A Guide to Estimating the Cost of Foodborne Disease and to Evaluating Regulation of Food Production

Prepared for

Food Standards Australia New Zealand

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Contents

Executive Summary

This report aims to provide a guide to Food Standards Australia and New Zealand (FSANZ) on how to value the cost of foodborne illness. The principal purpose of the guide is to allow FSANZ to determine the cost savings from a proposed regulatory intervention.

The quantification of economic costs of foodborne diseases typically comprises four main steps. These are estimates of:

1. The total quantity of intestinal illnesses due to various pathogens (e.g. campylobacteriosis, salmonellosis, listeriosis etc.) by severity category.
2. The proportions of the illnesses caused by production, processing, distribution and preparation of food.
3. The main impacts of the illnesses for government, businesses and households.
4. Money values attached to each of these impacts.

Section 2 provides an overview of the process involved in making these estimates.

In Section 3 the report describes in more detail how to estimate the following major categories of costs of foodborne diseases.

- Government regulation, surveillance and control costs
- Business costs, i.e. compliance costs, costs of foodborne incidents and any other impacts on industry activity (loss of output is treated as a separate category)
- Health care service costs
- Loss of workplace output, including loss of earnings when a household is caring for a sick dependent
- Other costs to households, i.e. losses due to pain and suffering and reduced functionality and premature mortality.

The paper gives special attention to estimates of variable costs. These are important when estimating the impact of a change in standards.

Section 4 discusses some special costing issues highlighted in the brief. These include actual and reported disease rates, estimating the health loss of individuals using disability weights and willingness to pay principles, estimating third party effects, the treatment of risk and uncertainty and the timeframe for the analysis.

The final section provides a guide to the evaluation of regulatory change. This discusses identification of the issues, establishing the Base Case costs and the options, estimating the costs and benefits of the options, and dealing with other issues such as risk and distributional effects.

1 Introduction

1.1 Objectives of Report

The report aims to provide a guide to Food Standards Australia and New Zealand (FSANZ) on how to value the cost of foodborne illness. The principal purpose of the guide is to allow FSANZ to determine the cost savings from a proposed regulatory intervention.

It may be noted that while the overall aim in the first sentence implies a guide to estimating the *total* cost of foodborne disease. The important practical aim of the report, as expressed in the second sentence, is to provide a guide to estimating the change in costs (the *variable* costs) associated with a change in policy or regulation.

FSANZ risk assessors would provide a range for the estimated reduction in specific diseases as a result of a regulation. The guide would then provide a method for estimating the consequential cost savings and a basis for a cost-benefit analysis.

In addition to providing this general guidance, the report discusses some specific issues raised in the brief. These are:

- How to factor and account for estimated actual and reported disease rates
- Indexation of fixed values from past studies for undertaking costings
- The valuation of health loss based on quality adjusted life days (disutility weighted) and willingness to pay principles
- The valuation of third party effects on related businesses in the affected industry
- The management of uncertainty
- The appropriate timespan for the analysis
- Guidance on breakeven points

1.2 Layout of Report

The report contains four main sections. Section 2 provides an overview of the issues associated with the costing of foodborne diseases. Section 3 describes in more detail how to estimate the total and the variable costs of foodborne disease. Section 4 addresses the specific issues raised in the brief noted above. Section 5 provides a guide to determining the cost savings (and costs and benefits) from a policy change.

2 Overview of Issues and Valuation Methods

2.1 Introduction

The quantification of economic costs of foodborne diseases typically comprises four main steps. These are estimates of:

1. The total quantity of intestinal illnesses due to various pathogens (e.g. campylobacteriosis, salmonellosis, listeriosis etc.) by severity category.
2. The proportions of the illnesses caused by production, processing, distribution and preparation of food.
3. The main impacts of the illnesses for government, businesses and households.
4. Money values attached to each of these impacts.

Intestinal illnesses can be classified in various ways. For example, in a recent NZ study of the costs of foodborne disease, Cressey and Lake (2008) based their classifications on the following diseases.

- Campylobacteriosis
- Listeriosis (invasive, perinatal and non-perinatal)
- Norovirus infection
- Salmonellosis
- Yersiniosis
- STEC infection

In a FSANZ-organised training workshop in late June, the participants agreed that this form of classification is an appropriate basis for estimating the costs of foodborne diseases.

The principal outcome of each of these illnesses (except listeriosis) is acute gastrointestinal illness (AGI) with varying degrees of severity.

Some AGI illnesses have sequelae such as Guillain Barre Syndrome (GBS), reactive arthritis (REA), inflammatory bowel disease (IBD) and haemolytic uraemic syndrome (HUS). For example most campylobacteriosis illness occurs only with AGI but sometimes with GBS or REA or IBD. Salmonellosis also occurs mainly in the form of AGI but can occur with REA or IBD. Cressey and Lake (2008) provide more details on the sequelae for each illness.

A significant issue is the ratio of actual intestinal diseases to reported diseases (i.e illnesses dealt with and reported in the health care system). Many people with minor

AGI do not see a GP or enter the health care system and consequently many minor illnesses are not reported. This is one of the specific issues discussed in Section 4 below.

Secondly, intestinal illnesses have to be attributed to major sources (foodborne, animals or water etc.). The attributions may be based on analysis of data, epidemiological and microbiological studies or expert elicitation. In Australia, estimates of the proportion of illnesses that are foodborne were based on information from relevant literature, data from outbreaks and expert opinion. For gastroenteritis, the expert opinions involved a Delphi process with 19 experts (Hall and the OzFoodNet Working Group, 2004). In addition specialists advised on sequelae due to foodborne disease. In New Zealand, current estimates of the percentages of diseases that are foodborne have been made primarily by expert elicitation (Cressey and Lake, 2007).

Ideally the estimated total of foodborne diseases would then be attributed to major source, poultry, eggs, raw milk etc. If this is not done (albeit with considerable approximations), there is a risk that the attributions made for each separate study will be inconsistent in that they total more or less than 100% of the estimated total attributed to foodborne disease.

Turning to the impacts of the illnesses, these depend on the type, length and severity of the illness. AGI may be associated with:

- recovery with no visit to a GP
- recovery with one or more visits to a GP
- recovery with hospitalisation (possibly plus visits to a GP)
- no recovery.

Most sequelae involve one or other of the last three dot points.

The main source of information on the impacts of different levels of each kind of illness is usually a community survey. This was the major source in Australia (the 2001-02 survey cited in Hall, G and the OzFoodNet Working Group, 2004) and in New Zealand (Adlam et al., 2007 study). Analysis of reported incidents may also be an important source of information.

Finally by way of introduction it may be noted that in public policy economics the notion of economic costs is a broad one. It means the estimation in dollars of any costs or loss of well-being borne by households, firms or government in the relevant country or province. Thus it includes not only health care costs and loss of output but also disutility associated with pain and suffering, loss of functionality and premature mortality and any other cost in so far as these costs can reasonably be ascribed a money value.

2.2 Classification of Costs

To establish a valuation framework, the various costs need to be classified in the most convenient way. In the classification (1) below, costs are classified under three headings: prevention, damage and repair. Generally prevention activities are fixed costs whereas damage and repair costs vary with policy or incident.

Classification of costs (1): prevention, damage and repair

Cost of preventive activities

- Government regulation, surveillance and monitoring costs
- Business compliance costs

Damage costs

- Households
  - Loss of earnings when not compensated by employer
  - Utility losses from pain and suffering and loss of functionality
  - Travel costs to medical services
  - Premature mortality
- Businesses
  - Loss of output / productivity (where not double counting with households)
  - Costs of dealing with foodborne incidents: disruption and recall costs
  - Other impacts on industry activity

Repair and restoration costs

- Health care service costs borne by government and households
- Carer costs borne mainly by households (including loss of earnings)

Alternatively costs may be classified by the party that bears them initially. This is shown in the second classification below.

Of course, some of these costs may be passed on. Costs borne by business may be passed on to households via higher prices or lower dividends. They may also lead to lower tax. Costs borne by government may be passed on in increased taxes or reduced services. However any such passing on of costs does not affect the total cost of foodborne diseases.

As can be seen, some of these costs are separate stand-alone costs, which can be attributed simply to one party (government, business or households). Examples are government surveillance and control costs and business compliance and food recall costs.

Classification of costs (2): by initial incidence of the costs

Government

Regulation, surveillance and control costs
Health care service costs (most of these costs)

Businesses

Compliance costs
Costs of dealing with foodborne incidents: disruption and recall costs
Other impacts on industry activity / exports
Loss of labour output / productivity (where borne by business)

Households

Loss of earnings when not compensated by employer
Carer costs (including loss of income)
Utility losses from pain and suffering and loss of functionality
Travel costs to medical services
Health care costs (a small share)
Premature mortality

Other costs such as health care and loss of output are shared between government and households and between employers and households respectively. The actual impact of the costs depends on arrangements for payment of health services and compensation for loss of working time. In these cases it makes sense *first* to estimate the total cost of health care services and the total value of lost output rather than to estimate how these costs are borne. If useful, the share of costs attributable to government, businesses and households can be estimated as a secondary piece of analysis.

However this apparently straightforward solution runs into problems when estimates are made of the costs to households inclusive of the disutility of pain and suffering and reduced functionality.

A preferred valuation approach in the economics literature is to estimate what household are willing to pay (WTP) *in total* to avoid a specific illness (see Abelson et al., 2006; Hammitt and Haninger, 2007; Roberts, 2007; Scharff et al., 2009; Scharff, 2010). However, the amount that households are WTP depends on the costs that they have to bear, including any health care costs and loss of earnings. An individual's WTP to avoid an illness rises with the amount of costs that they bear. If this WTP approach to estimating household costs is adopted along with separate estimates of the costs of health care services and the value of lost output, it is important to avoid double counting of costs.

Given these dilemmas, our suggested classification of costs is as follows. Items (1) to (4) are major separate items. There is no double counting between them. Their relationship to the costs of foodborne disease is clear. Estimating these as separate items is practical. The main issue concerns item 5. Here the challenge is to avoid any double counting of costs with items 3 and 4. In so far as household costs are counted in items 3 and 4, they should not be counted again in item 5. This issue is discussed in some detail in Section 3 below.

Recommended classification of costs

1 Government regulation, surveillance and control costs

2 Business costs (excluding loss of output)
i.e. compliance costs, costs of foodborne incidents and any other impacts on industry activity

3 Health care service costs

4 Loss of paid output
Including loss of earnings when caring for a sick dependent

5 Other costs to households
(a) Disutility due to pain and suffering, reduced functionality, travel costs to medical services, private payments to carers and so on. These costs can be valued *in toto* using a burden of disease / WTP approach outlined below. Any loss of earnings or health care costs included under head (3) or (4) would be subtracted to avoid double counting (this is discussed further in section 3.5).
(b) Premature mortality.

2.3 Valuation Principles especially for Households

Valuing the first four sets of costs is relatively straightforward and described in some detail in Section 3. Valuing household disutility is more complex and a preliminary discussion of the issues is provided here.

There are three main methods for valuing household costs from an illness.

(1) **The traditional 'cost-of-illness' (COI) method**. Under this method, the analyst estimates the cost of each quantified impact (loss of earnings, health care costs, travel costs and so on) on households and adds them up. An extra amount, often an arbitrary amount, may be added for pain and suffering and other unquantified

(2) **The willingness to pay method**. As noted above, the current literature on cost-benefit analysis in the health sector usually equates the value of health with amount that households are WTP to avoid an illness. This expenditure reflects the amount of goods and services that households are willing to give up rather than bear the illness. As discussed below, application of this method is constrained principally at present by a lack of robust research and measurements rather than in any weakness of principle.

(3) **The burden of disease / disability weights method**. Under this approach the total burden of an illness is measured in a unit such as a disability adjusted life year (DALY) borne or quality adjusted life year or day lost (a QALY or a QALD). An individual case may have an illness burden equating to a fraction of a DALY (because it lasts for only a few days) or 2 or 3 QALDs. The total burden for each disease is the product of the number of cases and the average burden for the illness. The total cost is therefore estimated total DALYs $\times$ \$ per DALY or estimated total QALDs $\times$ \$ per QALD.

Premature mortality can be included in the total DALYs. Thus

$$\Sigma DALYs = \Sigma YLD + \Sigma YLL \quad (2.1)$$

where *YLD* is the number of years lived with a disability and *YLL* is years of life lost.

Using the burden of disease approach, the total cost (*TC)* of an illness can be estimated and presented in various ways (*with the same result* if the same assumptions are made), for example:

$$TC = \Sigma DALYs \times WTP \text{ for life year in good health, or} \quad (2.2)$$

$$TC = N \times DW \times DAYS \times WTP \text{ for a day in good health} \quad (2.3)$$

where *N* is the number of cases of an illness in a year, *DW* is the disability weight and *DAYS* are average days of illness. The WTP value of a day in good health is the estimated value of a life year divided by 365 days.

Abelson et al. (2006) and Scharff et al. (2008) adopted essentially the approach in Equation (2.3), although the latter expressed the costs in terms of quality adjusted life days (QALDs) lost.

Whichever form of presentation is adopted, estimates are required for the number of illnesses by type and severity of illness, average disability weight, average number of days with the illness and the value of a healthy day.

However the Australian and American studies treated the value of lost output differently. The Australian study considered that an individual's WTP for a year or day of good health is a WTP for *all* the benefits of a healthy year or day inclusive of increased earnings and quality of life. Therefore, because lost earnings were estimated separately, the study subtracted the estimated earnings lost by households (assumed to be 20% of total lost earnings) from the total cost to households so as to avoid double counting. By contrast, the US study *added* the estimated loss of output (earnings) to the total household WTP for a healthy day.

Turning to a comparison of the three main valuation methods described above, each has some disadvantage. The COI method (1) focuses on tangible costs and provides a transparent accounting of all the elements of household costs. But it does not provide a valid and testable method for valuing pain and suffering or other unquantified impacts on household activities.

The WTP method (2) is often viewed as ideal in principle (see references above). However there are apparently no reliable research studies or surveys on WTP to avoid AGI illnesses. Actually there are two WTP studies by highly regarded researchers: by Showgren and Stamland (2007) and by Hammitt and Haninger (HH, 2007). However Showgren and Stamland acknowledge several weaknesses in their University of Wyoming Food Web Diary Project. There was a lack of internal consistency in the results and the responses contained 'poor information about how people perceive food safety risks and how they will respond'.

Although Roberts (2007) used the HH results to estimate foodborne cost in the US, we agree with the reservations expressed in Lusk (2007) and Scharff et al. (2009) that there is a surprising and unrealistic lack of variation in WTP with duration and severity of illness. Also, the results ranging from $8000 for a mild one-day illness to $16,000 for a severe 7-day illness appear high. In the absence of WTP surveys with more robust findings, in our view the direct WTP method is not a practical option at this stage.

The disability weighting method (3) avoids the disadvantages of (1) and (2) and has been used in Australia (Abelson et al., 2006) and the US. This report views this is the preferred method for estimating household costs. It includes a WTP allowance to avoid illness. However, sound estimates of the severity weights of illnesses (or DALY weights) and the dollar values of a life year or day are critical. Also valuations of household costs should be adjusted if household costs are included in separate estimates of lost output (earnings) or health care costs. For further discussion, see Section 3.5.

Finally it may be observed that these methods of putting a cost on illness relate to the cost borne by the sick person. It is sometimes observed that other family members may bear collateral costs or grief. In the current context a parent may be inconvenienced or concerned by a child's illness. Hammitt and Haninger (2007) find that the cost of foodborne disease is higher in households with children. And Jones-Lee (1992) suggests more generally that in cases of severe illnesses the household or social costs may sometimes be up to 1.4 times individual costs.

On the other hand, most studies of the cost of illness focus only on the costs to the individual. Jones-Lee's suggestions have not been adopted widely and, as noted, the results of the Hammitt and Haninger study have found limited acceptance. Valuation method (3) counts the cost of illness of a child at the same level as an adult illness, which some may view as an overestimate of the cost of child illness. Also, additional costs may be picked up in the loss of earnings of carers. Without more research on this issue, this paper would not recommend adding further costs for household impacts.

2.4 Further Valuation Issues

The costs noted above themselves fall into three groups.

1. Costs that are general and independent of the incidence of any specific illnesses: government surveillance costs and business compliance costs.

2. Costs that may be associated with difficulty with specific illnesses or outbreaks: some government control costs and some impacts on business.

3. Costs that can readily be associated with specific illnesses: health care services, loss of output and household costs.

Whether group (2) costs are associated with specific diseases or outbreaks or treated as a fixed cost of foodborne illness depends on the data available and the purpose of the exercise. In the Australian study (Abelson et al. 2006) all costs incurred by government and by business in dealing with foodborne disease were treated as fixed costs over a year and not attributed to specific illnesses.

On the other hand, all health care, output losses and household costs can be estimated for each class of illness.

However the severity and cost of illness within each illness class varies according to whether the case involves hospitalisation, a visit to an emergency department, GP visits or is simply a self-care event. Thus it is necessary to estimate:

- the incidence of illnesses involving each of these health care categories and
- the average cost of an illness (inclusive of all relevant costs) in each category.

The average cost of an illness is the average of these costs weighted by their incidence.

Two other general points should be made. The first concerns prices. A constant level of prices should be chosen. This is typically the prices in the current or immediately preceding year. The choice is one of practical convenience. But all cost estimates should be based on a constant unit of value and relate to the chosen period (usually a year). If some costs are based on prices in an earlier or later year, they should be adjusted by an appropriate price index. This is discussed further in Section 4.

Second, when costs occur in future years due to sequelae they should allow for the time differences. Given that resources are being invested in order to provide future benefits (reduced illness costs) it is usually recommended that future costs and benefits be discounted by the rate of return that the expenditure could have achieved on other projects, which is known as the opportunity cost of capital. The appropriate rate is discussed in Section 4.6.

3 Estimating the Costs of Foodborne Disease

This section describes how each major set of costs may be estimated. Some of the discussion is straightforward but included for purposes of comprehensiveness. Other costs, for example some business and household costs, are harder to measure. Special attention is also given to the difference between estimates of total and variable cost. As has been noted, estimates of variable costs are generally more important when estimating the impact of a change in standards.

3.1 Government Regulation, Surveillance and Control Costs

To exercise surveillance and control costs, government carries out the following tasks:

- Regulation of food businesses
- Administration of regulations including inspections of food outlets
- Laboratory (human diagnostic and food monitoring) testing for pathogens potentially transmitted by contaminated food
- Maintaining foodborne illness surveillance
- Surveillance of specific infections
- Investigation of outbreaks of foodborne disease
- Monitoring of food recalls.

Estimating the costs of these tasks is conceptually straightforward. In each case the relevant service(s) must be identified, the quantum and unit cost of each service estimated, and usually an allowance is added for related overhead expenses.

However, there are often significant practical difficulties because of the variety of the tasks and the number of agencies involved. Also many agencies conduct multiple activities, so that allocating expenses to a particular activity involves specific survey work using a method like activity based costing.

The Australian study of foodborne illness costs (Abelson et al., 2006), which estimated costs for most of these tasks, drew on several studies of specific activities that had been made. These included studies of the costs of public health laboratory functions (Deeble, 1999), the surveillance of specific infections (Dalton, 2004), the investigation of outbreaks of infections (various studies, see Abelson et al, 2006) and the costs of the food regulation system (KPMG, 2006). Some of these studies may be due for up-dating. There may also be variable costs associated with incident management and recalls.

When considering changes to existing standards, the relevant issue is the *change in costs* to government. This can be estimated relatively simply by (i) specifying the changes in resources required in each case as a result of the change in regulation(s) and (ii) estimating the unit costs of these resources.

3.2 Business Costs

As has been noted, there are three main kinds of business costs.

- Compliance costs
- Costs of foodborne illness incidents: disruption and recall costs
- Other impacts on industry activity

Compliance costs. Estimating the total cost of complying with food regulations is complicated. In the absence of relevant reported statistics, a purpose designed survey is required. However, this survey needs to distinguish between business-as-usual (BAU) expenses (those expenses designed to promote quality foods and a high quality brand in local and international markets) and the cost of complying with food regulations. The Allen Consulting Group (ACG, 2002) estimated that the costs of compliance with food regulations in Australia were within a large range between $200 million and $600 million depending on the proportions attributable to BAU practices and regulation compliance. The ACG study is now dated and possibly of limited relevance and consideration could be given to updating it.

When a change to a standard is proposed, this will generally change (up or down) the resources that companies employ to comply with the regulations. Some changes will involve capital expenditure on facilities or processes. Other changes may result in changes to recurrent expenses.

The cost implications of a change in standards can usually be estimated because the relevant parties can be readily identified. The cost of the change (or the savings from it) will usually be estimated though consultation with the relevant industry. This may involve consultations with the relevant peak body (who may survey some of their members), direct consultations with affected companies or a formal survey of relevant companies.

However, the estimates provided by the industry are indeed estimates and may be influenced by the industry's attitude towards the change. If the industry wants to avoid the change, it may overestimate the costs of the change. If the industry is willing to accept the change, possibly to deter new entrants, it may underestimate the costs of the change. It may therefore be necessary on occasion to employ an independent industry expert to advise on, or in some cases to examine, the industry's cost estimates.

Cost of foodborne illness incidents The cost to a business of a foodborne illness incident may include:

- Recall costs: the costs of managing a recall
- Remedial costs: the costs of dealing with the cause of the problem
- Information costs
- Stock replacement costs or loss of sales
- Litigation expenses
- Temporary or even permanent closure costs.

The most common costs to business are recall and replacement / loss of sales costs. If stock is replaced, the cost is the expenses associated with collecting and disposing of useless stock and producing and distributing the new extra stock. If sales are lost, the affected business loses the revenue, which may be higher than the replacement cost. However, this may be offset partly by some increased profits accruing to alternative suppliers.

The litigation cost is the actual expense of litigation. Any award of damages transfers the damage cost from the consumer to the business but is not in itself a net social cost.

If a business is closed temporarily, the cost to the business is the loss of profits measured as loss of sale revenue less any savings in production costs. There may also be costs to labour (a loss of labor income) if any workers laid off temporarily cannot find

alternative employment. Again some of these losses may be offset by increased profits accruing to alternative suppliers.

The costs of permanent closure are the loss of income to owners of capital and labour due to the closure. If the plant and equipment of the factory can be re-used as productively as before and if all labour can find re-employment at similar wages, there is little, if any, fall in payments to capital and labour (i.e. minimal cost). However there may be some write-down in the value of plant and equipment and some loss of labour income in the medium-term over and above short-run costs.

Changes in food standards may reduce or increase the probability of a food recall (depending on the nature of the change) and so these are potential relevant costs. However the costs tend to be case specific and estimates of costs may be available for only a few cases so that findings on the average cost of foodborne incidents cannot be drawn with confidence.

In estimating the business costs of foodborne incidents in Australia, Abelson et al (2006) drew on a detailed case study by Applied Economics (2003) of the costs to oyster producers of oyster contamination in Wallace Lake (NSW) and on four case studies reported by Minter Elllison (2002). In addition, FSANZ provided five examples of the costs of recalls including press advertisements, stock costs, cost recovery, labour costs and other associated costs. The costs ranged from very low up to A$1 million with a mean cost of about $300,000 per recall. However these estimates may not have included all associated costs.

Other impacts on industry activity The impacts of food incidents on third parties was raised as a specific issue in the brief and is discussed in Section 4 below.

3.3 Health Care Service Costs

The six main sets of health care costs are:

- Hospitalizations
- Visits to emergency departments
- Visits to general practitioners
- Specialist services
- Diagnostic testing
- Medication expenses

In each case the total cost of an illness is the product of the **quantity** of services per illness and the **unit cost** of these services. The marginal cost or cost saving associated with a regulation is the change in total cost. This is a function of the change in quantity of services and their unit cost.

In terms of quantity, the desirable data would include the estimated changes in: the number of hospitalizations and average days per hospital visit, the number of visits to emergency departments, specialists and GPs, the number of stool tests and other tests, and the number of cases involving medications outside hospitals.

Generally *changes* in the quantity of health care services will be directly proportional to predicted changes in illnesses. The various illnesses will be associated with various quantities of health care services according to the type and severity of the illness. Thus as the number of illnesses change, so will the quantity of health care services.

In the 2006 Australian study the hospital data were available from hospital morbidity records and the all non-hospital data for gastroenteritis was available from the national gastroenteritis survey in 2001-02. A survey by Beach (2004) provided data on visits to GPs and the numbers for a variety of related tests for irritable bowel syndrome. Dr. Hall at the National Centre for Epidemiology and Population Health in Canberra provided best assumptions on the quantities of non-hospital services for the other sequelae and Listeriosis. All of these estimates for each illness were made separately for age-groups 0 to 4, 5 to 14, 15 to 64 and 65 and over for males and for females and summed to a total. It may be desirable to extend and update the database that relates health care services to various foodborne illnesses.

Determining unit costs for health care services is relatively straightforward. A similar process could be used to that employed in the Australian costing study by Abelson et al (2006).

- For estimates of hospital costs FSANZ would identify the most relevant diagnosis related group (DRG) for each illness and apply the relevant national average hospital cost for this DRG.

- For emergency department visits, FSANZ would apply an average triage cost for gastroenteritis and a higher (level 2) triage cost for listeriosis.

- For visits to GPs and specialists, FSANZ would adopt costs based on the Medical Benefits Schedule plus assumed co-payments, with higher costs for initial (longer) consultations than for follow-up visits.

- Costs of laboratory tests and medical imaging would be based on the Medical Benefits Schedule.

- There is no simple reference for the costs of medicines. The Government subsidy element can be obtained from the Schedule of Pharmaceutical Benefits on the Medicare website. In addition there are private co-payments and private

3.4 Loss of Workplace Output

The loss of workplace output is the product of the **quantity** of work time lost and the **unit value** of work time. The work time gained or lost as a result of a regulation would apply both to workers who are sick *and* to carers of dependants who would otherwise be working in paid employment.

Again the key driver would be the illnesses themselves. Total days lost will be a function of the type and severity of each illness. The changes in days lost will be a function of the reductions in illnesses.

The days of work time lost for each illness may be derived from a community survey. This has been carried out for AGI in Australia (Hal and the OzFoodNet Working Group, 2004), New Zealand (Adlam et al., 2007) and Holland (Kemmeren et al., 2006). The last two studies included time lost when caring for dependents. FSANZ may need to decide whether the Australian data are of adequate quality and whether the results need to be updated.

Days of work lost are usually valued at the wage rate plus direct overheads (such as superannuation and leave entitlements) of the individual who misses work. In a competitive economy this dollar amount approximates the value of the marginal product of workers. Where possible and practical these dollar amounts should be averages for the ages, classes and sex of the individuals involved. However, such detailed data are often not available and use of average daily earnings plus an allowance for direct on-costs suffices for most purposes.

This estimate of unit value assumes a reasonably fully employed economy. That is, there is not a ready pool of unemployed individuals who can immediately step into the vacated position with no overall loss of output in the economy. A reasonably fully employed economy is a reasonable assumption for Australia.

3.5 Other Costs to Households

As discussed above the total cost of foodborne diseases to households can be estimated as a product of the total burden of illness (expressed in years or days of disability) associated with an illness and a dollar value for that unit of disability.

To avoid double counting, any household costs (for losses of earnings or health care expenses borne by the household) that have been estimated elsewhere should be

subtracted from this gross amount to obtain the **residual** household cost. It can be assumed that employers bear the loss of output for most sick employees. However self-employed persons and some part-time workers would bear lost earnings from sickness.

The **total illness burden** is a function of the **quantity** of illnesses of each kind, the **lengths** of each illness, and the **disability weight** attached to each illness. The aim of most policy changes is to reduce this total burden, although in some cases a relaxation of a regulation may result in a small increase in the burden.

Estimation of changes in costs (cost savings or increases in costs) can be estimated in two ways. The simplest way is to assume that costs will fall directly proportionally with the estimated fall in illnesses.

Alternatively the analyst may estimate the change in illnesses (down or up) and the dollar value attached to each illness. **Following Equation (2.3) above**, estimates would be needed for:

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

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

As these issues were specifically raised as an application issue, methods for estimating these dollar values are discussed further below (In Section 4.3).

4 Specific Application Issues

4.1 Actual and Reported Disease Infection Rates

Actual disease infection rates are generally significantly greater than reported disease rates because many individuals with minor AGI do not see a GP or enter the health care system. For the purposes of estimating the impacts of foodborne disease or for the impact of a change in a regulation, the quantity and cost of these unreported incidents should be accounted for.

Drawing on the 2001-02 Australian community study, Hall and OzNetFood Working Party (2004) found a multiplier of 3.9 and this number was adopted by Abelson et al. (2006). In the community study gastroenteritis was defined as at least three loose stools or two vomits within 24 hours. This was said to include moderate and severe gastroenteritis and to be consistent with international standards, but to exclude minor episodes. However there is an economic value, albeit a small one, from avoiding vomiting even once on a 24 hour period. The multiplier would be higher if all minor episodes were included.

This may explain why higher multipliers have been found and adopted in other countries. In a recent New Zealand study (Lake et al., 2009) the estimated ratio of community cases to visits to GPs was 4.5:1. In an earlier study, drawing on UK data Cressey and Lake (2008) adopted a ratio of 7.8 actual to recorded cases for campylobacteriosis. The multiplier for unreported cases also appears to be higher in the Scharff et al (2009) study for Ohio based on Mead et al. (1999) estimates for the United States.

Estimates of the *quantity* of unreported illnesses may be based on international research, local expert opinions or a local community survey, or from a combination of these. However, as noted, these estimates may vary with the definition of an illness.

Given that the extra unreported cases are mild and low cost, the impact on total cost is a much smaller than the multiplier impact on number of cases. The average cost of an illness will also change with the severity of the illness included in the count of illnesses.

Turning to the *unit cost* of an unreported illness, this is the product of the impacts (days off work or amount of disutility and so on) and the costs associated with these impacts. The kinds and quantities of the impacts of unreported diseases may be derived from international or local research, again noting that these may depend on the definition of an unreported illness. However the costs associated with these impacts should be based on the local (FSANZ) costing methods and parameter values.

4.2 Indexation of Values

The concept of indexation applies to the treatment of prices (not quantities) over time. As noted in Section 1.4, most cost-benefit studies are conducted in “constant” prices. These are the prices that apply at a given time, such as 2010. This is in contrast to studies in “current prices” which vary each year with inflation. However, a cost-benefit study conducted in 2011 or 2102 may be based on 2011 or 2012 prices respectively.

There are two main and partly related issues. One is how to allow for changes in the general price level. The other is whether and how to allow for changes in real (or

relative) prices over time. The latter occurs when some prices or values rise more or less than average prices or values.

A simple way to allow for changes in price levels is to pro-rate them with a change in an established price index such as the consumer price index (CPI) or a producer price index (PPI) The CPI is an index of the prices of goods and services consumed. The PPI is an index of the prices of goods and services produced domestically.

The CPI and PPI are usually very similar. The use of one index across all goods and services would simplify valuation processes and may be of adequate accuracy for many purposes. There is likely to be much greater uncertainty over the kinds and quantities of the impacts than over their unit costs. But over time application of a universal price index may be quite inaccurate for some values.

Our suggestions for indexing prices for the five major sets of costs identified in this report are as follows.

- Costs to government: index by PPI without imports (ABS Cat. No 6427.0)
- Costs to business: index by PPI without imports (ABS Cat. No 6427.0)
- Health care costs: index by costs of health care services estimated as part of CPI (ABS Cat. No 6401.0)
- Loss of productivity: index by average weekly earnings (ABS Cat. No 6302.0)
- Personal loss of function and disutility: index by average weekly earnings (ABS Cat. No 6302.0).

It will be noted that the first three indices are price indices and the last two are earnings indices. Earnings usually rise faster than prices (as real incomes rise). Put another way, prices generally rise less fast than labour earnings because increases in productivity offset part of the increase in payments to labour. We are also assuming above that productivity in government will rise as fast as in the private sector. This is sometimes questioned.

The above suggestions also imply that losses of productivity and personal disutility will become relatively more important with the passage of time – for studies done in say 2012 rather than in 2010.

This leads into the second issue identified at the start of this sub-section. This is whether costing studies *in a given year* should incorporate real annual increases in the value of lost output and disutility over time. Strictly this is implied by the above suggestions.

However, consistent with the advice of the Office of Best Practice Regulation (OBPR, 2008) this paper recommends that such potential real increases in values over time not be incorporated in a costing study. The main reason for this is ethical. Allowing for real

increases in the disutility of illness over time would reflect greater incomes and hence willingness to pay to avoid illness. It would give greater weight to the disutility of households with higher incomes and to avoiding illness in say 2015 than in 2010. This does not seem appropriate.

There is a stronger case for allowing for productivity increases over time. In this case, this report inclines to support a constant value for productivity on grounds of simplicity and conservatism of estimation. But increasing values for productivity over time in line with historic increases would be a defensible practice.

4.3 Estimating Health Loss of Individuals with Disability Weights and Willingness to Pay

In this section we briefly discuss estimates of disability weights and average days per illness and then discuss in more detail the value of a year or day in good health.

Mathers et al. (1999) is the main source of information and expertise on disability values in Australia. This report was the basis for the estimates of disability per illness in Abelson et al. (2006). Where Mathers et al. does not provide a direct estimate of disability, a best approximation may have to be made.

Kemmeren et al (2006) also provides well-researched disability weights for intestinal illnesses, which were applied initially in the Netherlands. These weights also form the basis of the disability rankings employed in New Zealand (Cressey and Lake, 2007 and 2009). Scharff et al. (2009) use equivalent quality of life measures for their estimates of the cost of foodborne disease in Ohio.

A complete review of disability weights and their application is beyond the scope of this paper. However it is apparent that there is an adequate data base for the derivation of disability weights for the major foodborne illnesses.

Abelson et al. (2006) provides data on the length of various foodborne illnesses in Australia. These data may need to be updated, but this should be available from a central agency such as the Australian Institute of Health and Welfare or from state health agencies.

Turning to the dollar cost of disability, this is usually generated from the value of statistical life (VSL) relevant to the country. The value of life is usually referred to as a value of a statistical life (VSL) because this value refers to the life of any unknown person rather than the life of a particular or known person. In Australia, OBPR (2008) recommended a VSL of $3.5 million in 2008 prices for general policy purposes.

Typically the value of a life year is assumed to be a constant annual value which when discounted over 40 years equals the full value of life. The outcome is sensitive to the rate of discount adopted. However for this purpose it is usual to adopt a time preference rate of discount of the order of 3%. Therefore for a value of life of $3.5m, the value of a life year would be $151,000.

$$\$3.5m = 151,000/1.03 + 151,000/(1.03)^2 + \ldots 151,000/1.04)^{40} \quad (4.1)$$

Conversely, the burden of disability adjusted life year would be $151,000. And the burden of a disability adjusted life day is $151,000 / 365 = $413. Conversely this is the value of healthy life day.

Given the way that the value of a quality adjusted life year is estimated, this represents the full value for avoiding the illness, including what individuals would be willing to pay to avoid loss of wages and payments for health care services. This is why any loss of earnings or health care expenses borne by households and estimated elsewhere should be deducted from household costs estimated using this method.

The cost of early deaths

The premature loss of life years is also a product of the expected life years lost and the value of a relevant life year. People who die from a foodborne illness are often elderly and have a pre-existing illness. Unlike the typical victim in a road accident who loses 40 or 50 years of life, they may lose 10 or fewer years. In this case the loss may be viewed as the loss of an expected number of life years.

If a year is worth $151,000, 10 years of lost life would be valued at:

$$\$1.29m = 151,000/1.03 + 151,000/(1.03)^2 + \ldots 151,000/1.03)^{10} \quad (4.2)$$

Note that is this case a 3% discount rate is used because the discount rate reflects the rate at which individuals discount time (known as the time preference rate) rather than the opportunity cost of capital

However, another group that may be disproportionately represented in the mortality figures is children. The convention is to value loss of a child's life at the full VSL.

4.4 Estimating Third Party Effects

When a foodborne incident is a major one with significant media coverage, there may be costs not just to the business directly implicated but also to the industry and in some cases to related industries. These costs may be especially significant if an industry loses

brand reputation in export markets as well as in the domestic market. The following two examples are cited in Abelson et al. (2006).

In a study of the outbreak of hepatitis A due to consumption of contaminated oysters from Wallis Lake in NSW, Applied Economics (2003) found that the oyster farmers around Wallis Lake bore a loss of net income of $0.5 million a year in both the year of the incident (1997) and for a few following years, that the local fishing industry may have incurred a small loss of about $0.20 million in 1997, and that there may have been small tourism losses. However the study did not find any evidence that oyster sales from other producing areas in NSW suffered from the incident.

In Adelaide in South Australia, in 1995 about 190 people suffered illnesses linked to eating mettwurst contaminated with *E.coli 0111*. Twenty-three children were hospitalised, five suffered long-term effects and one child died. The supplying business closed down but more relevantly here there was a reported 50% decline in sales of certain lines of processed meat. ANZFSA estimated that this outbreak cost the relevant small goods industry $400 million. However Minter Ellison (2002) noted that given that any loss of expenditure on these foods would be replaced by expenditure on other locally produced foods, the net cost to Australian industry would have been much lower than this.

In so far as food safety regulation succeeds in reducing major food outbreaks, these "other industry costs" may be a significant component of the potential benefits. However, given the variety of circumstances, it would be inappropriate to adopt a single figure as a plug-in for all cases.

In the few references on food costs that we have surveyed recently we have not seen any further discussion of this issue. However, more research would doubtless bring up more international and possibly Australian cases. Such research may well be viewed as a priority piece of work.

One other caveat should be made. The net cost to the economy is the loss due to the reallocation of expenditure from one business or industry to another business of industry. It is not the gross loss of revenue or even of profit to the firm responsible for the foodborne incident. In some cases other firms in the industry will also lose as a result. On the other hand, firms supplying substitute goods will gain from the incident. However when exports are lost, the costs to Australian industry may be higher because many of the substitute suppliers will be overseas competitors.

4.5 Treatment of Risk and Uncertainty

Three main issues arise in the treatment of risk and uncertainty: reducing risk (or uncertainty) by improving the information base, describing risk and the policy implications.

First, risks may be reduced by obtaining more information. Thus an initial exercise may determine the estimates subject to greatest variance and the estimates that can be most improved by application of a modest amount of study resources. A limited review of some existing FSANZ proposals suggests that there is greatest uncertainty in the causes of foodborne diseases rather than in the impacts of these illnesses or in the unit costs of these illnesses and that this uncertainty is not easy to reduce in the short-term.

Second, turning to the description of risks, ideally estimates of the cost of foodborne diseases or of the cost savings of changes in regulations would include an estimated frequency distribution of the costs or cost savings (or net social benefits, NSB). However, this may often be viewed as impractical given the many uncertainties and large number of assumptions required to estimate costs or NSB. If so, a cruder form of judgment may be the best that can be achieved. In the Australian study, Abelson et al. (2006) concluded that there was a probability of over 90% that the actual foodborne illness costs would be within 25% of the estimated costs. This was based on expert judgment rather than on statistical analysis of key variables.

Third there are the policy implications of any estimate of cost savings or net benefits of a policy change. If the estimated outcomes are regarded as highly uncertain or subject to large variance, a delay in decision making and an investment of resources in improving information may be the appropriate policy response (if there is a realistic possibility of obtaining improved information). In other cases, a pilot scheme or an incremental approach to introducing new standards may be warranted.

If such strategies are not available, the policy maker (the government) will have to make a decision based on best information available. If this is not a full frequency distribution of the estimated NSB (positive or negative), the information should contain some estimate of the likely mean NSB along with some information about the range of the NSBs and the probabilities of positive or negative NSBs occurring.

4.6 Timeframe of Analysis and Discount Rate

The general convention regarding timeframes for costs or cost-benefit analyses is that the timeframe should reflect the realistic economic lifespan of the project or policy. In the case of a project with major capital expenditure this may involve a major physical asset with a life of 30 or more years. Use of the asset is related to its continued maintenance and economic utility.

However policy changes may have a more limited actual or potential lifespan. In the case of food standards, businesses may respond to a policy change with limited capital expenditure and capital assets with a life of less than 10 years. Most of the changes may involve changes in operating processes, management and recurrent expenditures. In these cases regulations that do not produce a net social benefit within 10 years are unlikely to produce a net social benefit over a longer period.

The view of this report is that most regulatory changes regarding food can be assessed adequately over a 10 year period. Where capital assets with longer lives are created or where there are significant longer-term implications, perhaps those involving the regulations of genetically modified foods or loss of export trade, it may be appropriate to consider a longer period. It is generally a simple practical exercise to incorporate a longer period into the analysis. The main issues would be forecasting problems.

Turning to the choice of discount rates, this report concurs with the recommendation in the *Handbook of Cost-Benefit Analysis* (Department of Finance and Administration, 2008) that the social opportunity cost of capital, sometimes referred to as the producer rate of discount, is generally the appropriate rate of discount. This ensures that resources are used efficiently. In the context of food producers, this ensures that the rate of return on expenditure on food safety is a high as the rate of return on meeting other consumer preferences.

As far as this consultant is aware there is no formal Australian Government recommendation covering the actual discount rate to be used. The *Handbook* does not recommend any specific rate of discount. The Australian Government Guidelines for Preparing Submissions to the Pharmaceutical Benefits Advisory Committee (version 4.3, 2008) recommend use of a 5% real rate of discount.

This is on the low side of most recommendations. The NSW Treasury (2007) recommends the use of a 7% real rate of discount to be applied to projects and policies. We believe that this rate of discount is generally accepted as a realistic rate to reflect an appropriate real-risk free rate of return in the private sector (see Abelson, 2010).

4.7 Break-Even Points

Break-even points are usually estimated in time (years) or turnover (in the case of food safety this would generally be the percentage or number of illnesses avoided). So long as the concept of the discount rate is maintained, the breakeven point may be expressed equally well in terms of time or illnesses avoided. The discount rate allows for benefits and costs occurring at different points in time.

The use of a breakeven point assessment has two advantages. First, it avoids the need for precise estimates if it can be shown that a policy will at least break even (and may

show a small net benefit) with conservatively estimated benefits. Second it may be a useful indicator of the risk attached to a policy change. If the breakeven point is in only a few years ahead or at a low rate of illness avoided, the change is relatively low risk.

5 A Practical Evaluation Process

5.1 Introduction

For evaluations of most changes in regulations there are six main steps:

1. Identification of key problems and issues
2. Establishing Base Case incidents and costs
3. Establishing options
4. Estimates of costs of options
5. Estimates of benefits of options
6. Determining any other issues and establishing conclusions.

The main practical issues with respect to these six steps are discussed briefly in this concluding section. The discussion draws in large part on earlier sections and we have tried to avoid repetition.

The outlined evaluation format is consistent with that used in existing FSANZ Proposals for regulatory changes (e.g. FSANZ Proposal P282, 2010; FSANZ Proposal P301, 2009). These Proposals involve a strengthening of the regulations on poultry farmers and egg producers respectively.

In other cases, such as the Raw Milk Proposal (P1007, 2009), some standards for food production may be relaxed. The principles of the evaluation will be similar but the costs may be a minor health safety risk along with additional government monitoring and the benefits may be increased consumer choices. It is not possible to design a one-size template for all applications.

5.2 Key Problems and Issues

An accurate analysis of the size and type of problem to be resolved and of their cause(s) is essential to the development of good cost-effective standards.

As Adam Smith (1776) once observed about the role of government in the economy - the cure must be less costly than the disease. The disease, in this foodborne illness, needs to be of some substance to warrant a regulatory response.

Accuracy of diagnosis is critical to the cost-effectiveness of a cure. If the regulator does not have an accurate idea of the cause of a problem, the imposition of regulations across the board may impose unnecessary costs on businesses that do not relate to, or deal with, the cause of the problem.

5.3 Establishing Base Case Foodborne Incidents and Costs

All costs and benefits of a regulation should be estimated relative to a no policy change scenario, which is generally called the "Base Case".

This involves (i) estimating the quantum of illness by type and severity in the Base Case and (ii) the unit cost of each type of illness. Methods for estimating the number and type of incidents and the costs of illnesses have been described in earlier Sections 2, 3 and 4.

As described earlier, the Base Case costs are likely to include health care costs, loss of output and household disutility and pain and suffering and may also include other costs to government and businesses (see especially Section 3). If fixed costs associated with foodborne disease are included, they should be distinguished clearly from variable costs.

Ideally in an evaluation of a regulation the estimated Base Case cost should be related to the problem to be resolved or ameliorated. For example, if the problem is associated with campylobacteriosis in poultry or salmonella in eggs, the Base Case costs would be the *variable* costs associated with these diseases and products.

Estimating this Base Case cost is often difficult because the specific causes of illnesses are often not known except when illnesses are reported from specific foodborne incidents. Some information may also be obtained from community surveys.

However the attribution of the costs of foodborne illnesses to all specific causes should sum to the total cost of foodborne illnesses. To ensure overall consistency of estimated costs it would be useful if FSANZ research could establish approximate total and variable Base Case costs and the attribution of the variable costs to diseases and products.

5.4 Establishing Options

The range of possible policy options include:

- Legal liability, letting markets and courts determine outcomes
- Education and/or labelling, putting the responsibility on consumers

- Self-regulation, putting responsibility on producers
- Co-regulation, sharing responsibility between businesses and government
- Light regulation, light government action with penalties for non-compliance
- Moderate regulation, stronger actions and higher penalties for non-compliance
- Strong regulation, more prescriptive government controls and higher penalties.

There is no fixed set of options for each proposed regulation. Generally the less serious the problem (lower the Base Case costs) the lighter the likely policy response can be. The higher the Base Case costs the stronger the policy response would need to be. In this case there is little likelihood that the softer options will be effective.

The relevant options need to be developed in each case. Some policy options may be combined with others. Generally it may be expected that at least three policy options should be considered. This may include greater or lesser levels of regulation.

Two other points may be noted. First as noted earlier, one operational option is to obtain more information and defer making a determination. Another option is to set sunset clauses on a regulation so that it must be re-evaluated before it can be extended.

5.5 Estimates of Costs of Options

The major costs of most regulations will be the additional production and management costs imposed on businesses. These are likely to be both capital and recurrent costs. As discussed in Section 3, estimates of these costs would usually be obtained in the first instance from the businesses concerned although they may not always be a reliable source. These costs may be passed on to consumers, but who actually bears these costs finally is a separate issue.

Government may also bear extra costs in the form of additional monitoring and surveillance costs.

Thirdly, households may also bear some costs in the form of restricted products. This cost has not been discussed previously but it may be relevant to some food safety regulations. For example some households believe that regulations on raw milk products restrict the variety of products that may be based on raw milk.

Following standard valuation principles the net loss from restricted products is the difference between the maximum price that consumers are willing to pay for the banned product and the cost of producing it. This loss would be hard to value accurately but may be a relevant consideration in some cases.

5.6 Estimates of Benefits of Options

The major benefit of a food safety regulation is the reduction in foodborne disease costs compared with the Base Case.

The critical estimate is the proportion of foodborne diseases avoided as a result of the regulation. The confidence with which this proportion can be forecast is related directly to the regulator's knowledge of the causes of foodborne incidents in the Base Case.

Another key factor is the effectiveness of the regulations and the extent to which the regulations actually change the behaviour of businesses or consumers. This may depend in part of the efficiency of the monitoring arrangements.

Given that the change in foodborne disease can be estimated, if the fall in disease is uniform across all forms of illness, the benefit is a simple function of the size of the Base Case costs and the percentage fall in illnesses.

If the fall in disease varies with type and severity of illness, the reduction in numbers of each type of disease will have to be estimated and the benefits would be a function of these reductions and the unit cost savings for each type of disease.

5.7 Other Issues and Conclusions

The estimated net benefit will be the estimated benefits less costs. The net benefit is then discounted back to the present to provide an estimated Net Present Value (NPV) of a regulatory change. The estimated NPV may be positive or negative. Other things being equal, this would indicate an efficient or inefficient regulation respectively.

Other factors that a policy maker may wish to consider are unquantified factors, risk and uncertainty and distributional effects. In so far as the evaluation has not been able to forecast or quantify some potentially substantive effects, such as loss of consumer choice, this should be reported. Second, as discussed in Section 4.5, when there is significant variance in the projected results, policy makers should be informed of this in so far as it can be described. Policy makers may be more concerned about infrequent events with potentially large costs than with many small sets of costs. Third, policy makers may have a view about the distributional effects. They may believe that agencies that produce food should be more responsible for food safety issues and that consumers should be protected from unsafe products for which they are not responsible.

These other factors do not change the methods or estimates in a cost-benefit evaluation. However some discussion of the risks and distributional effects may be included in a report on an economic evaluation.

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