the Expert Consultation, the finalised policy and process will be submitted to a wider consultation, with the intention of achieving widespread acceptance.

It seems likely that it will be necessary to repeat the ranking process periodically, in order to include updated information and additional food/hazard combinations.

In the future, should risk ranking be expanded to encompass other foodborne risks, such as chemicals, then the categorisation system will need to be designed to ensure that the categories are compatible.

10   REFERENCES

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APPENDIX 1: QUANTITATIVE DATA FOR RISK RANKING

This Appendix contains summary sheets for the food/hazard combinations from completed Risk Profiles which provide the food safety issues for the current ranking process. The preliminary material describes the rationale for choosing the sources of this information.

INFORMATION ON THE TOTAL INCIDENCE OF DISEASE

Total incidence of disease

For notifiable diseases, incidence data were taken from annual surveillance summaries (see http://www.surv.esr.cri.nz/surveillance/annual_surveillance.php). For non-notifiable diseases, incidence figures were taken from other one-time studies, where these were available. Where no New Zealand estimates of disease incidence were available the incidence was reported as 'Unknown'.

Incidence of disease due to the following organisms are available from surveillance data:
- *Salmonella*
- *Campylobacter*
- *Listeria*
- *Yersinia*
- STEC

In addition incidence data are available for total tuberculosis, but not specifically for tuberculosis caused by *Mycobacterium bovis*.

Ratio of reported to unreported cases

A number of attempts have been made internationally to determine the degree to which disease surveillance data for infectious intestinal diseases underestimate the true incidence in the community.

Wheeler *et al*. (1999) followed a community cohort of 9776 randomly selected subjects, age and sex matched to represent the UK population, and 70 general practices serving 459,975 subjects. They found that for every salmonellosis case reported to national surveillance 3.2 cases were occurring in the community, while for campylobacteriosis the ratio was 7.6 to 1. For small round structured viruses (noroviruses) the ratio was much higher at 1562 to 1.

Todd (1989) used several estimation methods for the number of cases of foodborne disease in the United States due to a range of pathogens. The median figure of five estimation methods was generally of the order of 1,000 times the annual summary data figures.

Archer and Kvenberg (1985) used an estimate of 29.5 to 1 for unreported to reported cases of salmonellosis. They then generated a number of cases of campylobacteriosis cases from this number and a case-control study that suggested that campylobacteriosis was 2.5 times as common as salmonellosis. They used they salmonellosis correction factor of 29.5 to correct for under-reporting of shigellosis.

The approach of Wheeler *et al*. (1999) is certainly the most rigorous of these approaches and, consequently, Lake *et al*. (2000) applied the results of Wheeler *et al*. (1999) to the New Zealand situation for salmonellosis and campylobacteriosis and used an intermediate ratio (5 to 1) for all other bacterial pathogens, in an estimation of the costs of foodborne illness in New Zealand.

Temporal trends

On the basis of national surveillance data, the incidence of infectious intestinal diseases can be classified as increasing, not changing, or decreasing. A five year time frame is initially proposed for this trend, with a comment provided to indicate whether the trend is statistically significant or not.

INFORMATION RELEVANT TO THE APPORTIONMENT OF THE DISEASE TO FOODS

Percentage of population consuming food per day

This measure gives a metric for frequency of consumption of the food. Data come from the 1997 National Nutrition Survey and are derived from the proportion of the 4636 respondents who completed the 24 hour dietary recall (24HDR) component of the Survey. The associated percentage does not imply that other respondents will never eat the food of interest.

Average daily intake of food

Data may be derived from two main sources, however the two sources will produce significantly different results in some cases. Figures may be derived from the 1997 National Nutrition Survey 24HDR by summing all amounts of the food consumed and dividing by the number of respondents who participated in the 24 HDR component of the Survey. This figure is likely to be under-estimated due to a documented tendency of respondents in dietary surveys to under-report the quantities of food they consume.

Figures may also be derived from food production information, corrected for known volumes of export, import and stock feed. The resultant total weight of food available for domestic consumption can then be reduced to a per capita per day basis. Such figures are likely to overestimate daily consumption as no allowance is made of phenomena such as wastage and non-edible portions of the food.

The average daily intake gives a population level indicator of exposure to the food, taking into account both frequency of consumption and serving size.

Median serving size

Data on serving sizes will almost exclusive come from the 24 HDR component of the 1997 National Nutrition Survey and represents the magnitude of a typical food exposure event.

Contamination prevalence of food by the pathogen at consumption

Information under this heading is likely to be of universally high uncertainty, due to the age of the data, or the lack of representativeness of the sampling. Surveys of contamination prevalence are generally performed at production or at retail.

Outbreaks and epidemiology

These data, when available, provide the best available basis for estimating the contribution of a particular food to the total disease burden due to a particular organism.

Information on outbreaks will generally come from the ESR Annual Summary of outbreaks, prepared for the Ministry of Health. These summaries provide information on the numbers of outbreaks for which a food source is implicated and give a breakdown of the outbreaks for which specific foods are implicated. It should be stressed that in most cases reference is to a food 'implicated' and rarely to a food 'confirmed'.

Epidemiological investigation, such as case-control or case series studies, when available, are able to provide information on the relative risks associated with specific risk factors.

INFORMATION ON THE SEVERITY OF THE DISEASE

Percentage of cases hospitalised

Two sources are available for this information; national surveillance data captured by ESR in the Episurv database and hospital discharge data, as periodically reported by the New Zealand Health Information Service. Both of these sources have respective strengths and weaknesses. Some comparisons are given in Table 3 (NZHIS data provided by Rebecca Kay, NZHIS). Hospital discharge data may often have several ICD-10 codes (the coding scheme for the cause of the morbidity) associated with a single record. Hospitalisation statistics based on <u>any</u> occurrence of the ICD-10 code (amongst those assigned to a case) generally give higher estimates of hospitalisation due to a particular pathogen than national surveillance data, while hospitalisation statistics based on the specific ICD-10 code occurring as the <u>primary</u> code in hospital discharge records generally gives lower estimates of hospitalisation than national surveillance (see 2002 data in Table 3). Hospitalisation numbers from either hospital discharge data or national surveillance give figures of a consistent order of magnitude and use of either dataset is likely to give equivalent risk rankings.

Percentage case specific mortality

Two sources are available for this information; national surveillance data captured by ESR in the Episurv database and mortality and demographic data, as periodically reported by the New Zealand Health Information Service. Both of these sources have respective strengths and weaknesses. Table 4 gives a preliminary comparison of information provided by the NZHIS (Rebecca Kay, personal communication) with information available from national surveillance.

Mortality data collected by NZHIS generally assign lower numbers of deaths to infectious intestinal diseases than National Surveillance data.

Table 3: **Comparison of hospitalisation rates due to infectious intestinal disease from hospital discharge statistics and national disease surveillance for pathogens addressed in Risk Profiles**

Three character ICD-10 code	Code includes	Number of cases						
		Hospital discharges				National surveillance		
		2001*	2002a*	2002b#	2003*	2001	2002	2003
A02 Other *Salmonella* infections	A020 *Salmonella* enteritis A021 *Salmonella* sepsis A022 Localised *Salmonella* infections A028 Other specified *Salmonella* infections A029 *Salmonella* infection unspecified	267	215	146	203	279	206	167
A03 Shigellosis	A030 Shigellosis due to *Shigella dysenteriae* A031 Shigellosis due to *Shigella flexneri* A032 Shigellosis due to *Shigella boydii* A033 Shigellosis due to *Shigella sonnei* A038 Other shigellosis A039 Shigellosis unspecified	42	28	22	33	30	24	25
A04 Other bacterial intestinal infections	A040 Enteropathogenic *E coli* infection A041 Enterotoxigenic *E coli* infection A042 Enteroinvasive *E coli* infection A043 Enterohaemorrhagic *E coli* infection A044 Other *E coli* infection	26	27	8	24	16	16	24
A04 Other bacterial intestinal infections	A045 *Campylobacter* enteritis	639	731	570	937	393	515	633
A04 Other bacterial intestinal infections	A046 Enteritis due to *Yersinia enterocolitica*	23	29	14	19	17	31	30
A05 Other bacterial food-borne intoxications	A053 Food-borne intoxication due to *Vibrio parahaemolyticus*	0	1	NR	2	NN	NN	NN
A05 Other bacterial food-borne intoxications	A054 Food-borne *Bacillus cereus* intoxication	0	1	NR	1	NN	NN	NN

Three character ICD-10 code	Code includes		Number of cases						
			Hospital discharges				National surveillance		
			2001*	2002a*	2002b#	2003*	2001	2002	2003
A08 Viral and other specified intestinal infections	A081	Acute gastroenteropathy due to Norwalk agents	1	7	NR	12	NN	NN	NN
A32 Listeriosis	A320 A321 A327 A328 A329	Cutaneous listeriosis Listerial meningitis meningoencephalitis Listerial sepsis Other forms of listeriosis Listeriosis unspecified	28	21	6	29	17	17	22

*   Includes all discharge for which the relevant codes were listed

\#   Includes only discharges for which the relevant codes were listed as the primary diagnosis

NR   Not Reported

NN   Not Notifiable

Table 4:   Comparison mortality rates due to infectious intestinal disease from health statistics and national disease surveillance

Three character ICD-10 code	Number of cases					
	Mortality			National surveillance		
	1999	2000	2001	1999	2000	2001
A02 Other *Salmonella* infections	1	3	2	1	7	2
A03 Shigellosis	0	0	0	1	0	0
A04 Other bacterial intestinal infections – STEC/VTEC	0	0	0	0	0	0
A04 Other bacterial intestinal infections – Campylobacter	0	0	2	1	3	1
A04 Other bacterial intestinal infections – Yersinia	0	0	0	0	0	0
A32 Listeriosis	0	1	1	3	6	2

APPENDIX 2:   METHODOLOGIES FOR ELICITING AND AGGREGATING EXPERT OPINION

An intermediate stakeholder meeting on the current risk ranking project concluded that the process of apportioning the total disease incidence associated with a particular organism, to food in general and to particular foods, should be approached via the elicitation of expert opinion.

In risk analysis, use of expert opinion is often inevitable, due to the lack of information on variables of interest (Ouchi, 2004). A considerable amount of work has been carried out on attempts to establish more systematic approaches to the elicitation of expert opinion and the aggregation of the information elicited. Clemen and Winkler (1999) have reviewed a number of approaches and broadly classified them as either behavioural or mathematical approaches. Behavioural approaches encourage interactions between experts with a view to arriving at a consensus position or, at least, narrowing the variance of the opinions provided by the expert pool. In mathematical approaches the experts' opinions are elicited in the form of subjective probabilities and are combined by the decisionmaker or facilitator using mathematical methods.

Behavioural Approaches

The best known behavioural approach to elicitation and synthesis of expert opinion is the so-called Delphi method, developed by the RAND corporation in the 1950s. The basic Delphi method, as outlined by Helmer (1968) consisted of the following steps:
- Selection of issues/questions and formulation of questionnaires
- Selection of experts who are most knowledgeable about the issues/questions
- Familiarisation of experts by provision of sufficient details on the issues/questions
- Elicitation of expert opinions through questionnaire
- Aggregation and presentation of results from expert pool
- Review of results by experts and opportunity for revision of initial answers. Experts who take extreme positions should support these by arguments
- Revision of results followed by further review by experts. At this point the process is iterative and may undergo several cycles of revision, review and refinement before a final summary of results and arguments supporting extreme positions.

A modified Delphi method has been developed by the UK Veterinary Laboratories Agency and FAO (summarised in Murray, 2002). The major deviation of this approach from the basic Delphi is the inclusion of a facilitated face-to-face discussion following the first round of elicitation, analysis and review, but before the first opportunity for revision of opinion. In this respect the modified Delphi appears to be a hybrid of the Delphi and Nominal Group (see below) methods.

The Nominal Group method allows direct discussion of opinions between experts within a controlled environment designed to develop a consensus position. Such consensus approaches may suffer from a number of shortcomings, including:
- Conformity induced by the group interaction
- Dominance of strong personalities
- Group motive for quickly reaching agreement
- Group reinforced bias due to similarity of background of group members.

Kaplan (1990) proposed a further behavioural approach, in which a facilitator/analyst leads the expert panel in a discussion of the available information with a goal of establishing a 'consensus body of evidence'. When this consensus is arrived at, the analyst proposes a probability distribution or forecast value. The analyst then obtains assurance from the expert panel that the information has been correctly interpreted, often through a process of group negotiation.

Mathematical approaches

The mathematical approaches generally accept the experts' initial opinions, without providing an opportunity for revision, and concentrate instead on ways of mathematically weighting and combining the opinions to produce an overall estimate with associated uncertainty.

Axiomatic approaches combined the expert's individual probabilities or distributions either additively or multiplicatively. Each expert's opinion is assigned a weighting factor, representing their perceived quality. However, the determination of the weighting is itself a subjective assessment (Clemen and Winkler, 1999). In the simplest case all experts will be assigned uniform weightings, that is for n experts each will have a weighting factor of $1/n$.

A number of studies have concluded that for a risk analysis situation, where expert opinion is being used to inform a decisonmaker, a Bayesian update approach is most appropriate (Morris, 1977; Clemen and Winkler, 1999). In these approaches the decisonmaker is treating the expert opinion as data with which to update their own prior view, to produce a posterior probability or distribution. This can be represented in terms of the classical Bayes Theorem as:

$$P(x|D) = \frac{P(D|x) \times P(x)}{P(D)}$$

Where $P(x)$ is the decisionmaker's prior probability distribution for some variable x, $P(D|x)$ is the likelihood of some observational data D (the experts probability distributions) given x and $P(D)$ is a normalising factor.

While this approach if mathematically robust, the assessment of the likelihood function can be extremely complicated, as it must capture the precision and bias of individual expert's opinions as well as dependence between different experts. Dependence may occur due to different experts coming from similar backgrounds or organizations and not exhibiting truly independent opinions (Ouchi, 2004).

Psychological scaling approaches assumes that every expert has some internals value associated with a variable of interest and can only provide qualitative information, rather than numerical estimates. The facilitator/decisonmaker polls expert opinion in terms of paired comparisons, for example asking them which of two options they feel is more likely to occur, to produce a consensus with associated confidence bounds. Ouchi (2004) presents three methods for combining the paired opinions from a panel of experts to generate an overall probability. These approaches have the appeal of having a fairly simple elicitation process, but suffer from disadvantages of requiring a large number of experts and making major assumptions about experts assessment mechanisms (Ouchi, 2004).

Clemen and Winkler (1999) reviewed studies that attempted to empirically compare the performance of different mathematical aggregation methods and concluded that simple weighted or non-weighted averages performed as well as more sophisticated mathematical techniques for the combination of individual probability forecasts.

Overall comparison of mathematical aggregation method with behavioural methods give mixed opinions, with some proponents concluding that mathematical methods give more accurate estimates (Mosleh *et al*., 1988), while others conclude that there is little difference between the two approaches or that the evidence for a difference is equivocal (Clemen and Winkler, 1999).

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APPENDIX 3:   RISK SUMMARY SHEETS

Risk Summary Sheets are attached for the following food/hazard combinations:

- *Bacillus spp.* in rice
- *Campylobacter jejuni/coli* in poultry (whole and pieces)
- *Listeria monocytogenes* in ice cream
- *Listeria monocytogenes* in processed ready-to-eat meats
- *Mycobacterium bovis* in milk
- Norwalk-like viruses in mollusca (raw)
- *Salmonella* in poultry (whole and pieces)
- Shiga toxin-producing *Escherichia coli* (STEC) in red meat
- Shiga toxin-producing *Escherichia coli* (STEC) in uncooked, comminuted, fermented meat (UCFM)
- *Toxoplasma gondii* in red meat
- *Vibrio parahaemolyticus* in seafood
- *Yersinia enterocolitica* in pork

The Risk Summary Sheets have been restructured to better reflect the approach to risk ranking agreed at the consultation meeting in July 2004.

RISK SUMMARY SHEET:

HAZARD: *BACILLUS SPP.*

FOOD: RICE

Summary:
Spores of *Bacillus spp.* can survive well in stored dry rice, although the low water activity of the product does not allow growth. Spores are also able to survive the cooking process and cooked rice provides an ideal environment for bacterial growth.

Intoxication by *Bacillus spp.* may be caused by either a diarrhoeal or an emetic toxin. The symptoms of intoxication are generally mild and of short duration.

BACILLUS INTOXICATION: INCIDENCE DATA*

Notified incidence (cases/100,000/year, 2003):	Unknown
Number of cases per year (2003):	Unknown
Estimated ratio of actual/reported cases (under-reporting ratio):	Unknown
Temporal trends:	Unknown
Quality of scientific information:	Low

* *Bacillus spp.* infection is not notifiable in New Zealand. It is generally believed that the incidence may be significant, but that the symptoms are quite mild and of short duration.

BACILLUS INTOXICATION: APPORTIONMENT DATA – EXPOSURE

Food consumption, rice	
- percentage of population consuming per day:	11.2%
- average daily intake, population 15+ years old:	30.0 g
- median serving size (g):	216 g
Quality of scientific information:	Medium-High
Contamination prevalence at consumption:	Unknown*
Quality of scientific information:	Low

* A Dunedin survey suggests that 5-10% of rice from restaurants or takeaways outlets may present a risk of foodborne illness. Rice cooked at home is likely to present a lower level of risk.

BACILLUS INTOXICATION: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

The limited data from outbreaks indicate that rice or rice dishes are reasonably common

vehicles for the small proportion of outbreaks attributed to *B. cereus* or other *Bacillus* species. Takeaways, often Chinese-style or Indian-style, are premises frequently cited as a source of the implicated food. This suggests that, as in other countries, a small proportion of rice is not handled in a safe manner, allowing the regeneration and growth of spores. This is supported by the results of the survey in Dunedin, where 2/46 (4%) of samples had unsatisfactory levels of *B. cereus*.

BACILLUS INTOXICATION: SEVERITY

Percentage of cases hospitalised (five year average):	Unknown*#
Percentage case mortality (five year average):	Unknown*
Relevant trend data	Unknown*
Quality of scientific information:	Low

* *Bacillus spp.* infection is not notifiable in New Zealand. It is generally believed that the incidence may be significant, but that the symptoms are quite mild and of short duration. The likelihood of hospitalisation and/or death is low. There are no available New Zealand data to suggest that any population sub-group is particularly at risk.

Hospital discharge data reported one hospitalisation due to *B. cereus* intoxication in each of 2002 and 2003.

RISK SUMMARY SHEET:

HAZARD: *CAMPYLOBACTER JEJUNI/COLI*

FOOD: POULTRY (WHOLE AND PIECES)

Summary:
Campylobacter is the leading cause of infectious intestinal disease in New Zealand and the number of reported cases has increased significantly over the last 10 years. Raw poultry is commonly contaminated with *Campylobacter*. While thorough cooking is effective in destroying *Campylobacter* on poultry surfaces, undercooking of poultry or cross-contamination from poultry to other foods or kitchen surfaces may represent mechanisms by which *Campylobacter* on raw poultry may contribute to foodborne disease.

Campylobacteriosis may result in hospitalisation and occasionally death. Long term sequelae are also possible, such as Guillain-Barré syndrome and reactive arthritis.

CAMPYLOBACTERIOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):	395.6
Number of cases per year (2003):	14786

Estimated ratio of actual/reported cases (under-reporting ratio):
No New Zealand estimates available. A UK study (Wheeler *et al*., 1999) estimated 7.6 community cases of campylobacteriosis for every case reported to national surveillance.

Temporal trends:
Campylobacteriosis has increased in New Zealand every year since 1999. The increase is statistically significant and is judged to be a real phenomenon.

Quality of scientific information:	High

CAMPYLOBACTERIOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, poultry	
- percentage of population consuming per day:	27.5%
- **average daily intake, population 15+ years old:**	34.4 g
- median serving size (g):	84 g
Quality of scientific information:	*Medium-High*

Contamination prevalence at consumption:	Very low
Quality of scientific information:	Low-Medium

While the contamination prevalence of cooked poultry by *Campylobacter* is very low, the prevalence on raw poultry is very high (typically 50-70% on fresh product). The potential for cross-contamination of other foods, utensils, and other surfaces in the domestic environment may be significant.

CAMPYLOBACTERIOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

In New Zealand *Campylobacter* is identified as the causative agent in 10-15% of reported outbreaks. During 1998-1999 104 outbreaks were associated with *Campylobacter*, with chicken being confirmed as the cause in 14 outbreaks. Undercooking of the poultry was identified in a number of these outbreaks. Confirmation was mainly by epidemiological investigation.

Two large case-control studies and several smaller ones on campylobacteriosis have been conducted in New Zealand. The two major studies both identified consumption of undercooked chicken and eating chicken outside the home as risk factors. Freezing of chicken and eating chicken at home were consistent protective factors against campylobacteriosis.

CAMPYLOBACTERIOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range): 6.4 (5.3-7.6)*
Percentage case mortality, five year average (five year range): 0.01 (Nil-0.04%)#
Relevant trend data
Hospitalisation and mortality rates show no clear temporal trends.

Quality of scientific information: High

* Hospital discharge statistics report slightly higher numbers of campylobacteriosis cases being hospitalised than the national surveillance data, however, these data are of a similar order of magnitude (570 from hospital discharge compared to 515 from national surveillance in 2002)

New Zealand mortality data supplied by the New Zealand Health Information Service indicate lower numbers of fatalities due to campylobacteriosis.

The highest age-specific rates of campylobacteriosis occur amongst children 1-4 years (598.7/100,000 in 2003).

In some cases, campylobacteriosis is associated with subsequent development of a reactive, self-limiting autoimmune disease characterised by acute flaccid paralysis (Guillain-Barré Syndrome; GBS). Approximate 30-40% of GBS cases are reported to have had a previous, recent infection with *C. jejuni*, while it has been estimated that one in every 1000 to 3000 cases of *C. jejuni* infection will progress to GBS. *C. jejuni* infection has also been reported to trigger cases of reactive arthritis.

RISK SUMMARY SHEET:

HAZARD: *LISTERIA MONOCYTOGENES*

FOOD: ICE CREAM

Summary:
While the raw materials for ice cream manufacture may potentially be contaminated with *Listeria,* the production process for ice cream includes a pasteurisation step, which will destroy any *Listeria* present if performed correctly. While subsequent recontamination from additives or the environment is possible, bacteria would be unable to grow in properly stored ice cream.

Infection with *L. monocytogenes* may cause either:
- A mild short term gastroenteritis or,
- An invasive disease with severe consequences, including fatalities

The incidence of the gastroenteritis is unknown. The invasive form of infection has a low incidence in the population. Generally the risk of infection with *L. monocytogenes* for healthy adult consumers is low. The risks of invasive listeriosis are greatest for perinatal infants (via consumption of contaminated foods by the mother), the immunocompromised and the elderly.

LISTERIOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003): 0.6
Number of cases per year (2003): 24
Estimated ratio of actual/reported cases (under-reporting ratio):
No New Zealand estimates available. Given the severe nature of the condition, notification of invasive listeriosis is likely to be representative of the true incidence. Febrile gastroenteritis due to *L .monocytogenes* infection is rarely diagnosed and may be heavily under-reported.

Temporal trends:
The reported rate of listeriosis varies from year to year, but shows no clear temporal trends.

Quality of scientific information: High

LISTERIOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, ice cream
- percentage of population consuming per day: 13.6%
- **average daily intake, population 15+ years old:** 15.6 g
- median serving size (g): 80 g

Quality of scientific information: Medium-High

Contamination prevalence at consumption:	Very low

Quality of scientific information:	Medium

LISTERIOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Ice cream has not been implicated in any of the outbreaks of listeriosis reported in New Zealand. No New Zealand case-control studies are available. Available information on *Listeria* in New Zealand produced and imported ice cream suggests that levels of contamination are very low. Bacteria will not grow in properly stored (i.e. frozen) ice cream.

A US risk assessment of *Listeria* in ready-to-eat foods assigned ice cream the fourth lowest relative risk of the 23 foods considered.

LISTERIOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	98 (94-100)*
Percentage case mortality, five year average (five year range):	17.6 (11.1-27.3)#

Relevant trend data
Hospitalisation and mortality rates show no clear temporal trends.

Quality of scientific information:	High

* Hospital discharge statistics report slightly higher numbers of total listeriosis cases being hospitalised than the national surveillance data when the statistics are based on any diagnosis of listeriosis, however, hospital discharge statistics give lower numbers than national surveillance when only primary diagnosis codes are considered. In all cases the numbers of cases are of a similar order of magnitude (e.g. in 2002, 21 to 17 to 6, for hospital discharge any diagnosis to national surveillance to hospital discharge primary diagnosis)

New Zealand mortality data supplied by the New Zealand Health Information Service indicate lower numbers of fatalities due to listeriosis, with only one fatality reported in the period 2001-2003 compared to nine reported to national surveillance.

Invasive listeriosis primarily occurs as either perinatal cases or cases affecting children less than four years or adults greater than 50 years.

In one outbreak neurological problems (cranial nerve palsies) developed in 30% of the survivors of meningitis. Pre-term infants may suffer from excess fluid in the brain and partial paralysis.

RISK SUMMARY SHEET:

HAZARD: *LISTERIA MONOCYTOGENES*

FOOD: PROCESSED READY-TO-EAT MEATS

Summary:
Processed ready-to-eat meats provide a good growth medium for *Listeria monocytogenes* and often are not subjected to a heat treatment step between purchase and consumption. Ready-to-eat meats are consumed by a large proportion of the population.

Infection with *L. monocytogenes* may cause either:
- A mild short term gastroenteritis or,
- An invasive disease with severe consequences, including fatalities

The incidence of the gastroenteritis is unknown. The invasive form of infection has a low incidence in the population. Generally the risk of infection with *L. monocytogenes* for healthy adult consumers is low. The risks of invasive listeriosis are greatest for perinatal infants (via consumption of contaminated foods by the mother), the immunocompromised and the elderly.

LISTERIOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):	0.6
Number of cases per year (2003):	24

Estimated ratio of actual/reported cases (under-reporting ratio):
No New Zealand estimates available. Given the severe nature of the condition, notification of invasive listeriosis is likely to be representative of the true incidence. Febrile gastroenteritis due to *L .monocytogenes* infection is rarely diagnosed and may be heavily under-reported.

Temporal trends:
The reported rate of listeriosis varies from year to year, but shows no clear temporal trends.

Quality of scientific information: High

LISTERIOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, processed ready-to-eat meat	
- percentage of population consuming per day:	21.8%
- **average daily intake, population 15+ years old:**	11.2 g
- median serving size (g):	30.0 g

Quality of scientific information: Medium-High

Contamination prevalence at consumption:	1-10%

LISTERIOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Outbreaks of infection with *L. monocytogenes* in New Zealand are rare. Three outbreaks were reported between 1997 and 2001, with ready-to-eat meats (corned silverside and ham) identified as the source of one outbreak (non-invasive listeriosis) and smoked mussels with another (invasive listeriosis). No food source was identified for the third confirmed outbreak.

No case-control studies or risk assessments have been performed in New Zealand. A large US risk assessment identified ready-to-eat meats amongst the highest relative risk foods for listeriosis. Other foods judged to have a similar level of relative risk were non-reheated frankfurters, pâté and meat spread and unpasteurised fluid milk.

LISTERIOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	98 (94-100)*
Percentage case mortality, five year average (five year range):	17.6 (11.1-27.3)#
Relevant trend data	

Hospitalisation and mortality rates show no clear temporal trends.

Quality of scientific information: High

* Hospital discharge statistics report slightly higher numbers of total listeriosis cases being hospitalised than the national surveillance data when the statistics are based on any diagnosis of listeriosis, however, hospital discharge statistics give lower numbers than national surveillance when only primary diagnosis codes are considered. In all cases the numbers of cases are of a similar order of magnitude (e.g. in 2002, 21 to 17 to 6, for hospital discharge any diagnosis to national surveillance to hospital discharge primary diagnosis)

New Zealand mortality data supplied by the New Zealand Health Information Service indicate lower numbers of fatalities due to listeriosis, with only one fatality reported in the period 2001-2003 compared to nine reported to national surveillance.

Invasive listeriosis primarily occurs as either perinatal cases or cases affecting children less than four years or adults greater than 50 years.

In one outbreak neurological problems (cranial nerve palsies) developed in 30% of the survivors of meningitis. Pre-term infants may suffer from excess fluid in the brain and partial paralysis.

RISK SUMMARY SHEET:

HAZARD: *MYCOBACTERIUM BOVIS*

FOOD: MILK

Summary:
The majority of cases of tuberculosis are caused by infection by *Mycobacterium tuberculosis*, however, human tuberculosis can also result from infection by the 'bovine' organism *Mycobacterium bovis*. About 2-3% of human cases in New Zealand are attributable to *M. bovis*. Tuberculosis results in a high proportion of serious health outcomes (hospitalisation, death) compared to most other foodborne diseases.

M. bovis bacteria are shed directly from infected mammary tissue into the milk, which is an excellent growth medium unless it is frozen or further processed. Pasteurisation is effective in destroying the organism in milk. Cases of tuberculosis due to *M. bovis* infection are often due to reactivation of infections acquired by people prior to the adoption of widespread milk pasteurisation.

TUBERCULOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003): 11.2
Number of cases per year (2003): 418
Estimated ratio of actual/reported cases (under-reporting ratio):
No New Zealand estimates available. Given the severe nature of the condition, notification of tuberculosis is likely to be representative of the true incidence. About 2-3% of human tuberculosis cases in New Zealand are attributable to *M. bovis,* equating to a 2003 rate of 0.2-0.3 per 100,000.

Temporal trends:
The reported number of cases of tuberculosis has shown a steadily increasing trend over the past 25 years, following a long period of decreasing case numbers. However, the recent increases in case numbers appear to mirror increase in the New Zealand population and age-standardised rates show no clear temporal trend. It is unknown whether the underlying proportion of cases due to *M. bovis* follow any sort of trend.

Quality of scientific information: Medium-High

TUBERCULOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, milk
- percentage of population consuming per day: 86.2%
- average daily intake, population 15+ years old: 214 g
- median serving size (g): 40 g

The median serving size recognises milk drunk as a beverage and milk as a component of other foods, such as coffee.

Quality of scientific information:	Medium-High

Contamination prevalence at consumption:	Unknown, but likely to be very low
Quality of scientific information:	Low

M. bovis is destroyed by the pasteurisation process and should not be present in most of the milk consumed in New Zealand. It is uncertain what the prevalence of consumption of unpasteurised milk is, or the frequency of unpasteurised milk contamination with *M. bovis.*

TUBERCULOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Before the advent of pasteurisation milk was an important transmission route for tuberculosis. Unpasteurised milk is consumed in New Zealand, but the amounts are assumed to be quite low. This fact, in conjunction with the extensive programmes for control of bovine tuberculosis in New Zealand, suggests that milk will not be an important transmission vehicle for this hazard.

One New Zealand study has examined cases of infection with *M. bovis* in detail. Interviews with the eleven cases showed that all but one had lived or stayed on a farm. Six cases were in occupations that involved possible contact with diseased animals or farming in regions where bovine tuberculosis was known to exist at the time. Meat from a wild source (pork, venison, beef, goat, rabbit and possum) was more likely to have been consumed by males, and two cases had eaten raw meat, particularly mince and steak.

The interview data suggested that five of the eleven cases were likely to have been infected by consuming unpasteurised milk, and they had also lived on a farm. All these cases were older than 35 years. Of the other cases over 35 years of age, their occupations (slaughterhouse workers) and exposures (raw milk) while overseas were considered likely causes of infection. Cases younger than 35 years of age were more likely to have been infected by airborne transmission.

TUBERCULOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	61 (56-67)*
Percentage case mortality, five year average (five year range):	1.8 (0.5-3.1)#
Relevant trend data	

Hospitalisation rates reported through national surveillance appear to show a clear downward trend from 78% of cases hospitalised in 1997 to 57% in 2003. Mortality rates also appear to follow a downward trend, although the trend is less consistent than for hospitalisations.

Quality of scientific information:	High

* Hospital discharge statistics report significantly higher numbers of total tuberculosis cases being hospitalised than the national surveillance data (e.g. in 2002, 333 from hospital discharge data and 193 from national surveillance).

New Zealand mortality data supplied by the New Zealand Health Information Service indicate higher numbers of fatalities due to tuberculosis (e.g. in 2000, NZHIS data reported 12 deaths due to tuberculosis, while national surveillance reported 8).

The highest age-specific rates of tuberculosis are generally observed in those aged 20-29 years and over 70 years.

The course of tuberculosis is long term and may reactivate after periods of apparent freedom from the disease. National surveillance data reports that 3-9% of cases in any year may be due to reactivation rather than new cases.

RISK SUMMARY SHEET:

HAZARD: NOROVIRUSES

FOOD: MOLLUSCA (RAW)

Summary:
Molluscan shellfish are able to concentrate viruses from the environment due to their practice of filter feeding. Human viruses may enter the shellfish-growing environment through sewage discharge from boats, leakage from septic tanks and run-off from coastal areas. Noroviruses are moderately heat resistant and steaming of shellfish may be insufficient to inactivate the organism.

Gastroenteritis caused by noroviruses is generally mild and self-limiting. While hospitalisation has been reported in some cases, this is rare.

NOROVIRUS INFECTION: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003): Unknown*
Number of cases per year (2003): Unknown*
Estimated ratio of actual/reported cases (under-reporting ratio):
As norovirus infection is not a notifiable disease all cases are technically unreported, although some intelligence on norovirus is obtained through analysis of outbreak information.

Temporal trends:
Unknown

Quality of scientific information: Low

* Norovirus infection is not notifiable, but based on the number of outbreaks attributed to this organism, it is likely to have a high incidence. Based on information from the UK, the incidence of norovirus infection has been estimated as approximately 1434 cases/100,000/year or 46,000 cases.

NOROVIRUS INFECTION: APPORTIONMENT DATA – EXPOSURE

Food consumption, molluscan shellfish
- percentage of population consuming per day: 2.2%
- **average daily intake, population 15+ years old:** 2.7 g
- median serving size (g): 38-54 g

Information here refers to total consumption of molluscan shellfish, available information suggests approximately 20% of servings may be consumed raw.

Quality of scientific information: Medium-High

Contamination prevalence at consumption: Unknown

Quality of scientific information: Low

A limited survey suggested approximately 10% of oyster samples may contain noroviruses. Prevalence is likely to be lower for other shellfish species and will be further reduced if the shellfish are consumed in a cooked state.

NOROVIRUS INFECTION: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

NLV accounts for 5 – 22% of the outbreaks reported in New Zealand and 15 – 49% of the cases involved in outbreaks. Oysters are persistently implicated as a cause of NLV outbreaks, although the proportion of total outbreaks attributed to this food is highly variable from year to year.

Problems with NLV in oysters exported from New Zealand in 2001 caused recalls and export restrictions in Hong Kong and the US, and the closure of harvesting areas in New Zealand. These restrictions have now largely been relaxed.

NOROVIRUS INFECTION: SEVERITY

Percentage of cases hospitalised, five year average (five year range): 2.0 (0.5-3.6)*
Percentage case mortality, five year average (five year range): 0.11 (Nil-0.16)#
Relevant trend data
No obvious trends.

Quality of scientific information: Medium

* Percent hospitalisation figures are reported from analyses of outbreaks. Hospitalisation status was not reported in all cases and the percentages reported here use total outbreak cases as the denominator, not total outbreak cases for which hospitalisation status was reported. Hospital discharge statistics include hospitalisations due to 'acute gastroenteropathy due to Norwalk agent'. Figures under this category are lower than those from national surveillance of outbreaks (e.g. in 2003, 12 hospitalisations were reported from hospital discharge and 31 were reported from national surveillance).

Percent mortality figures are reported from analyses of outbreaks. New Zealand mortality data supplied by the New Zealand Health Information Service do not report any fatalities due to 'Norwalk agents'.

No information is available on age-specific rates of norovirus infection.

No long term sequelae have been reported for norovirus infection.

RISK SUMMARY SHEET:

HAZARD: *SALMONELLA (NON-TYPHOIDAL)*

FOOD: POULTRY (WHOLE AND PIECES)

Summary:
Salmonella is a significant cause of suspected foodborne illness in New Zealand. Raw poultry may be contaminated with *Salmonella,* although there is evidence to indicate that industry initiatives have been effective in significantly decreasing the prevalence of contamination. While thorough cooking is effective in destroying *Salmonella* on poultry surfaces, undercooking of poultry or cross-contamination from poultry to other foods or kitchen surfaces may represent mechanisms by which *Salmonella* on raw poultry may contribute to foodborne disease.

Salmonellosis results in hospitalisation in approximately 10-20% of cases and may result in death. Long term sequelae, including septicaemia and subsequent non-intestinal infections can occur. Reactive arthritis or Reiter's syndrome may occur 3-4 weeks after gastrointestinal symptoms.

SALMONELLOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):	37.5
Number of cases per year (2003):	1,401
Estimated ratio of actual/reported cases (under-reporting ratio):	

No New Zealand estimates available. A UK study (Wheeler *et al*., 1999) estimated 3.2 community cases of salmonellosis for every case reported to national surveillance.

Temporal trends:
Salmonellosis rates in New Zealand varying significantly from year to year, but follow no clear overall trend, although salmonellosis rates have decreased significantly in each of the last two years (2002 and 2003).

Quality of scientific information: High

SALMONELLOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, poultry	
- percentage of population consuming per day:	27.5%
- **average daily intake, population 15+ years old:**	34.4 g
- **median serving size (g):**	84 g

Quality of scientific information: *Medium-High*

Contamination prevalence at consumption:	Very low

Quality of scientific information:　　　　　　　　　　　　　　　Low-Medium

While the contamination prevalence of cooked poultry by *Salmonella* is very low, the prevalence on raw poultry has been reported to be high (typically 17 - 40% on fresh product). This information was collected in the early 1990s, and there are indications that the prevalence of *Salmonella* on fresh product has dropped considerably since then and is now in the range 1-2%.

SALMONELLOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Chicken is the most commonly implicated food in outbreaks of salmonellosis reported in New Zealand. A wide range of food and non-food sources of salmonellosis outbreaks are implicated and in 2003 3/24 outbreaks were linked to chicken.

Serotypes of *Salmonella* causing disease in humans in New Zealand are also commonly found in poultry, however, a case-control of an emerging serotype (STM160) did not identify poultry consumption as a risk factor.

SALMONELLOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):　　13.4 (10.7-14.9)*
Percentage case mortality, five year average (five year range):　　0.11 (Nil-0.4%)#
Relevant trend data
Hospitalisation and mortality rates show no clear temporal trends, although numbers of cases hospitalised and numbers of fatalities have decreased over the last two years, in line with the decrease in the rate of salmonellosis.

Quality of scientific information:　　　　　　　　　　　　　　　High

* Hospital discharge statistics report similar numbers of salmonellosis cases being hospitalised to the national surveillance data. While the data differ slightly, with discharge data giving higher numbers in some years and national surveillance giving higher numbers in other years, the orders of magnitude are consistent.

New Zealand mortality data supplied by the New Zealand Health Information Service indicate lower numbers of fatalities due to salmonellosis.

The highest age-specific rates of salmonellosis occur amongst children less than 1 year and children 1-4 years (153.7 and 135.6/100,000 respectively in 2003).

Septicaemia and subsequent non-intestinal infections can occur. Reactive arthritis or Reiter's syndrome may occur 3-4 weeks after gastrointestinal symptoms. Approximately 2-3% of a population exposed to a triggering infection will develop reactive arthritis, which may last for up to a year or longer. Several studies of outbreaks have suggested an even higher probability of subsequently developing reactive arthritis (approximately 16%).

RISK SUMMARY SHEET:

HAZARD: SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC)

FOOD: RED MEAT

Summary:
STEC organisms, in particular *E. coli* O157, are an increasing cause of illness in New Zealand. Infection can result in a range of serious health outcomes including death.

Red meat provides an excellent environment for microbial growth. The potential for STEC organisms to survive and grow on meat is increased by their tolerance to acid conditions, drying and fermentation.

STEC INFECTION: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003): 2.8
Number of cases per year (2003): 105
Estimated ratio of actual/reported cases (under-reporting ratio):
Based on studies in Canada, in New Zealand it has been assumed that 10-12 cases of STEC infection occur for each reported case.

Temporal trends:
As a newly emergent disease, rates of STEC infection have increased steadily since the disease first became notifiable in 1996.

Quality of scientific information: Medium-High

STEC INFECTION: APPORTIONMENT DATA – EXPOSURE

Food consumption, red meat (beef, sheep, pig, deer and rabbit)
- percentage of population consuming per day: 77.7%
*- **average daily intake, population 15+ years old:*** 135 g
- median serving size (g): 124 g

Quality of scientific information: Medium-High

Contamination prevalence at consumption: Very low

Quality of scientific information: Low-medium

While the data in the National Microbiological Database (NMD) for carcasses indicates an extremely low prevalence of *E. coli* O157:H7 contamination, little information is available on other serotypes or STEC contamination of retail meats.

STEC INFECTION: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

There is currently little information to suggest that transmission of STEC via red meat is occurring in New Zealand. Prevalence of STEC in carcass meats appears to be low by international standards. No outbreaks of STEC in New Zealand have been linked to consumption of red meat.

However, STEC has been found in the faeces of cattle and sheep and has been detected infrequently on raw meat samples.

STEC INFECTION: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	24 (17-33)*
Percentage case mortality, five year average (five year range):	Nil (Nil)#
Relevant trend data	

No clear trends in hospitalisation or fatality rates.

Quality of scientific information: High

* Hospital discharge statistics report similar or slightly higher numbers of total STEC infection cases being hospitalised than the national surveillance data, when all instances of *E.coli*-related diagnosis codes are considered. When only primary diagnosis codes are considered , national surveillance gives higher numbers of cases hospitalised (e.g. in 2002, 27 from hospital discharge data, any use of diagnosis code, 16 from national surveillance, 8 from hospital discharge using only primary diagnosis code).

New Zealand mortality data supplied by the New Zealand Health Information Service confirms that no fatalities due to STEC infection have been reported in the last five years. Two fatalities were reported prior to 1998, one each from *E. coli* O157 and O13. There was no evidence that these cases were food- related.

The highest age-specific rates of STEC infection are generally observed in children aged 1-4 years (25.4/100,000 in 2003).

STEC infection can result in serious long-term complication, particularly, *Haemolytic Uraemic Syndrome (HUS):* HUS follows Haemorrhagic Colitis (HC) and is normally associated with children. The condition is characterised by renal failure and the consequences of that including seizures, coma, death. The kidneys are attacked by toxins released by the organism. Typically 3-8% of notified STEC cases in New Zealand develop HUS.

RISK SUMMARY SHEET:

HAZARD: SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC)

FOOD: UNCOOKED COMMINUTED FERMENTED MEAT (UCFM)

Summary:
STEC organisms, in particular *E. coli* O157, are an increasing cause of illness in New Zealand. Infection can result in a range of serious health outcomes including death. In New Zealand *E. coli* O157 accounts for about 90% of all STEC cases.

Ingredient quality, pH reduction and water reduction are used to achieve a satisfactory microbial status in uncooked comminuted fermented meat products, such as salami.

STEC INFECTION: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):	2.8
Number of cases per year (2003):	105

Estimated ratio of actual/reported cases (under-reporting ratio):
Based on studies in Canada, in New Zealand it has been assumed that 10-12 cases of STEC infection occur for each reported case.

Temporal trends:
As a newly emergent disease, rates of STEC infection have increased steadily since the disease first became notifiable.

Quality of scientific information: Medium-High

STEC INFECTION: APPORTIONMENT DATA – EXPOSURE

Food consumption, UCFM
- percentage of population consuming per day: 1.6%
- average daily intake, population 15+ years old: 0.5 g
- median serving size (g):   15.5 g

Quality of scientific information: Medium-High

Contamination prevalence at consumption: Very low

Quality of scientific information: Low

While some information is available on the prevalence of STEC in New Zealand raw meat (particularly beef), there are no New Zealand data on STEC in UCFM.

STEC INFECTION: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

While UCFM has been associated with serious STEC outbreaks overseas, there is no evidence linking UCFM consumption to foodborne disease in New Zealand.

STEC INFECTION: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	24 (17-33)*
Percentage case mortality, five year average (five year range):	Nil (Nil)#
Relevant trend data	

No clear trends in hospitalisation or fatality rates.

Quality of scientific information:　　　　　　　　　　High

* Hospital discharge statistics report similar or slightly higher numbers of total STEC infection cases being hospitalised than the national surveillance data, when all instances of *E.coli*-related diagnosis codes are considered. When only primary diagnosis codes are considered , national surveillance gives higher numbers of cases hospitalised (e.g. in 2002, 27 from hospital discharge data, any use of diagnosis code, 16 from national surveillance, 8 from hospital discharge using only primary diagnosis code).

\# New Zealand mortality data supplied by the New Zealand Health Information Service confirms that no fatalities due to STEC infection have been reported in the last five years. Two fatalities were reported prior to 1998, one each from *E. coli* O157 and O13. There was no evidence that these cases were food- related.

The highest age-specific rates of STEC infection are generally observed in children aged 1-4 years (25.4/100,000 in 2003).

STEC infection can result in serious long-term complication, particularly, *Haemolytic Uraemic Syndrome (HUS):* HUS follows Haemorrhagic Colitis (HC) and is normally associated with children. The condition is characterised by renal failure and the consequences of that including seizures, coma, death. The kidneys are attacked by toxins released by the organism. Typically 3-8% of notified STEC cases in New Zealand develop HUS.

RISK SUMMARY SHEET:

HAZARD: *TOXOPLASMA GONDII*
FOOD: RED MEAT AND MEAT PRODUCTS

Summary:
Meat containing *Toxoplasma* cysts is regarded as the major source of infection for human toxoplasmosis (the organism is not considered to be transmitted from person to person). The organism does not grow outside a live host and will not multiply on meat.

In immunocompetent humans *Toxoplasma gondii* infection is common but clinical toxoplasmosis is rare. Infection produces an asymptomatic illness or, in about 15% of cases, a viral-like febrile illness, which is usually mild and self-limiting and individuals seldom seek medical attention. However, the risk for pregnant women is considerable, given the high likelihood of serious long-term illness caused by transmission of infection to the foetus. Three to four percent of infected neonates die, while the remainder will suffer from various forms of long-term disease (mental retardation, blindness and epilepsy).

TOXOPLASMOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):   Unknown*
Number of cases per year (2003):   Unknown*
Estimated ratio of actual/reported cases (under-reporting ratio):
Unknown*

Temporal trends:
Unknown*

Quality of scientific information: Low

* Toxoplasmosis is not currently a notifiable disease in New Zealand.

Toxoplasmosis does not cause serious disease in immunocompetent people. However, the risk for pregnant women is considerable, given the high likelihood of serious long-term illness caused by transmission of infection to the foetus. Three to four percent of infected neonates die, while the remainder will suffer from various forms of long-term disease (mental retardation, blindness and epilepsy).

The available data on seroconversion of pregnant women in New Zealand suggest that there may be approximately 66 babies born with congenital toxoplasmosis each year. However this estimate is not matched by cases of congenital toxoplasmosis reported to the hospital system, and even when congenital toxoplasmosis was a notifiable disease reported cases were few.

TOXOPLASMOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, red meat (beef, sheep, pig, deer and rabbit)
- percentage of population consuming per day: 77.7%
- average daily intake, population 15+ years old: 135 g
- median serving size (g):   124 g

Quality of scientific information: Medium-High

Contamination prevalence at consumption: Unknown

Quality of scientific information: Low

TOXOPLASMOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

It is likely that New Zealanders are exposed to *Toxoplasma* via domestically produced red meat, given that seropositivity amongst farmed animals is widespread. Imported red meat is less likely to contribute to exposure given that only small amounts of beef and sheep meat are imported, and pigmeat is required to be frozen. Ameliorating factors for any exposure are that seropositivity appears to overestimate infectivity, and *Toxoplasma* exposure will be controlled through cooking and freezing.

TOXOPLASMOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):   Unknown*

Percentage case mortality, five year average (five year range):   Unknown#
Relevant trend data
Unknown*

Quality of scientific information: Low

RISK SUMMARY SHEET:

HAZARD: *VIBRIO PARAHAEMOLYTICUS*

FOOD: SEAFOOD

Summary:
Due to the halophilic nature and the marine source of *V. parahaemolyticus*, raw seafood is often naturally contaminated and is the main food responsible for infection. In seafood stored at refrigeration temperatures, no growth and some decline in numbers will occur. However, harvesting may be carried out at times of year when the seafood may not reach safe temperatures for some time, and under these circumstances some growth may occur.

V. parahaemolyticus primarily results in gastrointestinal infection although wound infections and septicaemia may also result. Hospitalisation is required in approximately 7% of cases. The illness is usually self-limiting. Extraintestinal infections can occur. Reactive arthritis has been reported.

VIBRIO INFECTION: INCIDENCE DATA

Notified incidence (cases/100,000/year): 1.6*
Number of cases per year (2003): Unknown*
Estimated ratio of actual/reported cases (under-reporting ratio):
As *Vibrio* infection is not a notifiable disease all cases are technically unreported.

Temporal trends:
Unknown*

Quality of scientific information: Low

- *Vibrio parahaemolyticus* infection is not notifiable in New Zealand, although some cases get notified under the category of 'acute gastroenteritis'. Rates given in this section are from retrospective analysis of the communicable disease database (Episurv) or from case series.
-

VIBRIO INFECTION: APPORTIONMENT DATA – EXPOSURE

Food consumption, seafood
- percentage of population consuming per day: 15.6% (marine fish)
3.1% (molluscs)
1.8% (crustacea)
- average daily intake, population 15+ years old: 2.7 g
- median serving size (g): 76 g (marine fish)
59 g (molluscs)
40 g (crustacean)

Quality of scientific information:	Medium-High

Contamination prevalence at consumption:	Unknown, but probably low
Quality of scientific information:	Low

V. parahaemolyticus may be quite common in oysters from the North of New Zealand, but the proportion of these that are pathogenic is likely to be low.

VIBRIO INFECTION: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Investigation of outbreaks indicates that the occurrence of *V. parahaemolyticus* infection in New Zealand is strongly linked to the personal importation and consumption of seafood by Pacific Islanders. While there is a requirement that products personally imported must be cooked, dried or frozen, this measure does not appear to be fully effective in preventing infection. The only other food that has been associated with *V. parahaemolyticus* infection is recreationally harvested mussels in Auckland in 1983.

The absence of reported outbreaks of *V. parahaemolyticus* infection since 2000 should not be used as evidence that cases are not occurring. It is likely that most cases do not come to the attention of the health system, or, if they do, are not identified as being caused by this organism. Most cases will occur amongst population groups consuming raw seafood, particularly shellfish, or in geographical areas where sea and atmospheric temperatures are higher than average for New Zealand. The increasing popularity of raw fish foods such as sushi, may also make *V. parahaemolyticus* infection more common.

VIBRIO INFECTION: SEVERITY

Percentage of cases hospitalised:	12-15*#
Percentage case mortality, five year average (five year range):	Unknown#
Relevant trend data	
Unknown*	

Quality of scientific information:	Low

Vibrio parahaemolyticus infection is not notifiable in New Zealand, although some cases get notified under the category of 'acute gastroenteritis'. Rates given in this section are from retrospective analysis of the communicable disease database (Episurv) or from case series.

Hospital discharge statistics report only 0-2 people per year hospitalised due to 'Food-borne intoxication due to *Vibrio parahaemolyticus*'. No fatalities were attributed to this pathogen in NZHIS statistics.

The whole population is susceptible to infection, although immunocompromised consumers are at special risk for septicaemia and other sequelae

Reactive arthritis has been reported as a sequel to *Vibrio* infection.

RISK SUMMARY SHEET:

HAZARD: *YERSINIA ENTEROCOLITICA*

FOOD: PORK

Summary:
It is well established that *Y. enterocolitica* is able to grow on a range of pork products, even at refrigeration temperatures. Few data on the prevalence of *Y. enterocolitica* in New Zealand pigs and pork are available in the published literature.

In younger children (< 5 years) the symptoms of *Y. enterocolitica* infection are predominantly those of enterocolitis (vomiting, diarrhoea, low-grade fever and less frequently abdominal pain). In contrast, older children are more likely to experience abdominal pain as the prominent symptom. Adults usually present with non-specific abdominal pain and diarrhoea. Bacteraemia and sepsis may occur in high-risk individuals, such as those with diabetes, liver disease, immunosuppression etc. Abdominal pain in the lower right quadrant can lead to unnecessary appendectomies being performed.

Hospitalisation rates may be as high as 20%, but fatalities are rare. Complications of *Y. enterocolitica* infection may include reactive arthritis, septicaemia, lymphadenitis, disturbed liver function, and erythema nodosum.

YERSINIOSIS: INCIDENCE DATA

Notified incidence (cases/100,000/year, 2003):	11.7
Number of cases per year (2003):	439

Estimated ratio of actual/reported cases (under-reporting ratio):
No New Zealand estimates available. A UK study (Wheeler *et al*., 1999) estimated 3.2 community cases of salmonellosis for every case reported to national surveillance and 7.6 cases of campylobacteriosis for each reported cases. Lake *et al*. (2000) used the midpoint of these two estimate (5 community case for each notified case) to estimate a total number of yersiniosis cases.

Temporal trends:
Yersiniosis rates in New Zealand vary from year to year, but follow no clear overall trend.

Quality of scientific information: High

YERSINIOSIS: APPORTIONMENT DATA – EXPOSURE

Food consumption, pork	
- percentage of population consuming per day:	38.0%
*- **average daily intake, population 15+ years old:**	32.3 g
- median serving size (g):	47.6 g

Quality of scientific information:	Medium-High
Contamination prevalence at consumption:	Unknown
Quality of scientific information:	Low

Y. enterocolitica may be quite common on ready-to-eat pork products, although it is likely that the majority of organisms present are non-pathogenic.

YERSINIOSIS: APPORTIONMENT DATA – OUTBREAKS AND EPIDEMIOLOGY

Data on the prevalence of *Y. enterocolitica* in pork in New Zealand are limited, and the contamination rate found in a single study (6%) may be an underestimation, due to the known difficulty of isolating the organism from food. Approximately 30% of the pork supply in New Zealand appears to be imported, with the Canada being the major source. Literature information suggests that prevalence of *Y. enterocolitica* may be as high as 50% in Canadian pork. However, no all isolates of *Yersinia enterocolitica* will be pathogenic and methodological problems complicate prevalence assessment.

Rates of yersiniosis are relatively high in New Zealand compared to Australia and other countries. Pork has been implicated in a proportion of cases, through outbreak investigations and through a case-control study. However, it should be noted that the case-control study identified other more important risk factors for yersiniosis, such as unreticulated sewage. Water from a home supply and handling farm animals were identified as risk factors in another study. In addition the number of yersiniosis outbreaks is small and so the information from them is not strong.

YERSINIOSIS: SEVERITY

Percentage of cases hospitalised, five year average (five year range):	8.1 (6.1-11.6%)*
Percentage case mortality, five year average (five year range):	0.09 (Nil-0.4%)#
Relevant trend data	
Hospitalisation and mortality rates show no clear temporal trends.	
Quality of scientific information:	High

* Hospital discharge statistics report similar numbers of yersiniosis cases being hospitalised to the national surveillance data. While the data differ slightly, with discharge data giving higher numbers in some years and national surveillance giving higher numbers in other years, the orders of magnitude are consistent.

New Zealand mortality data supplied by the New Zealand Health Information Service do not record any fatalities due to yersiniosis during the years 1999-2003.

The highest age-specific rates of yersiniosis occur amongst children less than 1 year and children 1-4 years (54.9 and 48.1/100,000 respectively in 2002).

Complications of *Y. enterocolitica* infection may include reactive arthritis, septicaemia, lymphadenitis, disturbed liver function, and erythema nodosum. In a study of 261 Dutch patients these complications occurred generally in older patients. Of the 261 patients with gastrointestinal yersiniosis, uncomplicated enteritis was diagnosed in 169 patients, complicated enteritis in 37, appendicular syndrome in 33, ileitis in 8 and colitis in 14. Four patients died of generalised peritonitis, and other complications included reactive arthritis, septicaemia, lymphadenitis, disturbed liver function, and erythema nodosum.

In this study there was an additional group of patients (n=142) who had complicated yersiniosis such as arthritis and erythema nodosum without gastrointestinal symptoms.

Reactive arthritis (synonymous with Reiter's syndrome) may sometimes follow infection. People who are HLA (human lymphocyte antigen)-B27 positive are particularly at risk. The illness normally appears one to three weeks after infection and continues for a few weeks or months.