



The Economic Impact of Gastroenteritis on the Island of Ireland

Report to safefood



safefood

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Report to safefood (The Food Safety Promotion Board)

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Executive Summary

The main objective of this study was to estimate the economic burden of gastroenteritis on the island of Ireland.

The approach taken was to estimate the number of cases of gastroenteritis in a year, and the proportion of these cases that used the different health services using routine data, the overall costs to hospital and primary care services, costs to individuals and their families and friends, and costs to the economy. An additional output of the study was an estimate of the severity of the disease as measured by the need for hospital or community health services.

Although there have been studies of costs of gastroenteritis in other countries (examples: Hellard et al. 2003, Lopman et al. 2004), this is the first attempt to quantify the cost of gastroenteritis on the island of Ireland. A study of the rates of gastroenteritis on the island based on a telephone survey was carried out in 2000/01 (*safefood*, 2003).

Electronic data was acquired on the number of cases presenting to out-of-hours (OOH), to in-hours primary care services, and the hospitalised. It was possible to collect data for all hospitals that provide treatment for gastroenteritis in the Republic of Ireland (ROI) and Northern Ireland (NI) (with the exception of the Bon Secours private hospital in Glasnevin, Dublin). OOH data was collected for services that cover 38% and 80% of the populations in ROI and NI respectively. 25 GP practices (61 practicing GPs) supplied the data relating to in hours GP services. Because the hospital services and OOH primary care data relate to the majority of the population presenting with gastroenteritis on the island of Ireland, the denominators used were the general population and it is possible to place a large degree of confidence in the estimates. The sample of in-hours GPs was to cover different strata as they represent a smaller proportion of all GPs in the island, estimates of the population at risk are more problematic and estimated rates (and therefore costs) for the different strata (i.e. gender, age and types of location) are tentative but this does not materially affect the overall estimated burden.

The methods used in this study do not allow direct estimation of rates of the disease in the population that did not contact any formal health service. The proportion of cases that access in-hours GP services has been relatively constant from other studies and this proportion was used to derive estimates of the rates in the population. Although this is likely to be less precise than estimates from prospective population studies, cases not presenting to the health services tend to be relatively mild and, even though the numbers are large, their associated costs are low and errors in the estimation of frequency will not greatly affect the overall estimated cost of disease to the health services.

Although the cost of health services makes up a large part of the economic burden of gastroenteritis, a significant burden falls on patients, families and friends. To obtain estimates of the time off work for patients and their carers, as well as the costs to families, a survey of patients was carried out. The main aim of the survey was to gather data on family costs.

Results – Rates

The main estimates of the rates of gastroenteritis per 1,000 person years are shown in Table A.1. The rates found in the Telephone Survey are provided for comparison. The Telephone Survey used a number of different definitions of gastroenteritis and the definition included in Table A.1 is the nearest match to the definition of gastroenteritis used in this report.

Table A.1: Rates of gastroenteritis per 1,000 person years, from routine data and from Telephone Survey

	Routine Data		Telephone Survey
	ROI	NI	ROI and NI
Hospitalised	1.0	1.1	13.6
Presenting to GP in-hours	46	28	171
Presenting to GP out of hours	38	40	-
In the community	168	104	754

As can be seen, results from routine data suggest that rates of hospitalization are very similar for ROI and NI; there is a greater rate of presentation to GP in-hours practices in ROI than in NI, resulting in a higher estimate in the community rate in ROI than NI. ROI and NI differed in the relative proportions of patients using in-hours and OOH GP services – in NI the OOH rates were much greater than the in-hours rate.

Estimated rates were much higher in the Telephone Survey than in our study. While it is possible that the methods used in this study have underestimated rates presenting to primary care and those not presenting at all, it is unlikely that the rate of hospital attendances is more than ten times than that found in hospital records. Therefore in this study, we report the estimated costs of gastroenteritis based on our estimated rates from routine sources and based on the Telephone Survey findings.

Results – Costs

This study used vectors of unit costs to estimate the costs associated with the rates of gastroenteritis presenting in each setting. Deriving the cost vectors is not straightforward, and we present results of sensitivity tests applied to the different approaches used to estimate unit costs. The costs of hospital services were estimated on the basis of the best available routine data for services for this disease. In both jurisdictions, there are case mix adjusted cost estimation systems and these were used.

Costing the use of primary care services is more difficult since almost all patients in NI are provided with GP services free at the point of use, with GPs mainly paid a capitation fee. In ROI this is the case for only about a quarter of the population who have medical cards or GP visit cards, and others pay fees set by the GPs. In principle, there is no difference in the service received by the two categories of patients in ROI. It would not be appropriate to cost them differently, so estimates were made using both bases. Costs falling on families and friends were estimated from the patient survey. Costs of time off work were estimated on the basis of the occupation of the person concerned. Travel, phone calls and other costs were estimated from the distances and frequency involved. Where respondents reported indirect expenditure, this was included in the estimates of the total burden.

The tables below present the estimates of the total cost of gastroenteritis per annum for ROI, NI and the island of Ireland. The average cost is similar for the two jurisdictions, although the slightly lower rates in NI and the slightly lower costs of treatment mean that per capita costs are slightly lower in NI.

Table A.2: Total costs of gastroenteritis in ROI, NI and on the island of Ireland (presented in Euros and in Sterling)

Type of Cost	ROI	NI	Island of Ireland
Currency: Euros			
Hospital	€5,755,763	€3,016,349	€8,772,112
Out-of-hours	€33,617,694	€15,762,917	€49,380,611
In-hours	€42,845,977	€10,466,509	€53,312,487
Community	€19,399,623	€4,739,616	€24,139,239
Totals	€101,619,057	€33,985,391	€135,604,449
Currency: Sterling			
Hospital	£3,885,002	£2,035,963	£5,920,965
Out-of-hours	£22,691,137	£10,639,591	£33,330,727
In-hours	£28,920,006	£7,064,642	£35,984,649
Community	£13,094,280	£3,199,127	£16,293,406
Totals	£68,590,425	£22,939,323	£91,529,748

The overall cost of gastroenteritis for the island of Ireland is conservatively estimated at approx. €135 million (£90 million). This is the potential saving to the economy if measures were successful in preventing all gastroenteritis, and provides the benchmark against which potential preventive measures can be assessed.

1. Introduction

Assessing the economic burden of a disease enables a better understanding of the financial impact of the disease on the economy and can be used to inform decisions on measures to reduce disease.

There are two main criticisms of this type of study. First that the economic burden cannot estimate the suffering, and second that it does not include the effectiveness and cost-effectiveness of measures to reduce it. However, in the case of a common, usually mild, disease, the scale of the burden is often unknown and the extent of potential gains from reducing the burden tends to be underestimated. Perceived economic pay-off is increasingly central to setting up political priority for action and so disease burden must be estimated rigorously.

There is a growing awareness of food borne communicable diseases; measures are available to reduce the rate of gastrointestinal disease. It is hoped that this study will provide some additional understanding of the potential monetary savings of such measures.

2. Background

2.1 Background to the study

Gastroenteritis is an illness of the digestive system caused by infectious agents; usual symptoms are diarrhoea and vomiting. The majority of gastroenteritis cases are caused by infectious agents.

The illness is associated with significant costs to health, social care organisations, families and informal carers (Food Standards Agency (FSA) 2000, Roberts, Sockett and Gill 1989, Sockett and Roberts 1991, Fischer and Molbak 2001). Difficulties in assessing the economic burden include lack of information on incidence of the disease (FSA 2000), limited information on patterns of treatment and care and a poor understanding of how the disease affects families. Estimation of the number of cases of gastroenteritis is not straightforward as not all cases involve contact with formal service providers, and are not recorded. Patients who do not access a formal service still incur costs to themselves, their families, employers and society. Much of the treatment provided is within primary care, although a proportion of patients receive secondary and tertiary care with very high costs, but there is considerable variation in treatment and referral (Nathwani 1994). The primary aim of this report is to assess the economic impact of gastroenteritis on the island of Ireland, for individuals, families, informal carers, primary care and hospital services and on society in general.

To calculate the economic impact of gastroenteritis, it is necessary to derive accurate estimates of the number of people affected as well as the direct, indirect and opportunity costs incurred by these groups. We were helped in this by two studies: a recent Telephone Survey (**safe food** 2003) in the island of Ireland (from here referred to as the Telephone Survey) and from a large study of incidence and costs in England (FSA 2000). A problem in estimating the economic impact of gastroenteritis is the uncertainty around the incidence of disease. The Telephone Survey and the FSA (2000) studies estimated very different levels of gastroenteritis. The Telephone Survey estimated that 60% of individuals in the island of Ireland have an episode of gastroenteritis every year, and the FSA found 20% incidence in England. In fact higher estimates have consistently been found in telephone surveys based on reporting recall of disease over a past period than in prospective studies, where gastroenteritis is reported as they occur, and it has been argued that telephone surveys may suffer from 'telescoping' where the reported number of incidents is exaggerated by the inclusion of cases outside the period of recall (Wheeler et al. 1999).

It is traditional to think of the rates of gastroenteritis at different levels of the system as a pyramid. At its base are the rates of gastroenteritis in the community, independently of whether they present to any service. This is followed by the rates that present to in-hours and OOH primary care. At the top are the rates of hospital admission (Wall et al. 1996, Wheeler et al. 1999, **safefood**, 2003). This study reproduces this 'pyramid' using primary data collected from in-hours and OOH primary care practices. It uses secondary data to estimate the rate of admission to secondary care facilities and uses the estimates of **safefood** (2003) and FSA (2000) to calculate the incidence of the illness in the community, independently of whether they presented or not to any health service. These rates are used to get an estimate of the economic cost of gastroenteritis across the island of Ireland, inclusive of hospital, primary care, personal and family costs. The economic cost is calculated based on a combination of routine data on use of services, some secondary data from other studies and primary data from a survey of patients who presented to primary care with gastroenteritis.

The study also provides estimates of costs and rates by deprived/non-deprived and urban/rural strata with wider confidence intervals. Denominators for the strata are tentative and therefore these are indicative only.

The estimated average cost of a case of infectious intestinal disease (IID) in England was £79 at 1993-1995 prices (FSA, 2000). About 36% of this cost falls to the NHS, 8% is a direct cost to the case and 55% is a cost to employers in lost production by the case or a carer. The average cost of a case presenting to a GP is £250. This varies significantly depending on severity. The Telephone Survey indicated that because of gastroenteritis approximately 1.5 million working days are lost, corresponding to €173.5 (£114.0) million in lost earnings. This study contributes to the body of knowledge by providing an alternative estimate of gastroenteritis for all levels of the community. That is, an estimate of case numbers that do not present to a health service, that present to in-hours and OOH primary care services as well as an estimate of those who spent time in hospital. Estimates are also provided for the economic burden of the disease on families and carers, as well as an overall estimate of the socio-economic burden and its distribution.

2.2 Background to the health system

2.2.1 Health system in ROI

The Health Service Executive is responsible for allocating health system resources and the direct delivery of some parts of hospital and community services. Every individual who is a resident in the ROI is entitled to receive some or all of in-hours and out of hours GP care and hospital care free of charge with costs borne by the state, with small charges for most individuals for hospital emergency services. Individuals are in one of three groups: medical cardholders, GP visit cardholders and non-medical cardholders. The latter group is entitled to free hospital care (except for small in-patient and outpatient charges). Medical cardholders (28% of the population) receive all three services free. The General Medical Services (GMS) scheme also provides GP visit cards to individuals whose income is just above the medical card limit. This entitles them to free GP care but otherwise they have the same entitlements as non-cardholders. Approximately 52% of individuals are privately insured. Depending on the policy some or all of hospital services and some GP services are covered. Those without insurance who use private hospital care pay full fees themselves.

Prescribed drugs and medicines (with a few exceptions) are received free by medical cardholders and those with a long-term illness. Every other resident is subsidised under the drugs payment scheme once they are registered and pay a maximum of €85 per month for approved prescribed drugs and medicines. A family maximum payment is also €85.

In-hours GP services are supplied by approximately 2,030 GPs. GP practices can see GMS and non-medical card patients. It is required by the state that GMS patients register with a GP; non-GMS individuals are not required to register. GPs receive payment at time of consultation from non-medical card patients and are paid by capitation for GMS patients registered. The fact that not all individuals are registered in GPs means that there are no clearly defined populations at risk for the estimation of rates of patients presenting to GPs.

Data from 20 ROI GP practices are included in our study. Information on gastroenteritis patients was collected from 01 May 2004 to 30 April 2005. This information includes date of event, age, gender, date of birth, diagnosis and prescription data (where available). Data specific to the practice includes the percentage of GMS patients, patient list size, location, list of services provided and their fees, social deprivation and age/gender breakdown of the patient list.

Out-of-hours (OOH) GP care is supplied by 12 OOH co-ops in ROI. OOH co-ops supply some or all of the following services: nurse advice by telephone, doctor advice by telephone, home visit by a GP and a consultation with a GP in a treatment centre. Eight of these co-ops operate in eight of the former health board regions in ROI. These co-ops operate from 6pm-8am Monday to Friday and 10am-8am Saturday and Sunday and consist of a call centre and a number of treatment centres. The remaining four co-ops operate from 6pm-10pm Monday to Friday and 10am to 6pm Saturday and Sunday. These co-ops are based in Dublin and operate on a smaller scale, combining one treatment centre and a call centre in the same premises. The data for this study cover six of the larger and two of the smaller co-ops. The data gathered on gastroenteritis cases includes date of event, age, gender, date of birth, type of service received, assessed priority, diagnosis and treatment. Additional data gathered on individual co-ops include location and number of centres as well as type and price of services provided.

Hospital care is supplied by approximately 100 secondary care facilities, but only some of these treat gastroenteritis. The data used in this study was obtained from the Hospital In-Patient Enquiry Scheme (HIPE), which is the main source of data on discharges from acute hospitals in ROI. HIPE collects data from 69 hospitals and all but one (Bon Secours private hospital in Glasnevin Dublin) of the hospitals which treat gastroenteritis are included. Therefore this data set is close to being a census of gastroenteritis cases that were hospitalised.

2.2.2 Health system in NI

Healthcare in the United Kingdom is mainly supplied by the National Health Service (NHS), which was set up in 1948. In NI there are four Health and Social Services boards; the Eastern, Western, Southern and Northern Board. These boards are responsible for assessing the health needs of their populations and supplying services to meet these needs. Among the services provided are in-hours and OOH GP and hospital care. Patients pay no fees. The NHS also provides funding for free prescriptions for individuals who meet certain criteria. (http://www.centuralservicesagency.com/display/prescription_changes). Individuals have the option to use private care for a fee. It is possible to purchase private health insurance but this is not common and only a small minority have health insurance.

In-hours GP care is, for the most part, supplied by one of the NHS's 350 GP practices. Individuals register with a practice in their area. This report includes data from five NHS practices, collected from 01 May 2004 to 30 April 2005. As before, date of event, age, gender, date of birth, diagnosis and prescription data (where available) have been gathered. Practice specific data gathered relates to patient list size, location, list of services provided, and deprivation status and age/gender breakdown.

OOH co-ops exist in NI to supply primary care outside normal surgery hours. There are seven of these organisations within the four boards. The Northern, Western and Southern boards each have one co-op and there are four co-ops in the Eastern Board. Each co-op supplies some or all of the following services: doctor advice by telephone, consultations with a GP at patient's own home and consultation with a GP in the practice. Nurse consultation by phone is not offered here, but by NHS Direct (see below), and doctors do their own triage. The data gathered is from the Northern, Western and Southern Boards, and from two of the four co-ops in the Eastern Board. Consistent with the data gathered for ROI, details on date of event, age, gender, date of birth, type of service received, assessed priority and diagnosis, have been extracted. In addition data was gathered on the co-op's location and number of centres as well as the type and price of services provided. A further type of primary care offered to UK residents by the NHS is known as NHS Direct. This is a 24 hour service that allows individuals to speak to a nurse via telephone about their health problem. The nurse will then advise the patient on the most appropriate course of action. The aim of this service is to reduce the number of individuals with minor medical problems seeking primary or hospital care unnecessarily and to provide reassurance to anxious callers. If the symptoms are deemed more serious, the caller is advised on the appropriate action and, if necessary, NHS personnel will make the appropriate arrangements. Data for NHS Direct was not gathered for this study. This will not bias the rates of presentation to GP as NHS Direct nurse advice is not a GP consultation.

The majority of individuals receive their hospital care free of charge from one of the NHS hospitals in NI. Data for this study was obtained from the Department of Health, Social Services and Public Safety from their hospitals' in-patient system. A full list of NHS acute and community hospitals is available at <http://www.n-i.nhs.uk/index.php?link=hospitals>, and all of these hospitals are included in the sample. Because few opt for private care for the treatment of gastroenteritis it is likely that the sample is close to including all cases.

3. Methods

3.1 Rates of gastroenteritis

3.1.1 Introduction

This section describes how the rates of gastroenteritis were estimated for hospitalised cases, GP in-hours cases, for GP OOH cases and cases in the community. These estimates are based on data from routine sources where available (hospital episode data, GP records, GP OOH records, and Census based population estimates). Data from previous research (estimates from the Telephone Survey and IID) and in-hours estimates from this study are used to indirectly estimate the rate of gastroenteritis in the community. This method has the additional advantage of providing direct estimates of activity related to the management of the disease in primary and secondary care, and hence more accurate costing of the burden of the disease.

3.1.2 Estimation of rates of hospitalisation with gastroenteritis

The number of hospital admissions with a diagnosis of gastroenteritis was extracted from the HIPE system for ROI (01 Jan 2003 to 31 Dec 2004) and the Hospital Episode Statistics (HES) system for NI (01 April 2002 to 31 March 2004). All relevant hospitals are covered by HIPE (with one exception of a small private hospital in Dublin) and all relevant NHS hospitals are included in the HES system.

All hospital admissions with an International Classification of Disease (ICD) code corresponding to gastroenteritis as the primary diagnosis for admission were included in the study. In ROI, admissions were classified according to the 9th revision of the ICD, whereas the 10th revision was used in NI. The following variables were extracted for each identified admission for gastroenteritis: date of admission, primary diagnosis, up to nine secondary diagnoses, age, gender and date of discharge. A case transferred from one ward to another is considered a primary admission, so it is possible that a small number of hospitalisations with transfer from one ward to another were counted twice. This could lead to a small overestimate of the rates but will not affect the costing. The estimated populations of ROI (http://www.cso.ie/census/interactive_tables.htm) and NI (<http://www.nicensus2001.gov.uk/nica/common/home.jsp>) over a two-year period were used as denominators for the calculation of rates. Population estimates were based on the most recent census data for each jurisdiction. Age and gender-specific rates were calculated separately for ROI and NI.

Incidence rates were calculated by dividing the number of admissions in the two years by the population over two years and are presented as rates per 1,000 person years. For example, an incidence rate of 40 per 1,000 years equals 40 episodes reported among 1,000 individuals for one year. Ninety-five percent confidence intervals (95% CIs) were calculated by multiplying and dividing the rate by the error factor $\text{Exp}(1.96/\sqrt{d})$ where d = number of hospital admissions due to gastroenteritis during the study period (Clayton and Hills 1993). Since hospital record systems in both jurisdictions cover close to the entire population for hospitalisation due to gastroenteritis, and all records over a two-year period were included, the rate is calculated rather than estimated and no sampling uncertainty was introduced.

3.1.3 Estimation of rates presenting with gastroenteritis to GP in-hours practices

3.1.3.1 Cases

A sample size of 25 in-hours GP practices was used: 20 in ROI and 5 in NI. Since practices in NI have on average more GPs, there were 46 GPs in ROI and 15 in NI. This sample size was estimated based on the rates of 19.1 cases per 100 person years (Wheeler et al.1999) found in the IID Study to provide sufficient precision for a 95% CI ranging from 18/100 person years to 22/100 person years. Clearly confidence intervals for the estimates in each jurisdiction and strata would be wider. In-hours practices were selected using convenience sampling to include ROI/NI, urban/rural, and deprived/non-deprived areas. In ROI, of the 20 practices selected, 5 were in urban-deprived, 5 in rural-

deprived, 5 in urban-non-deprived, and 5 in rural-non-deprived areas. Of the 5 practices in NI, although we would have liked to have included at least 1 practice in each stratum, 4 of the 5 practices included were urban/deprived. Practices were selected on the information provided by the GP on the case-mix of their practice, but the actual urban/deprived classification was based on the geographical location of the practice, on Central Statistics Office (CSO) data for ROI practices and using census information on the Super Output Area² for NI practices. Because of the limitations of classifying practices and populations, to urban/rural and deprived/non-deprived areas, these specific rates are tentative and are presented in Appendix B.

GPs were initially approached by a letter describing the study, followed by a telephone contact. GPs who declined to participate were not contacted further. The remaining GPs were sent further information and offered the choice of extracting the data themselves or having a research team member perform the extractions. From each practice, records relating to consultations of potential GI illness were extracted for the study period. Some practices in NI and ROI use a Read Code system of classification of consultations; for those practices all consultations with a code corresponding to gastroenteritis were extracted and regarded as a case for the purposes of the rates estimation. For all practices which do not implement a Read Code system, diagnosis and symptom details are recorded by the GP in a free-text format, and a search algorithm was used to identify and extract all records that contained terms that were likely to correspond to GI illness³. For each record identified as a potential GI consultation, information was obtained on patient's age, gender, date of consultation and diagnosis. These potential GI records were then imported into an Access database on which a query was run to identify and exclude any records for which the consultation was clearly for morbidity unrelated to GI illness⁴. The remaining records were used as cases for the estimation of rates. The extracted data did not contain patient identification information.

3.1.3.2 Population at risk

Populations at risk are used to calculate rates of presentation. In NI almost all the population is registered with a GP. The number (and age sex distribution) of each practice population was collected and used as the denominator for the rates. In ROI, only GMS patients are registered; the population of non-GMS patients in ROI associated with a practice is not clearly defined. Practices have lists of patients, who have used their services, but patients may use more than one practice, and those who have not used any service may not be on any list. We calculated denominators for the ROI using the proportion of all ROI GPs included in the study, and applying this to the estimate of the population in the country. In ROI there are 2,030 GPs in practices of which 46 were included in the study. The total number of cases occurring in each age-gender category over the 12-month study period was then multiplied by the inverse of this proportion to estimate the total number of cases expected in each jurisdiction. This number was then divided by the size of the relevant population in this age-gender category, based on the most recent population estimates. That is: $[C_{if} * (1/p)] / N_{if}$ where C_{if} = number of observed in-hours cases in age group i and sex j ; p = proportion of GPs in the state included in the study and N_{if} = total population in the state in age group i and sex j .

Confidence intervals were estimated based on the original number of cases, before being grossed up. This assumes the ratio of GPs to population size in the study is representative of that jurisdiction. Not all cases had information on age and/or gender. To estimate age specific rates, we assumed that the missing data had the same age/gender distribution as the rest of the cases. Therefore, within each practice, cases with missing age and/or gender information were distributed among the age-gender categories according to the relative distribution of cases with non-missing data. Incidence rates are presented as numbers of cases per 1,000 person years.

² Super Output Areas (SOAs) are areas used in government statistics in NI relating to a sub population of the country. SOAs are used to present data at a high enough level so individual anonymity is not compromised but at a low enough level to allow analysis to be done on its population.

³ These terms are in Appendix A.

⁴ Details of the exclusion criteria are presented in Appendix A.

3.1.4 Estimation of rates presenting with gastroenteritis to GP OOH practices

3.1.4.1 Cases

All OOH practices in ROI and NI were invited to participate in the study. They were initially approached in writing and followed up by a telephone call. Those who declined to participate were not contacted further. In total there are seven co-ops operating in the four boards of NI. Of the four areas, the study has data gathered from three OOH co-ops operating in the Northern, Western and Southern board. Therefore, this relates to full coverage of these areas. The Eastern Trust contains four OOH co-ops within its perimeters, of which two are included. Overall the data gathered relates to population coverage of 80% in NI. In ROI, eight of the twelve existing co-ops agreed to participate, but two were excluded because of difficulties establishing the boundaries of the populations they covered. Therefore 6 co-ops were included from ROI relating to 38% population coverage. It is unlikely that OOH services that declined to take part have lower or higher rates of attendances than those which were included.

Co-ops were given the option of extracting the information themselves or having a member of the study team do the extraction. As with in-hours data, an electronic search was conducted on each database, to identify all potential GI consultations over the preceding 12-month period. The text relating to the condition the patient reported and the final diagnosis fields were searched for the text terms outlined in Appendix A. Variables extracted included date of event, gender, age, reported condition, and diagnosis. These potential GI records were then imported into an Access database, and records for which the consultation was for morbidity unrelated to gastroenteritis excluded (details of the exclusion criteria are presented in Appendix A). All cases remaining were used as the numerator for the estimation of rates.

3.1.4.2 Population at risk and calculation of rates of gastroenteritis

For the participating co-ops, the population covered (broken down by age and gender) was extracted from the most recent census data (see http://www.cso.ie/census/interactive_tables.htm for ROI and see <http://www.nicensus2001.gov.uk/nica/public/index.html> for NI) and used as denominators. The number of cases occurring in the 12-month study period in each age-gender category was divided by the counties covered by the included co-ops in the relevant age-gender category to obtain the rates. Again there is uncertainty about the urban/rural and deprived/non-deprived split, since co-ops cover mixed populations, and the limited data was not adequate to provide urban/rural and deprivation scale specific rates.

3.1.5 Estimation of the rate of GI in the community not presenting to health services

The Telephone Survey provided an estimate of the proportion of GI cases in the community that present to a GP. This was very similar to the estimate from the IID study. The inverse of this proportion was multiplied by the GP presentation rate found in the current study to obtain a rate of gastroenteritis in the community. Since the GP presentation rate in the Telephone Survey differed between NI/ROI and age/gender, the calculation was carried out separately for these categories. As there were no cases under the age of one year in the Telephone Survey, we applied the rate of presentation of children aged one to four to estimate the rate of gastroenteritis in infants.

3.2 Costs of health care use

3.2.1 Introduction

The costs were calculated for in-hours and OOH GP services and hospital services separately to identify where the biggest burdens falls. The disease imposes burdens on the wider economy in terms of time lost from employment or other worthwhile activities. Efforts have been made to include these costs. In attempting to estimate the burden of disease it is not of great importance who pays the costs. However, burden distribution can affect an individual's incentives when choosing whether to use a health service. The constraints and incentives to use

services will differ in those eligible for free or reduced cost treatments from those paying full cost. This is an issue when aggregating data from NI and ROI and for the different schemes available in ROI. An attempt has been made to explore these issues to assess the extent they may affect the use of health services and thus costs.

In the calculation of estimates, an approximation has been made on the underlying opportunity costs to the health sector, people with the disease, their families and wider society. However, we have based our cost estimates on charges, fees etc. which may not always reflect the true economic value to society. When data is not available, assumptions about costs have been made which err on the side of lower options, but sensitivity analysis has been applied to all cost vectors used. Thus, the final total of the burden reported is likely to be at the lower end of the spectrum of costs. Therefore, it is likely to reflect the minimum amount to be saved if gastroenteritis were eliminated from the community.

3.2.2 Costs of GP in-hours provision

The cost of in-hours services falls upon GP practices, the patient and the government. The costs of GP in-hours consultation services depend on the number of cases presenting to the practice and the associated cost of those services: time costs of staff, drug costs and any associated travel costs. Attributing the share of GP costs to gastroenteritis is difficult, as it is provided jointly with other health services. Any attempt to apportion costs with complete accuracy requires vectors of costs and frequency for the other items of service and this is beyond the scope of this study. The cost components described in this section form a cost vector which, when multiplied by the relevant rates provide estimates of in-hours costs by the relevant strata.

3.2.2.1 Consultation costs

For ROI we relied upon schedules of fees and charges and hypothesised that these, if they were negotiated in a contractual negotiation between the GPs, the government and insurance payers, represent an approximation to the opportunity costs of use of GP services. It is also assumed that the GP did not discriminate among patients based on their funding scheme, and the quality of care received by a patient with gastroenteritis is the same independent of their GMS status. The in-hours practice's consultation fee is used as an initial proxy of the cost of treating a patient.

Sensitivity analysis reconsiders the proxy used for the cost of a consultation. Rather than using the fee set by a GP practice, a proportion of the capitation fee is used. To estimate the cost of a GP in-hours consultation, information from the national GMS payments to doctors was utilised. This gives full account of all the payments made to GPs in ROI attributed to capitation. Precise estimation of the average cost of a visit from this information requires information on the average number of visits by GMS patients annually. Based on Madden et al. (2003) it is estimated on average GMS patients attend their GPs 6.4 times annually.

Using this information a proxy is calculated for the cost of an in-hours consultation. Again, it can be argued that this cost represents the opportunity cost of a GP's time as well as other practice staff time and running costs associated with the visit, because this amount is set through bargaining between the government and a representative on behalf of the GPs.

Whilst it was possible to calculate an estimate of the cost of gastroenteritis for in-hours consultations it was not possible from routine data to distinguish between costs borne by the patient and other parties such as the government. This is because the data did not contain an identifier to allow us to distinguish between GMS and non-GMS patients. A question on the survey (see Appendix A) asked the patient whether they possessed a medical card, and this was used to calculate the proportion of GMS patients. Assuming that GPs were non-discriminating, when asking GMS and non-GMS patients to participate, and the response rate was similar, this proportion provides

a reasonable estimate which was used to aggregate the costs of GP consultations. If the proportion was wrong, this will not influence the total cost of gastroenteritis but the breakdown of the burden between individuals and government.

For NI, the costs associated with in-hours primary care visits was calculated from the capitation fees paid to NHS doctors. Again it is argued that the capitation rate reflects the opportunity costs of services as negotiated between the government and GPs. The cost of a GP consultation in the surgery or in the home has been calculated for NHS patients and is available from *Unit Costs of Health and Social Care (2005)*. The estimated costs are inclusive of all overheads and consumables.

3.2.2.2 Prescription costs

Data on prescriptions was only available for eight of the twenty practices in ROI, so the estimated costs include imputed prescription costs for the remaining practices. Full prescription data was only available for three of four NI practices and the estimated overall costs again include imputed prescription costs for the remaining practices. The costs associated with the various drugs prescribed to patients were obtained for March 2006 from the Monthly Index of Medical Specialists (MIMS) Ireland for ROI and from the British National Formulary (BNF) for NI.

As we were not able to identify which prescription costs were covered by the family and by other sources, all prescription costs were included in the patient's burden only to avoid double-counting. The ROI government pays the total cost of prescribed drugs for GMS patients and the costs of drugs for non-GMS patients who are over the threshold in the drug payments scheme. To a small extent this will overestimate the burden of costs on the patients. To calculate an estimate of prescription costs that are borne by patients and their families in ROI, an estimate of the proportion of GMS patients presenting with gastroenteritis to in-hours practices is calculated using survey responses and used to calculate an estimate of the burden of prescriptions that fall on patients and their families. Certain patients in NI are covered by the NHS for prescription drugs. When estimating the burden of prescription costs that fall on the individual and their family, the latter are excluded for individuals if identifiable. However, certain characteristics are not recognisable in the data and the burden may be overestimated for some individuals. This does not affect the assessment of the overall economic cost but may, to a small degree, affect the assessment of the burden distribution.

3.2.2.3 Telephone usage

It is assumed that patients in ROI and NI will make a telephone call to book in-hours primary care consultation. The initial estimates assumed that one phone call is made; the average price of a call is estimated using rates for a five minute conversation from the provider's Eircom and British Telecom for ROI and NI respectively (as they are the market leaders). Sensitivity analysis considers varying the length of the call. The data gathered does not contain information on whether the patient telephoned the practice, however this seems a realistic assumption.

3.2.3 Costs of GP OOH provision

The cost of an OOH visit falls on a combination of the organisation's staff, the patient and the government. Therefore, as in the case of in-hours primary care service, a cost vector has been constructed that contains consultation fees, prescription costs and the cost of phone calls. Multiplying by the relevant rates produces estimates of the costs of gastroenteritis relevant to GP OOH.

3.2.3.1 Consultations

In ROI, again no discrimination is made when costing GMS and non-GMS patients. In the first instance the fee set by an OOH service for a home and treatment centre visit is used as a proxy for the consultation. For the nurse and doctor advice services, while these services are free to patients, a tangible cost to the OOH service is the cost

of the call to the patient. The length of this call is not known but the time is. Applying local rates, an estimate for the total cost of these calls is calculated. It is argued that while this may underestimate the cost of nurse and doctor advice, the additional costs of providing these services are considered by OOH management when setting their consultation fees.

A sensitivity analysis re-estimates the costs of home and treatment centre visits based on the capitation, fees and allowances paid by the government for OOH arrangements. Again this is a justified proxy for opportunity cost since the payment is set through bargaining between the government and representatives. These figures vary, depending on whether a patient receives a consultation in a treatment centre or their own home. In the case of treatment centre consultations, the OOH fee the government pays to the GP varies depending on the time the service is supplied. In the case of home visits the fee again varies depending on the distance the patient lives from the OOH centre. The Data Protection Act (1988-2003) prevents data of such sensitivity being disclosed and therefore the results base all estimates on the lowest band. That is, it is assumed that every patient treated lives within the shortest distance and therefore the lowest fee applies. The estimate is therefore the lowest cost associated with this service.

As for in-hours GP provision, it was not possible to identify costs borne by the patient and by other parties such as the government, because of the lack of an identifier for GMS patients. The method used to overcome this difficulty is the same used for in-hours cases.

In NI the costs of OOH services vary with the type of service received. In the case of direct consultations the burden always falls on the government, and these costs are calculated based on *Unit Costs of Health and Social Care 2005*, as used for in-hours consultations. These costs vary depending on whether the service received is a home or treatment centre consultation.

The services of doctor and nurse advice are again a tangible cost to the OOH service. The latter is the price of the phone call to the patient and is calculated in the same way as for ROI using the tariffs of the dominant provider BT. The average call is assumed to be 5 minutes. This is varied in the sensitivity analysis.

3.2.3.2 OOH prescription costs

Data on prescriptions are available for all OOH services and an average cost is calculated based on the cost of drugs in MIMS Ireland and the BNF directory. Again we did identify costs borne by the patient and by other sources. We estimated this burden for ROI and for NI using the approach described for in-hours services.

3.2.3.3 Telephone costs for use of OOH services

Aside from the telephone costs that fall on the OOH practices for doctor and nurse advice, the data gathered also contains information on whether the patient's initial contact with these services was by a phone call or a walk in. When the contact was by phone the same method to that used for in-hours services is used to calculate a total cost for these calls.

3.2.4 Costs for hospital services

Although gastroenteritis is generally a mild self-limiting disease it can sometimes be more serious and involve hospital admission and even death. Outbreaks sometimes occur in hospital with very severe consequences involving closing wards. Such outbreak costs are substantial but outside the scope of this study whose focus is on the costs of individual cases admitted to hospitals during the study period. This section outlines the data used to construct a hospital cost vector. Multiplying this vector by the rates outlined in Section 3.2 yields the hospital costs associated with the various strata.

3.2.4.1 ROI

Hospital costs in ROI were calculated using secondary data obtained from the National Casemix Programme. These data reflect cost per case by DRG based on 37 participating hospitals and 2003 costs and activity. Because these figures are averaged over all hospitalised cases, the figure is the same for every case hospitalised with gastroenteritis. Data on length of stay for individual cases are averaged to give an estimate of the average stay of a gastroenteritis case. The costs associated with patients who stay a longer or shorter duration compared to this average are adjusted accordingly.

3.2.4.2 NI

Secondary data are used to construct the cost vector for NI. The data are for 2002/2003 and 2003/2004. The figures are averaged across hospitals and are the same for every case of gastroenteritis admitted to hospital. Data on length of stay are averaged over the cases to give an estimate of average stay and costs are adjusted in proportion with the actual length of a patient's stay.

3.3 Other costs to patients, families, friends, carers and the economy

Costs to patients and their families, friends and carers include out-of-pocket expenses and losses resulting from time lost to activities such as employment or leisure as a consequence of illness. These data are used to form a cost vector of direct and indirect costs. Multiplying this vector by the relevant rates yields estimates of total costs.

3.3.1 Data source for direct and indirect costs to patients and carers

The information obtained from the questionnaire provides the additional data required to include costs to patients and families and is presented as Appendix 2. This questionnaire was distributed by 20 GP practices and 5 OOH services to individuals who presented with gastroenteritis in ROI and NI. Out of 714 patients asked to participate in the study we received 275 responses resulting in 38.5% response. The low response rate may be due to lack of follow up. Once the GP handed the survey to the patient no follow up was possible, since this would have required information on patient identity. 45% of the responses were received from OOH primary care services; the remainder came from in-hours practices. Of the survey questionnaires returned 77% of respondents resided in ROI with the remainder residing in NI. The actual population on the island of Ireland is made up of approximately 70% of individuals residing in ROI and 30% residing in NI. The majority of respondents (63%) were female. It is common to have a higher response from female patients (Korkeila et al.2001) and the population is made up of 51% females and 49% males. Further details on respondent characteristics are provided in Appendix D.

To check the reliability of the data from the surveys a comparison was made of information collected in both the questionnaire and directly from in-hours and OOH data: the cost of consultation, medicines and the phone call to make a GP appointment. Results from this exercise indicate that the data from the survey is a good approximation of the direct costs collected directly or from routine data. The results are illustrated in Table 3.1 below:

Table 3.1: Comparison of costs information collected in Survey and In-hours Routine Data:

Direct Cost Comparisons (Contain direct costs associated with an in-hours & out-of-hours visit only)		
Primary Care Facility	Average Cost from Survey	Average Cost from Data
OOH ROI (using private fees)	€51.38 (£34.68)	€47.36 (£31.97)
OOH NI	€39.00 (£26.33)	€40.28 (£27.18)

The questionnaire contains information on the effects on family members in terms of time off work and time taken to accompany the sick person to the surgery; on occupation, symptoms and duration, how symptoms interfered with daily activity, previous history of illness, medicines prescribed and/or over the counter medication taken and the treatment recommended by the GP. Family/carer level information was also requested and relates to the effects on the family of the patient's illness. Patients were asked to report other expenses they incurred during the spell of illness as well as provide information on duration of forgone activities such as school, college, work etc. Using the survey it is possible to get an estimate of costs to cases and their families. Adding the latter to the estimates of direct costs will yield an estimate of the economic cost associated with gastroenteritis.

3.3.2 Indirect costs

The first indirect cost considered is forgone labour. A person in active employment provides productivity to the employer in exchange for labour time. Therefore, the price of labour is seen as the value of the output of that labour and reflects opportunity costs. If an individual misses work, assuming they are not replaced and/or are irreplaceable, the cost of lost output to the economy is estimated as follows.

Average price of labour * Days missed (5)

The price of labour is based on the occupation of the patient and their current employment status. For individuals who are working, their labour price is based on CSO data on earnings relating to 2003 and the findings of the New Earnings Survey (2003) for ROI and NI patients respectively. It is assumed that reported wage costs reflect the opportunity cost of lost productivity. All calculations are based on the quantity of days the patient missed work.

An average loss of productivity is calculated as:

- **(Price of labour * Days missed)/number of respondents in the stratum**

For individuals who are not in paid employment, the categories of never worked, worked but currently unemployed, home maker, attendance at primary school, secondary school and attending third level college are considered. To assign a monetary value of zero would disregard their value to the individual. For the latter four categories the minimum wage in each jurisdiction is used as an estimate of the cost of missing these activities. This figure may under-value these activities to the individual. All calculations are based on information supplied by the patient in relation to duration of symptoms and number of days they missed. Unemployment payments are used to cost forgone activities for individuals who never worked or are currently unemployed. All calculations are based on the information supplied by the patient in relation to the duration of symptoms and quantity of days missed.

An average loss is calculated as:

- **(Price of unpaid labour * Days missed)/number of respondents in the stratum (6)**

For patients who are younger than sixteen or have a guardian who cared for them while ill, the guardian's forgone labour and time is priced using the definitions discussed above. This information is retrieved from Questions 4 and 5 in Section A for children under 16 and Questions 7 and 8 for every respondent to the survey. The time taken by a person who was not ill to accompany the respondent is also included. These calculations are based on information supplied in Question 5 and 6 in Section D. The cost is calculated based on the total time it took to travel to the surgery (Question 4, Section D) plus 15 minutes allowed for a consultation. The latter allows us to weight costs by the fraction of the day missed but does not include an allowance for time spent waiting for the consultation. Therefore it is expected that this figure will be downward biased.

3.3.3 Travel costs

Travel costs are calculated based on questions 1 through 4 in Section D of the questionnaire. The calculations take into account mode of travel, distance travelled and time taken to cover the distance. The cost of using a car is estimated using the price of fuel documented on the Automobile Association website relevant to ROI and NI for the week the survey was received and assuming every individual drives a 1.2 litre car. For bigger engines, the costs will be underestimated slightly. For individuals who took a taxi, costs are based on fees set by the relevant local authority for each taximeter area including a hiring fee for ROI respondents. For NI respondents the cost is based on the fees documented for metered taxis on the Department of the Environment's website. For individuals who took the bus or train the relevant costs are calculated using prices retrieved from the CIE and Translink websites. These were chosen as they are the dominant carriers. All of these estimates are based on distance travelled. If a respondent supplied the cost of the journey, this cost is verified using these sources and included.

Costs to patients are calculated based on information about expenses incurred as a result of illness in Question 8, Section D. These expenses are quantified by the respondent in Question 8a. This monetary figure is verified based on type of activity and included in the estimates of patients' costs. Where an individual reported that they did not incur any other expenses as a result of their illness, while it may be argued that this is not true, it is assumed that if the individual did not value the expense high enough to write it on the questionnaire then it should not be included in the overall burden. Adding together the costs directly incurred by patients and the losses experienced by time taken from work or leisure gives an estimate of the costs that are excluded in the previous calculations. Adding the direct costs to the non-direct costs documented here provides an estimate of economic costs for the age, gender and North/South strata.

3.3.4 Costs for individuals who do not present to any health service

As this study gathered information only on individuals who present to a health service, it did not directly collect cost information for those with the disease who did not present to any health service. Based on the in-hours direct costs it is possible to estimate the costs associated with the community who do not present based on the findings of Roberts et al. (2003). From this study it is postulated that the ratio of costs for people who present to in-hours GPs compared to those who do not present is of the ratio 201.69:34.31.

4. Results

4.1 Introduction

This chapter is divided into two sections: rates of gastroenteritis and costs of gastroenteritis.

4.2 Rates of gastroenteritis

Here we present estimates of rates admitted to hospital, presenting to in-hours and OOH GP services and in the community.

4.2.1 Rates of hospitalisation

The rates of hospitalisation per annum for which the primary diagnosis was recorded as gastroenteritis are shown in Table 4.1.

**Table 4.1: Rates of hospitalisation due to gastroenteritis as the primary diagnosis in ROI and NI
(Rates per 1,000 person years)**

ROI Age	Males		Females		NI			
	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)
<1	1,122	20.18 (19.03-21.39)	405	18.22 (16.53-20.08)	373	17.65 (16.01-19.45)	948	17.76 (16.66-18.92)
1-4	1,491	6.53 (6.20-6.87)	730	7.59 (7.06-8.16)	613	6.74 (6.27-7.25)	1,493	6.86 (6.52-7.21)
5-7	224	1.37 (1.20-1.56)	133	1.79 (1.51-2.12)	143	2.03 (1.71-2.41)	220	1.42 (1.25-1.63)
8-17	246	0.42 (0.37-0.47)	124	0.46 (0.39-0.55)	91	0.35 (0.30-0.42)	275	0.49 (0.44-0.55)
18-64	367	0.15 (0.13-0.16)	318	0.32 (0.29-0.36)	408	0.40 (0.36-0.44)	578	0.23 (0.22-0.25)
65-74	110	0.47 (0.39-0.57)	65	0.59 (0.46-0.75)	133	0.98 (0.77-1.25)	121	0.47 (0.39-0.56)
75+	168	1.16 (1.00-1.35)	99	1.38 (1.13-1.68)	217	1.69 (1.39-2.06)	333	1.41 (1.26-1.57)
Total	3,728	0.96 (0.93-0.99)	1,874	1.14 (1.09-1.19)	1,978	1.14 (1.09-1.20)	3,968	1.01 (0.98-1.04)
Overall rates	No. of cases		Rate (95% CI)		No. of cases		Rate (95% CI)	
Total	7,696		0.98 (.96-1.00)		3,852		1.14 (1.09-1.20)	

The overall annual rates of hospitalisation with gastroenteritis as the primary diagnosis were around 1 per 1,000 persons, in both ROI and NI. The age specific rates were similar in the two jurisdictions, with highest rates among infants (about 18 per 1,000 per year) and children 1 to 4 years of age (about 7 per 1,000 per year). Rates were much lower in other age groups, with the elderly higher than the rest of the adult population. There was little difference in the rates between males and females. The rates of hospitalisation with gastroenteritis as a primary or secondary diagnosis were 1.6 per 1,000 per year in NI and to 3.3 per 1,000 per year in ROI, where 10 diagnosis fields are available.

4.2.2 Rates in GP in-hours practices

The age and gender specific rates of presentation with gastroenteritis to in-hours GP practices are shown in Table 4.2 for ROI for NI.

Table 4.2: Rates of presentation with gastroenteritis to GP in-hours practices in ROI and NI by age and gender (Rates per 1,000 person years)

ROI Age	Males		Females		NI Males		Females	
	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)
<1	97	840.05 (688.45-1025.02)	81	740.68 (595.73-920.89)	22	198.06 (146.98-266.89)	21	204.60 (134.44-311.38)
1-4	183	134.74 (116.57-155.75)	162	124.87 (107.05-145.66)	48	101.60 (82.98-124.40)	45	00.83 (76.06-33.66)
5-7	32	37.69 (26.65-53.29)	35	43.67 (31.36-60.83)	5	13.59 (8.91-20.73)	17	47.60 (19.81-14.37)
8-17	54	17.61 (13.49-22.99)	90	30.90 (25.14-38.00)	22	16.60 (12.24-22.51)	19	15.04 (9.92-22.80)
18-64	361	28.12 (25.36-31.17)	608	47.62 (43.98-51.56)	91	18.38 (16.06-21.02)	122	24.02 (19.55-29.51)
65-74	38	31.30 (22.78-43.02)	41	30.73 (22.63-41.74)	9	16.00 (11.32-22.61)	23	34.85 (17.99-67.52)
75+	22	29.39 (19.35-44.64)	55	44.83 (34.42-58.39)	9	25.79 (17.89-37.17)	20	30.82 (16.13-58.85)
Total	787	38.98 (36.35-41.80)	1,072	52.42 (49.38-55.66)	206	25.34 (22.10-29.04)	267	31.25 (27.72-35.23)
Overall rates	No. of cases		Rate (95% CI)		No. of cases		Rate (95% CI)	
Total	1,859		45.74 (43.71-47.87)		473		28.37 (25.92-31.04)	

The annual rate of presentation to in-hours practices was higher in ROI (46 per 1,000 per year) than in NI (28 per 1,000 per year). The age specific shape of the curve was similar, with highest rates of presentation in infants and under fives, low in adults, and among adults higher in the elderly. The rate among infants was extremely high, particularly in ROI where it was almost 800 per 1,000 person years, equivalent to an average of 0.8 episodes per infant per year.

4.2.3 Rates in GP OOH practices

The rates of presentation with gastroenteritis to OOH GP practices are shown in Table 4.3 for ROI and NI.

Table 4.3: Rates of presentation with gastroenteritis to GP OOH co-ops in ROI and NI
(Rates per annum per 1,000 person years)

Age	ROI				NI			
	Males		Females		Males		Females	
	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)
<1	1,146	102.95 (97.16-109.08)	1,041	98.78 (92.96-104.96)	52*	5.75 (4.39-7.55)	38*	4.43 (3.22-6.08)
1-4	9,085	196.87 (192.86-200.96)	8,332	189.01 (184.99-193.11)	7,953	203.28 (198.86-207.80)	7,332	197.76 (193.28-202.33)
5-7	2,332	70.29 (67.50-73.21)	2,176	69.14 (66.30-72.11)	2,244	74.13 (71.16-77.30)	2,069	72.24 (69.19-75.42)
8-17	2,856	23.49 (22.65-24.37)	2,982	25.83 (27.92-26.77)	2,726	24.54 (23.64-25.48)	2,945	27.78 (26.79-28.80)
18-64	6,185	13.39 (13.06-13.73)	11,752	26.59 (26.12-27.08)	6,828	17.32 (16.62-17.74)	12,731	31.46 (30.92-32.02)
65-74	1,044	21.55 (20.28-22.89)	1,643	32.69 (31.15-34.31)	1,181	27.08 (25.58-28.67)	2,108	39.59 (37.93-41.31)
75+	1,906	60.06 (57.43-62.82)	3,658	76.09 (73.66-78.59)	1,894	68.54 (65.53-71.70)	4,044	82.01 (79.52-84.57)
Total	24,554	32.56 (32.15-32.97)	31,584	42.58 (42.11-43.05)	22,878	34.96 (34.51-35.42)	31,267	45.44 (44.94-45.94)
Overall rates	No. of cases	Rate (95% CI)		No. of cases	Rate (95% CI)			
Total	56,318	37.53 (37.22-37.84)		54,145	40.33 (39.99-40.67)			

The overall rate of presentation with gastroenteritis is 40 per 1,000 per year, both in ROI and in NI. The age distribution follows the same pattern for hospitalisations and presentation to GP in-hours, with high rates in under fives, low in adults (although higher in elderly adults). Rates in those under one in NI are very low but this may be due to small numbers of this age group presenting to OOH. The age distribution follows the same pattern

for hospitalisations and presentation to GP in-hours, with high rates in under fives, low in adults (although higher in elderly adults). In ROI, each of the age-specific OOH rates was higher than the corresponding age-specific in-hours rates, but this was not true for NI.

4.2.4 Rate of gastroenteritis in the community

The estimated rates of gastroenteritis in the community are shown by age and gender in Table 4.4 for ROI and NI.

Table 4.4: Rates of gastroenteritis in the community in ROI by age and gender
(Rates per annum per 1,000 person years)

ROI					NI			
Age	Males		Females		Males		Females	
	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)	No. of cases	Rate (95% CI)
<1	26,713	2400.13 (1967.01-928.62)	22,307	2116.23 (1702.09-631.13)	5,504	495.15 (325.35-753.55)	5,405	511.50 (334.81-781.42)
1-4	50,398	384.98 (333.05-445.00)	44,614	356.77 (305.86-416.17)	12,217	254.00 (191.61-336.70)	11,459	252.08 (188.42-337.23)
5-7	12,472	152.39 (107.76-215.49)	13,642	176.60 (126.80-245.96)	1,934	52.03 (21.66-125.05)	6,410	182.24 (112.60-294.97)
8-17	21,047	71.20 (54.53-92.97)	35,079	124.96 (101.64-153.64)	8,582	63.55 (41.91-96.34)	7,422	57.58 (36.79-90.06)
18-64	140,705	113.70 (102.55-126.05)	236,977	192.56 (177.85-208.49)	35,085	70.37 (57.27-86.44)	47,068	91.96 (77.00-109.86)
65-74	9,767	83.48 (60.74-114.72)	10,539	81.95 (60.34-111.30)	2,088	37.65 (19.44-72.95)	5,553	82.00 (54.66-123.02)
75+	5,655	78.38 (51.61-119.04)	14,137	119.55 (91.79-155.71)	2,182	60.68 (31.77-115.90)	4,654	72.52 (46.55-112.93)
Total	277,767	142.73 (133.09-153.05)	378,356	191.96 (180.80-203.8)	77,242	94.03 (80.93-106.35)	100,046	115.82 (101.48-128.99)
Overall rates	No. of cases	Rate (95% CI)			No. of cases	Rate (95% CI)		
Total	656,122	167.50 (160.05-175.29)			175,068	103.88 (94.91-113.66)		

The rate in the community is approximately 100 per 1,000 person-years for ROI and NI. Approximately 10% of people had gastroenteritis during a 1-year period. This rate varies by age with a rate of 20% to 40% for children aged 1 to 4 years and much lower for adults. The estimated rate in infants was very high: 2,262 per 1,000 person years, an average of 2.3 episodes per year.

4.3 Costs

This section documents the costs that form the burden of gastroenteritis, for those presenting to in-hours or OOH primary care service, the costs associated with being hospitalised and the costs incurred by individuals who do not present to any service. This section also provides an estimate of the burden of costs that fall on patients, their families and carers. Costs are shown in Euro with the value in Sterling in brackets. The currency conversion is based on €1 = £0.674976. This definition is consistent throughout the report.

4.3.1 In-hours costs

Tables 4.5 and 4.6 document the direct costs associated with gastroenteritis presenting to in-hours primary care for ROI and NI.

Table 4.5: ROI: Direct costs associated with in-hours presentation

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€43.26 (£29.20)	€404,448 (£272,993)	€44.98 (£30.36)	€351,158 (£237,023)
1-4	€45.21 (£30.52)	€797,516 (£538,304)	€45.30 (£30.58)	€707,320 (£477,424)
5-7	€45.15 (£30.48)	€139,27 (£94,005)	€45.47 (£30.69)	€153,411 (£103,549)
8-17	€45.65 (£30.81)	€237,629 (£160,394)	€45.50 (£30.71)	€394,721 (£266,427)
18-64	€45.51 (£30.72)	€1,583,450 (£1,068,791)	€45.39 (£30.64)	€2,660,336 (£1,795,663)
65-74	€44.88 (£30.29)	€164,400 (£110,966)	€45.48 (£30.70)	€179,716 (£121,304)
75 +	€45.82 (£30.93)	€97,163 (£65,583)	€44.93 (£30.33)	€238,201 (£160,780)
Total		€3,423,877 (£2,311,036)		€4,684,863 (£3,162,170)

Table 4.6: NI: Direct costs associated with in-hours presentation

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€35.85 (£24.20)	€78,939 (£53,282)	€37.90 (£25.58)	€81,930 (£55,301)
1-4	€36.90 (£24.91)	€180,324 (£121,714)	€37.04 (£25.00)	€169,787 (£114,602)
5 to 7	€36.57 (£24.68)	€18,478 (£12,472)	€36.91 (£24.92)	€61,810 (£41,720)
8 to 17	€36.34 (£24.53)	€81,453 (£54,979)	€36.48 (£24.63)	€70,707 (£47,725)
18 to 64	€36.89 (£24.90)	€338,046 (£228,173)	€37.49 (£25.30)	€460,958 (£311,136)
65 to 74	€35.78 (£24.15)	€31,764 (£21,440)	€36.83 (£24.86)	€86,927 (£58,674)
75 +	€37.33 (£25.20)	€34,618 (£23,367)	€36.95 (£24.94)	€73,080 (£49,328)
Total		€763,622 (£515,427)		€1,005,199 (£678,486)

A sensitivity analysis, based on the capitation distributed to GPs in ROI, is shown in Appendix C. Exchanging these two proxies results in a 14% decrease in the total direct costs associated with gastroenteritis patients who present to in-hours. The low costs for those under 1 year of age in ROI are explained by a low frequency of medication in infants: 48% of infants in our sample were not prescribed medication. Little variation exists across costs between other age groups. The average cost for females is €45.29 compared to males at €45.06.

In NI there are only small differences in average costs between age/gender strata – the largest being a difference of 5.5% in average costs across <1 males and females. These differences are primarily the result of variation in prescription costs. There is a slight tendency for women of all ages (except those over 75) to use more medicine than men. In both jurisdictions, the most common recommendation is re-hydration rather than medication.

The calculations in both Tables 4.5 and Table 4.6 are based on the patient ringing the surgery one time to make an appointment. Varying the length of the call randomly results in only minor changes to total costs of 0.79% and 0.38% for ROI and NI respectively, while doubling the quantity of phone calls only changes total costs by 0.39% and 0.08%.

4.3.1.1 Additional Costs

Survey respondents who had visited in-hours practices reported additional costs associated with their illness. These costs cover the cost of transport, other additional visits to primary care, medicines taken before contacting the surgery, time taken off work/school/college/other by the individual who is ill, time taken off work/school/college/other by an individual who is not ill to care for the ill individual, time taken by an individual who is not ill to accompany the patient to the in-hours practice plus any additional costs (taken from the response to Question 8, Section D). Using the data from the survey it is possible to get an estimate of these costs. Aggregating these with estimates in Table 4.7 gives an estimate of the total burden of gastroenteritis for in-hours primary care. Given the relatively small number of respondents the presentation by age and gender can only be illustrative.

Table 4.7: Direct costs; indirect costs (time lost to work or leisure)

	Gender = male		Gender = female	
Age	Average cost	Total cost	Average cost	Total cost
<1	€94.05 (£63.48)	€1,086,444 (£733,324)	€251.65 (£169.86)	€2,508,803 (£1,693,382)
1-4	€228.18 (£154.02)	€5,140,005 (£3,469,380)	€176.06 (£118.84)	€3,556,246 (£2,400,380)
5-7	€117.08 (£79.02)	€420,281 (£283,679)	€221.46 (£149.48)	€1,117,933 (£754,578)
8-17	€303.71 (£205.00)	€2,261,491 (£1,526,452)	€304.86 (£205.77)	€3,235,463 (£2,183,860)
18-64	€280.17 (£189.11)	€12,316,282 (£8,313,195)	€251.43 (£169.71)	€17,826,272 (£12,032,306)
65-74	€213.69 (£144.24)	€972,403 (£656,349)	€131.71 (£88.90)	€831,378 (£561,160)
75 +	€294.52 (£198.80)	€897,683 (£605,914)	€156.86 (£105.88)	€1,141,802 (£770,689)
Total		€23,094,589 (£15,588,293)		€30,217,897 (£20,396,355)
Jurisdiction	Average cost	Total cost		
ROI	€239.11 (£161.40)	€42,845,977 (£28,920,006)		
NI	€218.94 (£147.78)	€10,466,509 (£7,064,643)		
Totals		€53,312,487 (£35,984,649)		

Source: Department of Agriculture and Rural Development (2006)

From Table 4.7 costs of attendance at in-hours services are significantly higher when a broader measure of costs is used. The estimated cost of visits to in-hours services rises from €8,108,736 (£5,473,202) and €1,768,821 to €42,845,977 (£28,920,006) and €10,466,509 (£7,064,643) for ROI and NI respectively. Again, given these costs are partially driven by the rates reported in Section 4.2.2, lower and upper bands for these costs are provided in Appendix C.

There are differences in average costs across age and gender. For example, there are large differences between costs of male and female patients under one year and over 75, but smaller differences between male and female adults. In over 75 year olds, much of the difference in costs relates to the number of visits paid by men and women to the GP. Some other differences may relate to different patterns of respondents between the men and women in the study – it may be that male responders were sicker than females, and therefore higher users of services. Average costs for children under 7 are higher for females compared to males. These differences are caused by a combination of differences in childcare and medication costs as well as the job type of the parent across groups. To illustrate the composition of the total costs presented in Table 4.7, Table 4.8 provides more detail.

Table 4.8: Components of direct costs and indirect costs

	ROI	NI
Prescription costs	0.2%	0.31%
Phone charges	0.04%	0.021%
Consultation costs	17.44%	14.61%
Previous consultation costs	7.22%	3.98%
Other medications taken before GP visit	0.15%	0.07%
Cost of the journey to the GP practice	2.7%	3.1%
Costs associated with missing work	42%	45.5%
Costs associated with missing school/college	9.35%	5.21%
Costs associated with a non-ill person taking time to care for the gastroenteritis patient	2%	5.1%
Costs associated with a non-ill person taking time to accompany the gastroenteritis patient to the in-hours practice	2.9%	1.1%
Other expenses (Including forgone activities)	16%	21%

4.3.2 OOH costs

Tables 4.9 and 4.10 show the direct costs associated with gastroenteritis for OOH primary care services in ROI and NI respectively.

Table 4.9: ROI OOH primary care services direct costs

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€31.17 (£21.04)	€89,222 (£60,223)	€32.36 (£21.85)	€85,337 (£57,601)
1-4	€32.28 (£21.79)	€725,906 (£489,969)	€33.78 (£22.80)	€695,205 (£469,247)
5-7	€32.01 (£21.61)	€184,157 (£124,302)	€31.65 (£21.36)	€169,019 (£114,083)
8-17	€31.91 (£21.54)	€221,575 (£149,558)	€32.51 (£21.94)	€235,696 (£159,089)
18-64	€32.01 (£21.61)	€530,372 (£357,988)	€31.45 (£21.23)	€1,029,246 (£694,716)
65-74	€32.79 (£22.13)	€82,668 (£55,799)	€33.34 (£22.50)	€140,131 (£94,585)
75 +	€32.82 (£22.16)	€142,239 (£96,008)	€32.00 (£21.60)	€287,914 (£194,335)
Total		€1,976,139 (£1,333,846)		€2,642,548 (£1,783,656)

Table 4.10: NI OOH Primary Care Services direct costs

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€33.76 (£22.79)	€2,159 (£1,457)	€36.40 (£24.57)	€1,703 (£1,149)
1-4	€31.95 (£21.57)	€312,415 (£210,872)	€32.44 (£21.90)	€291,663 (£196,866)
5-7	€31.81 (£21.47)	€87,697 (£59,193)	€30.88 (£20.84)	€78,471 (£52,966)
8-17	€39.38 (£26.58)	€130,532 (£88,106)	€35.82 (£24.18)	€128,260 (£86,572)
18-64	€43.57 (£29.41)	€376,330 (£254,014)	€43.00 (£29.02)	€692,442 (£467,382)
65-74	€57.09 (£38.53)	€85,754 (£57,882)	€54.86 (£37.03)	€147,076 (£99,273)
75 +	€66.93 (£45.18)	€164,961 (£111,345)	€67.01 (£45.23)	€352,671 (£238,044)
Total		€1,159,848 (£782,869)		€1,691,286 (£1,142,252)

Table 4.9 reports costs that incorporate information on the individual fees set by OOH services independently for home and treatment centre visits. A sensitivity analysis, using the payment relating to GMS patients, is presented in Appendix C. Exchanging the costs in Table 4.9 for those in Appendix C results in a small difference of -5.5% between the two groups in the total direct costs. There is little variation in these direct costs by gender. It is possible to vary the length of the call in the case of the patient receiving doctor and/or nurse advice by way of a sensitivity analysis; however results illustrate only a 0.09% and a 0.08% increase in the total direct costs associated with patients who present to OOH services for ROI and NI respectively. As in the in-hours case sensitivity analysis is reported for all total costs in Appendix C based on the confidence intervals.

Comparing average costs across ROI and NI, bigger differences exist between the average costs in the age groups over 18, with NI exhibiting higher average costs in every case. This is caused mainly by the differences in the cost of a home visit. That is, the value placed on a home visit by *the Unit Costs of Health and Social Care (2002)* which is used to price home visits in NI, is far larger than the monetary amount set by the OOH services independently which are used to cost home visits in ROI. Total direct costs of use of OOH services in ROI and NI are €4,618,687 (£3,117,502) and €2,851,134 (£1,250,251) respectively. These costs are partially driven by the rate of presentation to OOH practices documented in Section 4.2.3. The data showed a very low rate of attendances of children under 1 year in NI to OOH services.

4.3.2.1 Indirect OOH cost

In addition to costs reported in Tables 4.9 and 4.10, the respondents who received their survey from an OOH facility were asked about the additional costs associated with their illness. These costs were used to provide estimates of indirect and opportunity costs. The latter were combined with the information in Tables 4.9 and 4.10 to provide an estimate of the total burden attributed to individuals who experience GI illness and attend an OOH service. Table 4.11 presents estimates across strata for the island of Ireland and the bottom of the table provides an estimate for ROI and NI individually.

Table 4.11: Total Cost Burden (Direct and indirect costs):

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€235.95 (£159.26)	€690,479 (£466,057)	€232.84 (£157.16)	€624,845 (£421,755)
1-4	€159.17 (£107.44)	€5,136,024 (£3,466,693)	€178.01 (£120.15)	€5,264,107 (£3,553,146)
5-7	€141.08 (£95.23)	€1,200,582 (£810,364)	€252.22 (£170.24)	€1,988,028 (£1,341,871)
8-17	€321.18 (£216.79)	€3,295,042 (£2,224,074)	€315.61 (£213.03)	€3,418,383 (£2,307,326)
18-64	€302.44 (£204.14)	€7,623,113 (£5,145,418)	€266.66 (£179.99)	€13,021,224 (£8,789,014)
65-74	€240.44 (£162.29)	€967,378 (£652,857)	€183.19 (£123.65)	€1,261,153 (£851,248)
75 +	€266.22 (£179.69)	€1,809,713 (£1,221,513)	€216.02 (£145.81)	€3,080,541 (£2,079,291)
Total		€20,722,331 (£13,986,976)		€28,658,281 (£19,343,651)
Jurisdiction	Number of cases	Average cost	Total cost	
ROI	97	€230.44 (£155.54)	€33,617,694 (£22,691,137)	
NI	25	€232.86 (£157.17)	€15,762,917 (£10,639,591)	
Totals	122		€49,380,611 (£33,330,727)	

Table 4.11 presents the direct costs of NI OOH primary care services incorporating the price of visits, phone call fees and prescription charges for the treatment centre visits, home visits, doctor advice and nurse advice. The differences in the average costs for different genders in the same age group are explained by differences in propensity to receive one of the four services over the other three. For ages 18 to 64 the differences in average costs compared to younger individuals is explained by an increased tendency of these groups to use medication (over the counter rather than prescribed). The high average cost associated with over 65 year olds is associated with an increased tendency of these groups to receive a home visit and the high costs associated with these visits (Lordan 2007).

As shown in Table 4.11 costs are higher when indirect and opportunity costs of the illness are accounted for in the costings. Lower and upper bands for these costs are provided in Appendix C. In contrast to what was found in the case of in-hours services, there was little variation by age and gender in the costs of OOH services

Table 4.12: Components of the Direct costs: indirect costs (time lost to work or leisure)

	ROI	NI
Prescription costs	0.20%	0.26%
Phone charges	0.01%	0.009%
Consultation costs	11.64%	13.97%
Previous consultation costs	3.38%	1.62%
Other medications taken before GP visit	0.05%	0.19%
Cost of the journey to the GP practice	1.75%	1.98%
Costs associated with missing work	50.5%	47.6%
Costs associated with missing school/college	5.91%	8.21%
Costs associated with a non-ill person taking time to care for the Gastroenteritis patient	9.21%	6.42%
Costs associated with a non-ill person taking time to accompany the gastroenteritis patient to the in-hours practice	0.85%	1.81%
Other expenses (including forgone activities)	16.5%	18%

4.3.3 Hospitalisation costs

Tables 4.13 and 4.14 document the direct costs associated with gastroenteritis in the community for individuals who are hospitalised for ROI and NI respectively. It is clear that costs of hospitalisation is high, but the numbers are relatively small compared to those attending primary care or not using formal services at all. The variation in average costs across groups is reflected in the varying lengths of stay experienced by patients across age/gender. Therefore, the high average costs associated with 75+ age category is unsurprising given that this group is the most vulnerable and may take longer to recover. Similar reasoning applies to those between 65 and 74. In general hospital costs are higher for women.

The total direct hospital costs to ROI and NI are €5,755,763 and €3,016,349 respectively. Lower and upper bounds for these costs are provided in Appendix C based on the appropriate confidence intervals.

Table 4.13: Hospital Costs ROI

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€1,413 (£954)	€792,739 (£535,080)	€1,319 (£890)	€625,112 (£421,936)
1-4	€1,186 (£800)	€883,798 (£596,543)	€1,137 (£768)	€849,070 (£573,102)
5-7	€980 (£662)	€109,791 (£74,106)	€1,125 (£759)	€123,737 (£83,520)
8-17	€569 (£384)	€70,004 (£47,251)	€1,279 (£863)	€175,830 (£118,681)
18-64	€2,124 (£1,433)	€389,670 (£263,018)	€1,873 (£1,264)	€541,162 (£365,272)
65-74	€2,921 (£1,972)	€160,653 (£108,437)	€3,168 (£2,139)	€191,690 (£129,386)
75 +	€3,296 (£2,225)	€276,871 (£186,881)	€3,397 (£2,293)	€565,636 (£381,791)
Total		€2,683,526 (£1,811,316)		€3,072,237 (£2,073,688)

Table 4.14: Hospital Cost NI

Age	Gender = male		Gender = female	
	Average cost	Total cost	Average cost	Total cost
<1	€1,115 (£752)	€222,918 (£150,464)	€1,044 (£704)	€193,604 (£130,678)
1-4	€1,022 (£690)	€371,475 (£250,737)	€1,058 (£714)	€321,625 (£217,089)
5-7	€1,004 (£677)	€66,743 (£45,050)	€936 (£632)	€66,909 (£45,162)
8-17	€1,191 (£804)	€73,864 (£49,857)	€1,361 (£919)	€61,940 (£41,808)
18-64	€1,755 (£1,185)	€278,234 (£187,801)	€1,931 (£1,303)	€393,833 (£265,828)
65-74	€3,012 (£2,033)	€97,879 (£66,066)	€3,403 (£2,297)	€224,574 (£151,582)
75 +	€4,074 (£2,750)	€197,579 (£133,361)	€4,122 (£2,782)	€445,174 (£300,481)
Total		€1,308,691 (£883,335)		€1,707,658 (£1,152,628)

4.3.4 Total cost to individuals who do not present

Table 4.15 presents the costs for individuals who do not present to any health service. It was beyond the scope of this study to carry out primary research on numbers of people with the disease who do not present, and the associated costs. Therefore estimates are based on the relevant rates and the ratio of cost for those who do and those who do not seek care taken from the IID study. It is estimated (Wheeler et al. 1999) that the burden on individuals who do not present to any service compared to individuals who present to an in-hours GP practice equates to a ratio of 3431:20169. Given the methods used to extrapolate from costs and numbers presenting to in-hours services no further breakdown of these costs is presented above the strata of ROI/NI. In future research it may be useful to carry out primary studies that improve the precision of the estimated cost for those who do not present, but these costs are small relative to those who in general have more serious disease and who do present to formal health services. Therefore impact on the economic burden is relatively small.

Table 4.15: Costs to the community of those who do not present

Strata = ROI/NI		
Stratum	Average cost	Total cost
ROI	€40.68 (£27.46)	€9,399,623 (£13,094,280)
NI	€37.24 (£25.14)	€7,739,616 (£3,199,127)
Total		€24,139,239 (£16,293,407)

4.3.5 The total burden on the economy

The total burden of costs attributed to gastroenteritis on the island of Ireland is a combination of in-hours and OOH primary care direct costs, costs associated with hospitalised cases, as well as indirect and opportunity costs that fall on the individual who has the illness and their families. These include costs incurred to individuals with the illness who do not present to any health service. An estimate of the total burden of the illness is illustrated in Table 4.16. For comparative purposes, these costs are re-calculated using the rates emanating from the Telephone Survey. Because the Telephone Survey did not consider presentation to OOH services this cost is excluded. This is followed by an estimate of the total burden of gastroenteritis for ROI and NI separately.

Table 4.16: Total burden of costs on economy

Type of cost	Total cost for ROI	Total cost for NI	Total cost on island of Ireland	Total cost using Tel Survey rates
Hospital cost	€5,755,763 (£3,885,002)	€3,016,349 (£2,035,963)	€8,772,112 (£5,920,965)	€115,958,068 (£78,268,913)
OOH cost	€33,617,694 (£22,691,137)	€15,762,917 (£10,639,591)	€49,380,611 (£33,330,727)	N/A
In-hours	€42,845,977 (£28,920,006)	€10,466,509 (£7,064,642)	€53,312,487 (£35,984,649)	€225,007,109 (£151,874,398)
Do not present	€19,399,623 (£13,094,280)	€4,739,616 (£3,199,127)	€24,139,239 (£16,293,406)	€213,803,756 (£144,312,404)
Totals	€101,619,057 (£68,590,425)	€33,985,391 (£22,939,323)	€135,604,449 (£91,529,748)	€554,768,933 (£374,455,715)

Using the assumptions of costs involved with GI the estimate of the burdens on the economies of the two jurisdictions is a total cost of €135,604,449 (£91,529,748), which is approximately €24.20 (£16.33) cost per resident per annum. Given the generally conservative assumptions used to derive this estimated cost it is likely that the real burden is higher than this.

There is a higher burden per head in ROI (€25.94/£17.51 per head per annum) as compared to NI (€20.16/£13.61 per head per annum), which is the result of both lower presentation to primary care in NI and slightly lower costs of some services. This total cost represents the potential economic gain if the number of cases of gastroenteritis were reduced. As can be seen, using the much higher rates resultant from the Telephone Survey, these costs are severely increased.

4.3.6 The total burden on the family

Although the costs to health services are visible, a significant part of the burden falls on families. The total burden of costs attributed to gastroenteritis on the island of Ireland that fall on the individual who is sick and their respective family, friends and guardians is presented in Table 4.17.

Table 4.17: Burden of costs on families in ROI

Type of cost	Proportion of total costs falling on families in ROI	Proportion of total costs falling on families in NI
Hospital cost	46%	0%
OOH – Direct cost only	70%	3%
OOH – Direct, indirect & opportunity costs	91%	63%
In-hours – Direct cost only	72%	2%
In-hours – Direct, indirect & opportunity costs	92%	67%
Do not present	100%	100%

It is clear in ROI the proportion of costs that fall on the patient and their families is always higher if the individual presents to a health service. The latter is because the NHS covers costs for hospitals, in-hours and OOH services for all the population, whereas in ROI GMS only covers the full cost for certain individuals in the community.

5. Discussion

5.1 Introduction

The main objective of this study was to assess the economic impact of gastroenteritis on the island of Ireland. An important intermediate objective was to calculate rates of presentation of the disease. The perspective taken was societal, that is the costs were assessed regardless of who bears them. It was therefore necessary to assess costs to primary and secondary health services, those falling on individuals, families and friends, and those falling on third parties such as employers. Losses to the economy overall are assessed as the sum of these different costs. There is no direct attempt to assess losses in output, but this is assessed indirectly as losses to employers and employees.

Because of lack of reliable denominators for urban/rural and deprived/non-deprived rates, these are presented as indicative only in Appendix B.

In most cases the results presented in this report are based on data gathered and analysed specifically for this study. However, secondary data was used to calculate costs to people with gastroenteritis who did not use formal health services. The methods used assessed costs on the basis of the relative costs for these patients and those who used in-hours primary care. While this procedure has limitations, it can be justified on two grounds – firstly other studies found these costs to be a relatively small part of the total, and secondly other studies have found a consistent relationship between costs to those who do and those who do not access health services.

5.2 Rates

5.2.1 Rates of hospitalisation

Data on hospitalisations are different in ROI and NI, and include different numbers of fields for diagnosis (10 in ROI and 3 in NI). Two sets of rates are presented: 1) when gastroenteritis is the first diagnosis and 2) when gastroenteritis is mentioned in any of the fields. Since the data gathered cover all hospitals that normally treat gastroenteritis the approach taken will have missed very few cases. However, if the diagnosis were not accurate, cases may have been missed. This may be more frequent when gastroenteritis is acquired in hospital. There is potential for double counting of cases, with changed wards (estimated to be under 10%). This would lead to overestimation of the actual rate.

The higher rate of hospitalisation in the Telephone Survey, compared to rates based on routine data is unlikely to be explained by cases that present to specialised hospitals not being in the system (which do not normally treat gastroenteritis) or by cases with errors in the recorded diagnosis. It is more likely the result of “telescoping” in the Telephone Survey – that is, people reported cases as if they happened during the period of enquiry when they happened earlier.

5.2.2 Rates presenting to GPs

Counting cases presenting to GPs has limitations. Cases presenting to GPs were identified by READ code when this was used by the GP or by diagnosis in free text fields when READ code was not used. This involved some subjective decisions by the study team.

The estimation of the population at risk (that would present to GP practices if they had gastroenteritis) was made based on the proportion of GPs in Ireland, in NI and ROI that are in this study. This assumes that all registered GP are in practice, that the proportion of part time GPs in this study is the same as the national averages and that practices in this study cover on average populations of similar size to that of the average practice in Ireland. If there are many registered GPs in Ireland who do not practice, this would lead to an underestimation of the population at risk and an overestimation of the rates presenting to GPs. The practices in the study might not be representative of the practices of NI and ROI, but this would lead to only small errors in the estimated presentation rates.

The results in this study on numbers presenting to GPs show much lower rates than reported in the Telephone Survey. Specifically 4.6% (46 per 1,000 person years) in ROI and 2.9% (29 per 1,000 person years) in NI are reported in this study, compared to a 20% presentation rate reported by the Telephone Survey for the island of Ireland. It is common to find this type of difference between studies using routine data and those based on recalled morbidity. There are different opinions about what is behind this finding. One possibility is that telephone surveys with reported recall suffer from telescoping. Another possibility is that prospective studies underestimate rates by having more rigorous criteria for defining a case, and by not including cases where there is another diagnosis such as respiratory disease. This study found the rates reported in the Telephone Survey to be 5 times higher than routine data. Since this was based on routine data rather than prospective surveillance, cases could not have been discouraged from presenting for fear of having to give a stool sample; and in searching for symptoms in the symptoms field, rather than using the Read diagnosis, cases were not excluded with respiratory symptoms in addition to gastroenteritis. The main weakness of the rates estimation was the need to project rates relating to the population from the sample of GPs in the study, with the possibility that the sample was not completely representative. Rates could be underestimated if GPs in the study served a smaller population than the average GP practice in Ireland. In England the IID study using prospective design found presentation rates that were higher than those estimated from two different reported recall surveys. The rates of presentation found in the IID study were close to the rates from the Royal College of General Practitioners Surveillance Scheme (Flemming et al. 1994).

5.2.3 Rates presenting to OOH co-ops

The rates were estimated based on the cases in the OOH co-ops database – selected as free text so again with the same limitation as for cases presenting to GP in-hours. The population for the co-ops were estimated based on the proportion of the populations living in areas covered by the co-ops that participated in the study. Again there is the possibility of some over/under estimates but in this case the proportion of the population covered in the study was higher than that for in-hours GPs. The results indicate a 4% presentation rate per annum, both in ROI and NI.

5.2.4 Rates in the population

The rates are derived from the numbers presenting to GPs in this study and the proportion of cases presenting to GPs derived from the Telephone Survey. The proportion presenting to GPs estimated in the Telephone Survey – 30% - is remarkably stable, and very similar proportions were estimated in other studies (Wheeler et al. 1999, Hoogenboom-Verdegaal et al. 1994).

Overall the rates estimated in this study (approximately 100 per 1,000 person years or 10%) are of similar magnitude to the rates estimated in European studies using prospective approaches (Wheeler et al. 1999, Hoogenboom-Verdegaal et al. 1994) and systematically lower than those in Europe using reported recall, either in telephone surveys or face to face interviews, and lower than those found in the Americas by either method. Studies using telephone surveys acknowledge the potential for overestimation in retrospective reporting (Roy et al. 2006, *safefood*, 2003).

In conclusion, it is clear that rates for Telephone Survey and from routine data are of very different magnitude and cannot both be right. The Food Standards Agency has funded a second study of IID (IID2) (<http://www.food.gov.uk/science>). This will use the two approaches in parallel to estimate rates of gastroenteritis in the community and presenting to GPs, using prospective reporting and recall on a telephone survey. The telephone survey component will investigate rates over two different recall periods. This will help clarify this question.

5.3 Costs of Gastroenteritis in Ireland

5.3.1 The range of estimates

A wide range of sensitivity analyses on costs was carried out (with consequential selection of possible estimates of overall cost). The main estimate of total cost for ROI and NI combined is €135,604,449 (£91,529,748). It has been the policy in this study to err on the side of underestimating the costs where a range of possible values was considered and therefore this may be viewed as a minimum.

5.3.2 Costing in primary care

There are inevitable problems where the basis for costing was different. The costs of primary care in NI were estimated using information for all NHS primary care. There are no fees routinely paid, so it is necessary to apportion the capitation fee over the activity of GPs. Using this information an annual cost of gastroenteritis of €10,466,509 (£7,064,643) and €15,762,917 (£10,639,591) resulted for in-hours and OOHs primary care services operating in NI respectively. In ROI there are transactions between GPs and their patients which can be used as a proxy for cost. Using this information the costs associated with GI for in-hours and OOHs services in ROI were €42,845,977 (£28,920,006) and €33,617,694 (£22,691,137) respectively. Although the decision to use an approach that reflected the payment mechanisms in each jurisdiction can be justified, it is always unsatisfactory to have inconsistent approaches to costing the same thing.

5.3.3 Costing hospital care

To a smaller extent there are similar problems in the ways in which hospital costs were estimated. As discussed above, there are differences in the ways cases are coded between NI and ROI, and differences in the ways unit costs are assessed. However, in neither case is this likely to be a large source of errors. The resulting estimates illustrated an annual cost of hospitalisation associated with GI of €5,755,763 (£3,885,004) and €3,016,349 (£2,035,963) for ROI and NI respectively.

5.3.4 Costing burdens on individuals

The current report has used information from the Telephone Survey to estimate the proportion of GI cases that present to a GP. This estimate may be imprecise, and any error will affect the accuracy of costing the burden of those who do not present to services. There are also potential errors in the valuation of time off work and study. The costs to individuals and their families represent less than 20% of the overall burden, so errors of this sort are relatively unimportant. These translate into costs of €19,399,623 (£13,094,280) and €4,739,616 (£3,199,127) for ROI and NI respectively.

5.4 Further research

This study shows that gastroenteritis imposes a substantial economic burden in ROI and NI. Specifically, the total annual burden is €101,619,057 (£68,590,425) for ROI and €33,985,391 (£22,939,323) for NI. The implication of this is that it is likely that measures to reduce the burden will include some that are highly cost-effective, but more work is needed to assess the current evidence, model different prevention strategies and identify important gaps in knowledge.

Although care has been taken to estimate accurately the burden of gastroenteritis, limitations of the study leave some uncertainty, especially in relation to the costs that fall on people in the community who do not use health services. This could only be achieved with a population based study with data collected on cost generating events and costs in a way similar to what has been done in this study.

The other shortcoming of this research has been the failure to identify with confidence if costs vary between urban/rural and more/less deprived areas. There were several reasons why this was difficult – firstly since the study used retrospective data it was not feasible to obtain permission from patients to access details that would allow geographic and socioeconomic data to be downloaded; secondly the OOH co-ops cover wide areas and the location of centres provides only a poor guide to who are the users; thirdly, GP practices are often located on borders between more/less deprived areas and not easily classified. The limited evidence suggests there may be differences in GI rates according to location and deprivation, but studies addressing this issue need to be conducted.

Perhaps the most important limitation of this research, although not ever part of the planned work, is the lack of definitive diagnostic data on the particular infective agents responsible for the cases. It is likely that a better understanding of the extent to which the cases are preventable, and the best candidate interventions to prevent cases, would be the result of more detailed information on patterns of the different pathogens and the number and severity of cases.

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Appendices

Appendix A: Further Information on Data and Data Collection Tools

A.1 Information sheet relevant to the attached questionnaire

You are being asked to take part in a study called 'The Economic Impact of Gastroenteritis in Ireland'. Thank you for taking the time to read this document.

What is the purpose of this study? We are doing this study to assess the economic impact of diarrhoea across the island of Ireland.

What will this study actually look at?

Specifically this study will look at the number of cases of diarrhoea and in particular the number of diarrhoea cases presenting to GPs. It will identify the effect of diarrhoea on the use of diagnostic and treatment services and estimate the total burden on families and informal carers of cases of diarrhoea.

Who is involved?

Two organisations are involved in this study. The group that is overseeing the study has representatives from the Faculty of Health Sciences, Trinity College, Dublin, and the London School of Hygiene and Tropical Medicine. The project is funded by the Food Safety Promotion Board.

How will this study be carried out?

The study will be carried out by obtaining data from GP practices and hospitals. The questionnaire survey that you are being asked to fill in is another source of information for this project.

What will I have to do if I agree to take part in this study?

You have been asked to participate in a questionnaire survey. To be a part of the study, simply fill out the attached questionnaire. The questions that are asked address the costs that are borne by a patient, their family and carers in the event of a diarrhoea infection. The answers that you give will be used solely for estimating the costs of diarrhoea in Ireland and your identity will remain totally anonymous and will not be divulged.

What are the benefits of participating in the study?

By filling out the questionnaire you will help us to study the rates of presentation of diarrhoea in primary care, the treatments provided for patients and their associated costs, and to explore the impact that diarrhoea has on families and carers of patients.

How long will this study be carried out for?

The study will commence in June 2004 and run over 24 months.

Do I have to participate?

Your participation is completely voluntary. Even if you decide to participate, you can stop at any time you wish or skip any question you choose.

Who can provide additional information if you need it?

Ms. Grace Lordan is co-ordinating this study. Please feel free to contact her:

Grace Lordan

Faculty of Health Sciences,
3-4 Foster Place,
Trinity College Dublin,
Dublin 2.

Telephone 01 608 2185

E-mail lordang@tcd.ie

If you are happy to proceed please indicate that this is so by placing your signature below and continuing onto the questionnaire.

Signature

A.2 Questionnaire

Questionnaire

This questionnaire forms part of a study which has as its aim to examine the rates of presentation of diarrhoea in primary care, the treatments provided for patients and their associated costs and to explore the impact that diarrhoea has on families and carers of patients. Thank you for agreeing to participate in this study. Your answers may help us to estimate and understand the total burden of diarrhoea gastroenteritis on our society.

The results of this survey are strictly confidential and your participation in this research study is greatly appreciated. When filling out the questionnaire you may skip any question that you wish and you may stop at any time. Participation in the study will not affect your treatment in any way, no additional tests or treatments will be involved and it will not affect your statutory rights. Any worries that you may have regarding your condition should be conveyed to your GP.

GP Practice ID: _____

Please complete all the following questions:

Section A Background Patient Information

1. Date of Birth

2. Gender Male Female

Questions 3-6 are relevant to the patient themselves in the case of an adult patient and relevant to the parent/guardian in relation to a child patient:

3. Marital Status Married Single Divorced Separated Widowed

4. Occupation of the patient, in the case of children the occupation of the head of household:
(if they are not at work please indicate their last occupation)

- Self-employed (not farmer)
- Farmer (self-employed)
- Professional/Sen. Managerial
- Other non-manual worker
- Skilled manual worker
- Unskilled manual worker
- Home Maker
- Never worked
- Other

5. At the moment are you:

- Working
- Retired
- Unemployed
- Sick leave

6. Nationality Please State _____

7. Do you have a medical card? [ROI only] Yes No

8. Do you have private health insurance? Yes No

If 'YES' please specify health insurance company: VHI BUPA Other (please state) _____

Section B Patient Medical Information

1. Please specify gastrointestinal symptoms experienced recently:
 - a) Fever Yes No
 - b) Vomiting Yes No
If 'YES', was it 3 or more times per day?
 - c) Diarrhoea Yes No
If 'YES', was it 3 or more times per day?
 - d) Bloody diarrhoea Yes No
 - e) Abdominal pain/cramps Yes No

2. How many days did these particular symptoms last?
(i.e. from date of first symptom to date of return to normal health or to this interview) Days

3. Are you currently experiencing these symptoms? Yes No

4. Did these symptoms incapacitate you? Yes No

5. Did these symptoms interfere with your normal daily activity? Yes No
If 'YES', how many days of work/paid or unpaid did you miss? Days
If 'YES', how many days of school/college did you miss? Days

6. When was the last time that you experienced gastroenteritis? months ago

7. Do you suffer from any long standing illness or disability? (e.g. Asthma, Diabetes etc.) Yes No
If 'YES' please specify nature of long term illness(s):

The next few questions refer to the diarrhoea you had now:

8. Is this your first visit to the GP with since you got ill with diarrhoea? Yes No
If 'NO' please state:

Number of visits to GP surgery	<input type="text"/> Visits
Number of visits by GP to patient at home	<input type="text"/> Visits
Number of visits to Out of Hours surgery	<input type="text"/> Visits
Number of visits of Out of Hours GP to patient at home	<input type="text"/> Visits

9. Did you have a stool specimen taken? Yes No
10. Do you suspect food poisoning?
If 'YES' please state suspected source:

11. Was a sick certificate issued? Yes No
If 'YES', for how many days was sick certificate issued: Days
12. Were you prescribed medicine by your GP for this recent episode? Yes No
If 'YES',
a) Please state name of prescriptive medicine: -----
b) Please state number of days this medicine was prescribed: Days
13. Were any long term medicines prescribed for you? (e.g. antacids, insulin etc.) Yes No
If 'YES' please state name of long term medicine: -----
14. Did you take any non-prescriptive medication before your visit to the GP? Yes No
If 'YES' please state name of non-prescriptive medication: -----
15. Did you continue taking this particular non-prescriptive medication after seeing the GP? Yes No
If 'YES' please specify number of days: Days
16. What treatment was originally recommended by your GP?

17. Was a hospital referral issued? Yes No
If 'YES'
a) Please state name of hospital: -----
b) Please specify type of admission: Emergency admission
Outpatient appointment

Section C Family/Carer Level Information

1. How many members are there in your household?
2. How many are less than five years of age?
3. How many are over sixty years of age?

4. Have any members of your household experienced similar symptoms in the last four weeks? Yes No
If 'YES' how many members of your family/household had symptoms:

5. Were you the first in the household to be ill? Yes No

6. Have any members of your household who were not ill missed work as a result of your illness? Yes No
If 'YES',
a) How many work days were missed? Days
b) Please state occupation of person missing work: _____

7. Have any members of your household who were not ill missed school/college as a result of your illness? Yes No
If 'YES', how many school/college days were missed? Days

8. Have any other people (friends/carers/neighbours) missed work as a result of your illness? Yes No
If 'YES',
a) How many work days were missed? Days
b) Please state occupation of person missing work: _____

9. Did you have any contact, in the 10 days before your illness started, with any other people outside the household who you know were suffering with similar symptoms? Yes No

Section D Transportation Information

1. How far (in km) do you live from the surgery? Km
2. How did you travel to the surgery today?
- a) Walk
 - b) Cycle
 - c) Car (yourself)
 - d) Taxi
 - e) Bus
 - f) Train
3. What was the total cost of the return journey to the surgery? (euro/Sterling)
4. What was the total time that it took you to travel to the surgery?
5. Did someone accompany you to the surgery today? Yes No
- If 'YES', please specify if the person accompanying you had to take time off from:
- Work
 - School
 - Other

6. Please state occupation of person who accompanied you to the surgery today: (If they are not at work please indicate their last occupation).

Self-employed (not farmer)

Farmer (self-employed)

Professional/Sen. Managerial

Other non-manual worker

Skilled manual worker

Unskilled manual worker

Home Maker

Never worked

Other

7. At the moment the individual is:

Working

Retired

Unemployed

Sick leave

8. Did you incur any other expenses as a result of your illness, not already mentioned above?

Yes No

If 'YES',

a) please state amount of expense: (euro/Sterling) _____

b) Please state type of expense _____

THANK YOU FOR ANSWERING THE QUESTIONS.

THIS INFORMATION WILL BE ENTERED ON COMPUTERISED RECORDS AND IS COVERED BY THE DATA PROTECTION ACT. NO INFORMATION WILL BE CONVEYED OUTSIDE THIS STUDY WITHOUT YOUR PERMISSION.

PLEASE ENSURE YOU HAVE SIGNED THE CONSENT FORM AND PROVIDED A CONTACT TELEPHONE NUMBER SHOULD YOU WISH TO BE ENTERED INTO THE PRIZE DRAW.

ALL SURVEYS AND CONSENT FORMS MUST BE COMPLETED & SENT BACK, IN THE STAMPED ADDRESSED ENVELOPE PROVIDED WITHIN 4 WEEKS, TO BE ENTERED IN PRIZE DRAW.

A.3 Search terms used for extraction of potential cases of gastroenteritis from OOH Co-op databases.

Patient Reported Condition:

Patient Reported Condition Quantities

Keyword

Diar, Vomit, Stomach, Food, Gast,
Stools, Bowel, Abd, Tummy, D & V,
D&V, D+V, D AND V, Eaten,
Throwing Up, Nausea, Dehydration

Diagnosis Field

Keyword

Diar, Vomit, Stomach, Food, Gast,
Stools, Bowel, Abd, Nausea, D and V,
D&V, D+V

A.4 Criteria to remove false positive gastroenteritis records from GP in-hours and OOH datasets

Diarrhoea and Vomiting

Like “*DIAR*” And Like “*VOM*” And Not Like “*NO DIAR*” And Not Like “*NO VOM*”

Like “*D&V*”

Like “*D+V*”

Like “*V&D*”

Like “*V&D*”

Like “*V&D*”

Like “*V & D*”

Like “*D AND V*”

Diarrhoea without vomiting

Like “*DIAR*” And Not Like “*NO DIAR*” And Not Like “*NO VOMITING OR DIAR*”

Vomiting without diarrhoea and without pregnancy or alcohol

Like “*VOM*” And Not Like “*NO VOM*” And Not Like “*NO DIARRHOEA OR VOM*” And Not Like “*PREGN*”

And Not Like “*ALCO*”

Sick stomach without pregnancy or alcohol

Like “*STOMACH*” And Like “*SICK*” And Not Like “*PREGN*” And Not Like “*ALCOH*”

Sick tummy without pregnancy or alcohol

Like “*TUMMY*” And Like “*SICK*” And Not Like “*PREGN*” And Not Like “*ALCOH*”

Stomach bug

Like “*STOMACH*” And Like “*BUG*”

Tummy bug

Like “*TUMMY*” And Like “*BUG*”

Gastric flu

Like “*GAST*” And Like “*FLU*” And Not Like “*FLUID*” And Not Like “*REFLUX*”

Gastric bug

Like “*GAST*” And Like “*BUG*”

Viral Gastritis

Like “*GAST*” And Like “*VIRAL*”

Intestinal Infection

Like “*INTEST*” And Like “*INFECT*”

Gastroenteritis

Like “*GASTROENT*” Or Like “*GASTRO-ENT*” Or Like “*GASTRO ENT*”

Like “*GASTRO*” And Not Like “*GASTRO-INT*” And Not Like “*GASTROS*” And Not Like “*GASTROC*”

A.5 ICD codes used to identify hospital admissions of gastroenteritis in ROI (HIPE) and NI of Ireland (HES)

ROI (HIPE)

Applicable ICD-9-CM diagnosis codes

003.0 Salmonella Gastroenteritis
 003.2 Localized Salmonella infections
 003.8 Other specified Salmonella infections
 003.9 Salmonella Infection, Unspecified
 004.0 Shigella Dysenteriae
 004.1 Shigella Flexneri
 004.2 Shigella Boydii
 004.3 Shigella Sonnei
 004.8 Other specified Shigella infections
 004.9 Shigellosis, unspecified
 005.0 Staphylococcal Food Poisoning
 005.1 Botulism
 005.2 Food poisoning due to C. Welchii
 005.3 Food poisoning due to other Clostridia
 005.4 Food poisoning due to Vibrio parahaemolyticus
 005.8 Other bacterial food poisoning
 005.9 Food poisoning, unspecified
 008.0 Intestinal Infection due to E.Coli
 008.41 Intestinal infection due to Staphylococcus
 008.42 Intestinal infection due to Pseudomonas
 008.43 Intestinal Infection due to Campylobacter
 008.44 Intestinal infection due to Yersinia Enterocolitica
 008.45 Intestinal infection due to Clostridium Difficile
 008.46 Intestinal infection due to other anaerobes
 008.47 Intestinal infection due to other gram-negative bacteria
 008.49 Intestinal infection due to other specified bacteria
 008.5 Bacterial enteritis, unspecified
 008.61 Enteritis Due To Rotavirus
 008.62 Enteritis Due To Adenovirus
 008.63 Enteritis Due To Norwalk Virus
 008.64 Enteritis Due To Other Small Round Viruses [SRV's]
 008.65 Enteritis Due To Calicivirus
 008.66 Enteritis Due To Astrovirus
 008.67 Enteritis Due To Enterovirus NEC
 008.69 Enteritis Due To Other Viral Enteritis
 008.8 Intestinal Infection Due To Other Organism, NEC
 009.0: Infectious Colitis, Enteritis, and Gastroenteritis
 009.1 Coillitis, Enteritis, and gastroenteritis of presumed infectious origin
 009.2 Infectious Diarrhea
 009.3 Diarrhea of presumed Infectious origin
 041.4 E.Coli infection in Conditions classified elsewhere and of unspecified site
 041.9 Bacterial infection, Unspecified, in conditions classified elsewhere and of unspecified site
 536.2 Persistent Vomiting

NI (HES)

Applicable ICD-10-CM diagnosis codes

A020 Salmonella enteritis
 A022 Localized Salmonella infections
 A028 Other specified Salmonella infections
 A029 Salmonella Infection, Unspecified
 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
 A050 Foodborne Staphylococcal intoxication
 A051 Botulism
 A052 Foodborne Clostridium perfringens [Clostridium welchii] intoxication
 A047 Enterocolitis due to Clostridium difficile ?
 A053 Foodborne Vibrio parahaemolyticus intoxication
 A058 Other specified bacterial foodborne intoxications
 A059 Bacterial foodborne intoxication, unspecified
 A040 Enteropathogenic Escherichia coli infection
 A050 Foodborne Staphylococcal intoxication ?
 A045 Campylobacter enteritis
 A046 Enteritis due to Yersinia enterocolitica
 A047 Enterocolitis due to Clostridium difficile
 A048 Other specified bacterial intestinal infections
 A049 Bacterial intestinal infection, unspecified
 A080 Rotaviral enteritis
 A082 Adenoviral enteritis
 A081 Acute gastroenteropathy due to Norwalk agent?
 A085 Other specified intestinal infections ?
 A083 Other viral enteritis
 A084 Viral intestinal infection, unspecified ?
 A090 Diarrhoea and gastroenteritis of presumed infectious origin
 A044 Other intestinal Escherichia coli infections

Appendix B: Further rates calculations

B.1 Rates presenting to GP in-hours and OOH practices by urban/rural and deprived/non-deprived strata

Table B.1: Rates of presentation with gastroenteritis to in-hours practices in ROI and NI according to urban/rural location. Rates are per 1,000 person years

Area	No. of cases	Estimated no. of cases in population	Rate (95% CI)
ROI			
Urban (10 GP practices)	1,178	113,546	48.68 (45.94-51.50)
Rural (9 GP practices)	681	65,641	41.47 (38.47-44.70)
Total for ROI	1,859	179,187	45.74 (43.71-47.87)
NI			
Urban (4 GP practices)	369	37,294	33.26 (32.03-36.83)
Rural (1 GP practice)	104	10,511	18.63 (15.38-22.58)
Total for NI	473	47,805	28.37 (25.92-31.04)

Table B.2: Rates of presentation with gastroenteritis to GP in-hours practices in ROI NI according to deprived/non-deprived area. Rates are per 1,000 person years

Area	No. of cases	Estimated no. of cases in population	Rate (95% CI)
ROI			
Deprived (9 GP practices)	538	51,857	56.60 (53.63-59.74)
Non-deprived (10 GP practices)	1321	127,330	31.10 (28.58-33.84)
Total ROI	1859	179,187	45.74 (43.71-47.87)
NI			
Deprived (4 GP practices)	369	37,294	41.32 (37.31-45.76)
Non-deprived (1 GP practice)	104	10,511	13.43 (11.08-16.27)
Total for NI	473	47,805	28.37 (25.92-31.04)

Table B.3: Rates of presentation with gastroenteritis to OOH co-ops in NI according to urban or rural status of residence. Rates are per 1,000 person years.

Urban/rural area	No. of cases	Estimated no. of cases in population	Rate (95% CI)
Urban	34,241	42,982	38.53 (38.12-38.94)
Rural	19,904	24,985	43.86 (43.26-44.48)
Total	54,145	67,967	40.33 (39.99-40.67)

Table B.4: Rates of presentation with gastroenteritis in OOH co-ops in NI separately for deprived and non-deprived areas. Rates are per 1,000 person years.

Deprived/non-deprived area	No. of cases	Estimated no. of cases in population	Rate (95% CI)
Non-deprived	27,148	34,078	49.05 (48.46-49.63)
Deprived	26,997	33,889	34.27 (33.87-34.68)
Total	54,145	67,967	40.33 (39.99-40.67)

Appendix C: Further cost calculations

C.1 Sensitivity Analysis based on confidence intervals

The cost results in Chapter 3 are calculated from rates of gastroenteritis that are based on the various data sources that were collected for this study. As is common in statistics, confidence intervals are produced for these rates and therefore this section is devoted to documenting upper and lower bounds of these costs based on these confidence intervals.

C.1.1 In-hours Practices

Table C.1: In-hours ROI direct costs

Age	Actual	Lower	Upper
Gender = male			
Total	€3,423,877 (£2,311,035)	€2,913,739 (£1,966,705)	€4,051,586 (£2,734,722)
Gender = female			
Total	€4,684,860 (£3,162,168)	€4,092,262 (£2,762,178)	€5,395,412 (£3,641,774)
Strata = urban			
Total	€5,087,586 (£3,433,999)	€4,805,193 (£3,243,390)	€5,386,575 (£3,635,809)
Strata = rural			
Total	€3,021,150 (£2,039,204)	€2,802,552 (£1,891,655)	€3,256,800 (£2,198,262)
Strata = deprived			
Total	€33,003,247 (£22,276,400)	€31,253,958 (£21,095,672)	€34,810,845 (£23,496,485)
Strata = non-deprived			
Total	€10,558,726 (£7,126,887)	€9,709,954 (£6,553,986)	€11,475,400 (£7,745,620)

Table C.2: In-hours NI direct costs:

Age	Actual	Lower	Upper
Gender = male			
Total	€763,622 (£515,427)	€377,304 (£254,671)	€1,070,034 (£722,247,269)
Gender = female			
Total	€1,005,199 (£678,486)	€3,367,379 (£2,272,900)	€4,436,773 (£2,994,715)
Strata = urban			
Total	€1,382,196 (£932,949)	€1,368,482 (£923,692)	€1,396,325 (£942,486)
Strata = rural			
Total	€386,626 (£260,963)	€379,362 (£256,060)	€394,096 (£266,006)
Strata = deprived			
Total	€1,382,196 (£932,949)	€1,368,146 (£923,466)	€1,396,245 (£942,432)
Strata = non-deprived			
Total	€386,626 (£260,963)	€379,141 (£255,911)	€394,110 (£266,015)

Table C.3: In-hours direct and indirect costs: ROI and NI combined

Age	Actual	Lower	Upper
Gender = male			
Total	€763,622 (£515,427)	€377,304 (£254,671)	€1,070,034 (£722,247,269)
Gender = female			
Total	€30,217,897 (£20,396,355)	€25,874,627 (£17,464,752)	€35,664,640 (£24,072,777)
Strata = NI			
Total	€10,466,509 (£7,064,643)	€9,562,614 (£6,454,535)	€11,451,499 (£7,729,487)
Strata = ROI			
Total	€42,845,977 (£28,920,006)	€40,941,901 (£27,634,801)	€44,910,500 (£30,313,510)

C.1.2 OOH practices

Table C.4: OOH direct costs: ROI and NI combined

Age	Actual	Lower	Upper
ROI			
Gender = male			
Total	€1,976,139 (£1,333,846)	€1,916,878 (£1,293,848)	€2,037,529 (£1,375,284)
Gender = female			
Total	€2,642,548 (£1,783,656)	€2,623,248 (£1,736,881)	€2,714,053 (£1,831,921)
NI			
Gender = male			
Total	€1,159,848 (£782,869)	€1,123,338 (£761,226)	€1,197,825 (£808,504)
Gender = female			
Total	€1,692,286 (£1,142,252)	€1,648,587 (£1,112,758)	€1,737,435 (£1,172,727)

Table C.5: In-hours direct and indirect costs: ROI and NI combined

Age	Actual	Lower	Upper
Gender = male			
Total	€20,722,331 (£13,987,076)	€20,086,660 (£13,558,012)	€21,381,799 (£14,432,201)
Gender = female			
Total	€28,658,281 (£19,343,653)	€27,918,187 (£18,844,106)	€29,422,234 (£19,859,302)
Strata = NI			
Total	€15,762,917 (£10,593,118)	€15,562,427 (£10,504,265)	€15,826,818 (£10,682,722)
Strata = ROI			
Total	€33,617,694 (£22,691,137)	€33,340,745 (£22,504,203)	€33,896,944 (£22,879,624)

C.1.3 Hospitalisation

Table C.6: Hospitalisation costs ROI

Age	Actual	Lower	Upper
ROI			
Gender = male			
Total	€2,683,526 (£1,811,316)	€2,454,239 (£1,811,316)	€2,906,146 (£1,961,579)
Gender = female			
Total	€3,072,237 (£2,073,686)	€2,842,353 (£1,918,520)	€3,344,167 (£2,257,233)
NI			
Gender = male			
Total	€1,308,691 (£883,335)	€1,156,950 (£780,914)	€1,490,376 (£1,005,968)
Gender = female			
Total	€1,308,691 (£883,335)	€1,156,950 (£780,914)	€1,490,376 (£1,005,968)

C.1.4 Costs for the Community who do not present

Table C.7: Community costs

Age	Actual	Lower	Upper
Gender = male			
<1	€330,653 (£223,183)	€262,400 (£177,114)	€419,400 (£283,085)
1-4	€1,556,105 (£1,050,334)	€1,314,704 (£887,393)	€1,846,998 (£1,246,679)
5-7	€215,432 (£145,411)	€144,072 (£97,245)	€332,792 (£224,626)
8-17	€1,146,065 (£773,566)	€842,880 (£568,924)	€1,565,270 (£1,056,520)
18-64	€6,283,159 (£4,240,982)	€5,558,422 (£3,751,801)	€7,113,838 (£4,801,670)
65-74	€265,565 (£179,250)	€184,007 (£124,200)	€389,562 (£262,945)
75 +	€239,932 (£161,948)	€149,507 (£100,914)	€388,986 (£262,556)
Total	€10,036,911 (£6,774,674)	€8,455,992 (£5,707,591)	€12,056,846 (£8,138,081)

Table C.7: Community costs

Gender = female			
<1	€759,535 (£512,668)	€590,110 (£398,310)	€983,821 (£664,056)
1-4	€1,074,473 (£725,244)	€898,513 (£606,475)	€1,288,635 (£869,798)
5-7	€565,249 (£381,529)	€387,977 (£261,875)	€827,558 (£558,582)
8-17	€1,653,663 (£1,116,183)	€1,295,419 (£874,377)	€2,128,321 (£1,436,566)
18-64	€9,116,463 (£6,153,394)	€8,291,553 (£5,596,599)	€10,037,133 (£6,774,824)
65-74	€219,121 (£147,902)	€156,354 (£105,535)	€307,761 (£207,731)
75 +	€307,179 (£207,338)	€226,855 (£153,122)	€418,294 (£282,339)
Total	€13,695,683 (9,244,257)	€11,846,781 (£7,996,293)	€15,991,523 (£10,793,876)

C.2 Using Capitation, Fees and Allowances as proxies when costing ROI consultations

Table C.8: In-hours Practices direct costs

Age	Gender = male	Gender = female
<1	€366,512 (£247,387)	€309,215 (£208,712)
1-4	€684,523 (£462,036)	€609,342 (£411,291)
5-7	€118,977 (£80,307)	€130,887 (£88,345)
8-17	€203,229 (£137,175)	€337,176 (£227,586)
18-64	€1,351,745 (£912,395)	€2,272,355 (£1,533,785)
65-74	€141,504 (£95,512)	€153,690 (£103,737)
75 +	€83,429 (£56,313)	€203,942 (£137,656)
Total	€2,949,919 (£1,991,124)	€4,016,607 (£2,711,112)

Table 13: OOH Practices direct costs

Age	Gender = male	Gender = female
<1	€89,222 (£60,223)	€85,337 (£57,601)
1-4	€725,906 (£489,969)	€695,205 (£469,247)
5-7	€184,157 (£124,302)	€169,019 (£114,083)
8-17	€221,575 (£149,558)	€235,696 (£159,089)
18-64	€530,372 (£357,988)	€1,029,246 (£694,716)
65-74	€82,668 (£55,799)	€140,131 (£94,585)
75 +	€142,239 (£96,008)	€287,914 (£194,335)
Total	€1,976,139 (£1,333,847)	€2,642,548 (£1,783,656)

Appendix D: Survey characteristics

Figure D.1: Respondents to Survey Age Breakdown

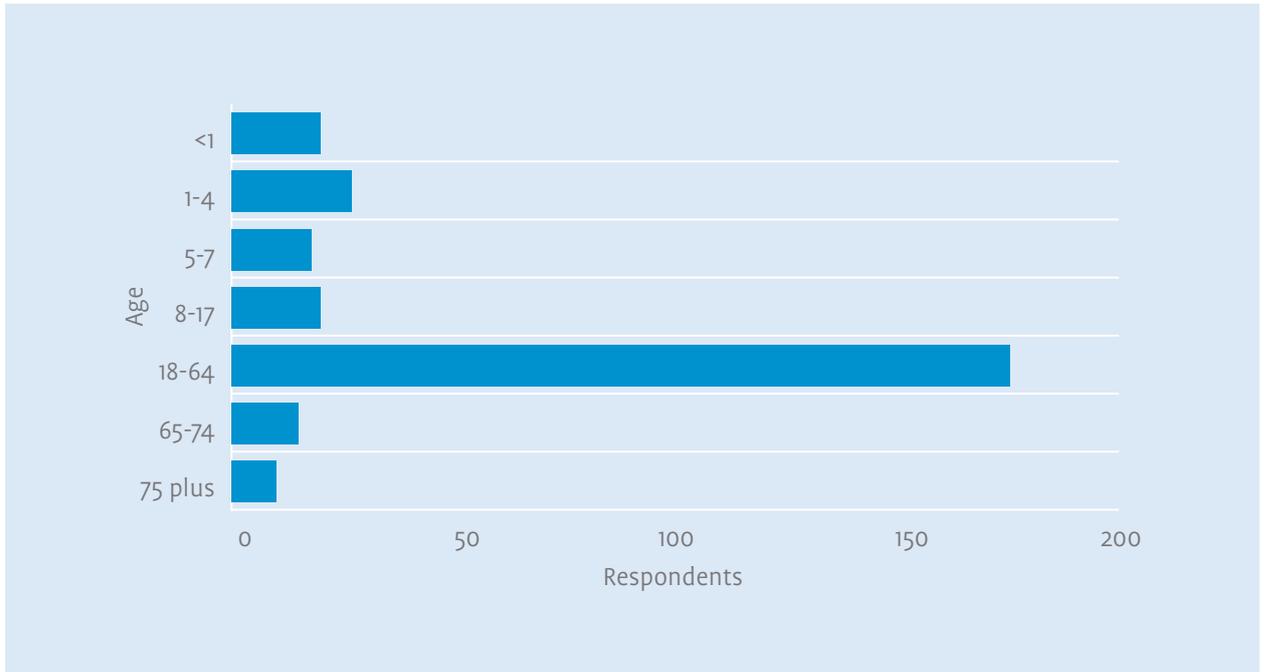


Figure D.2: Practices which distributed surveys by location: Urban/Rural

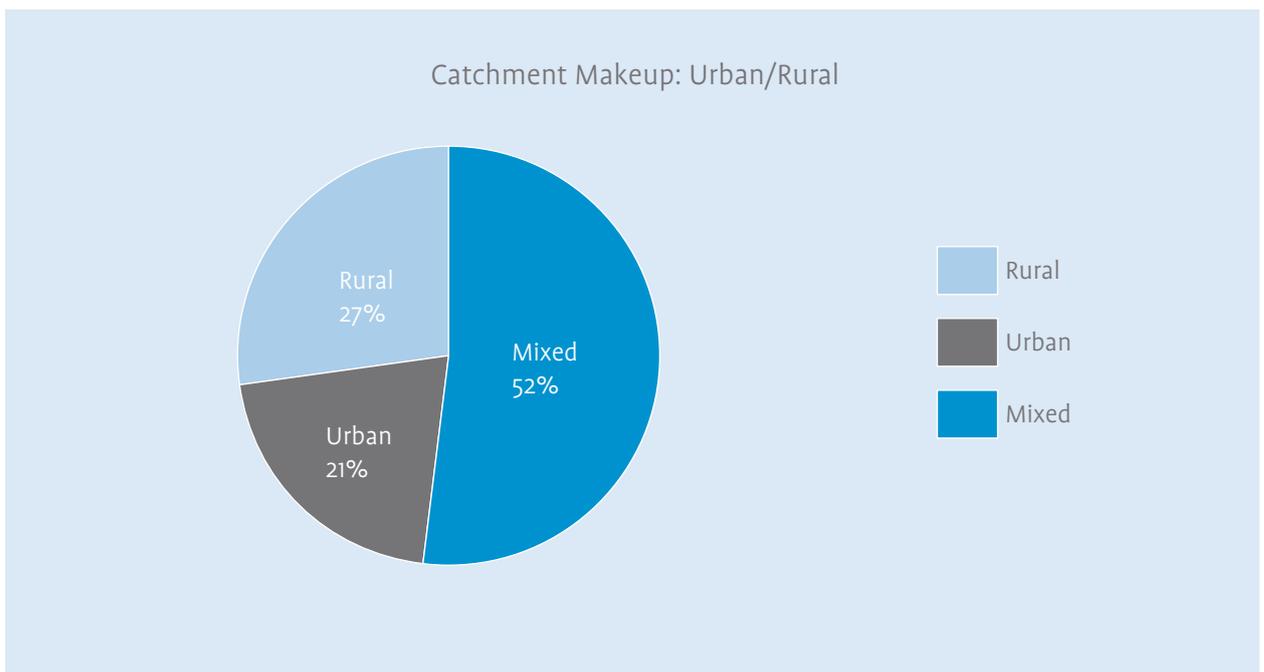


Figure D.3: Practices which distributed surveys by location: Deprived/Non-Deprived

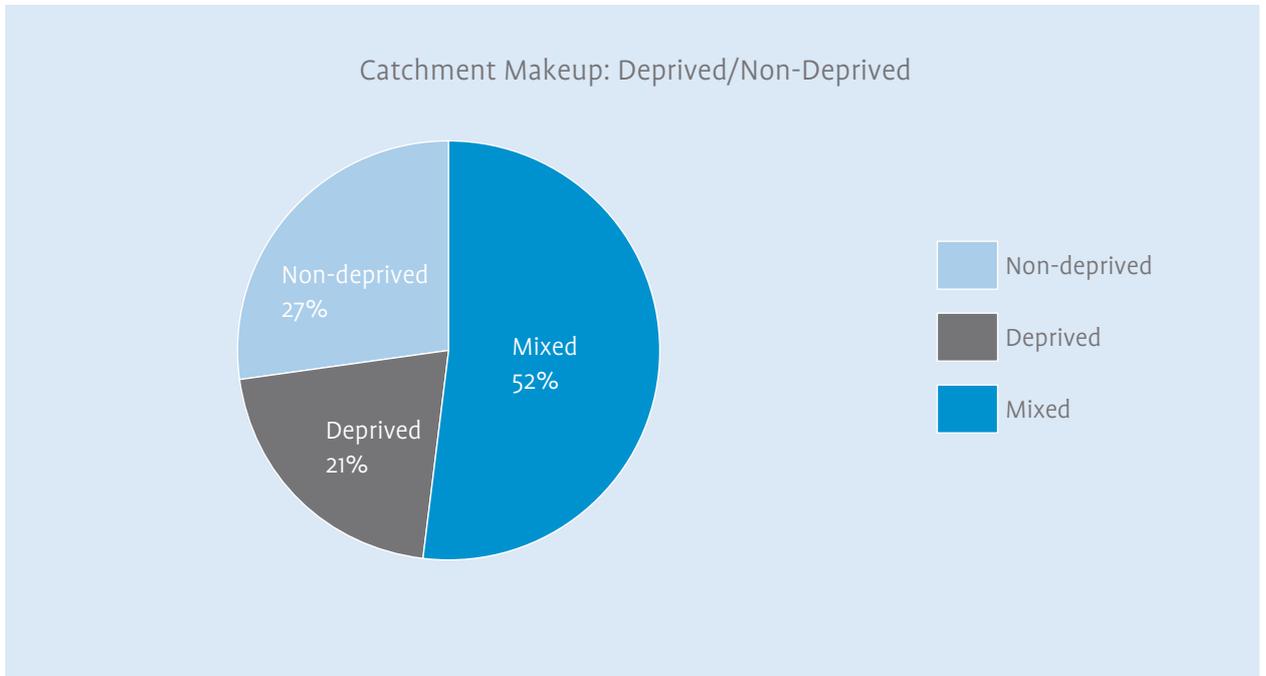


Figure D.4: Respondents by occupation

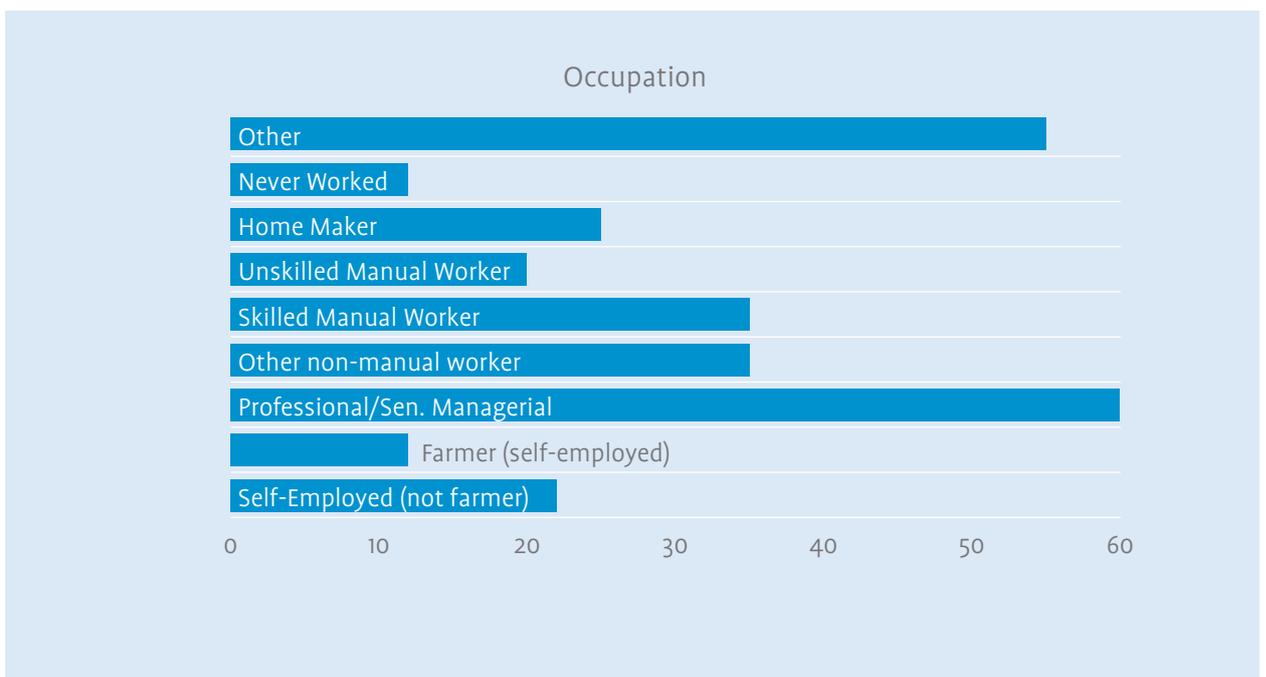


Figure D.5: Respondents' Marital Status

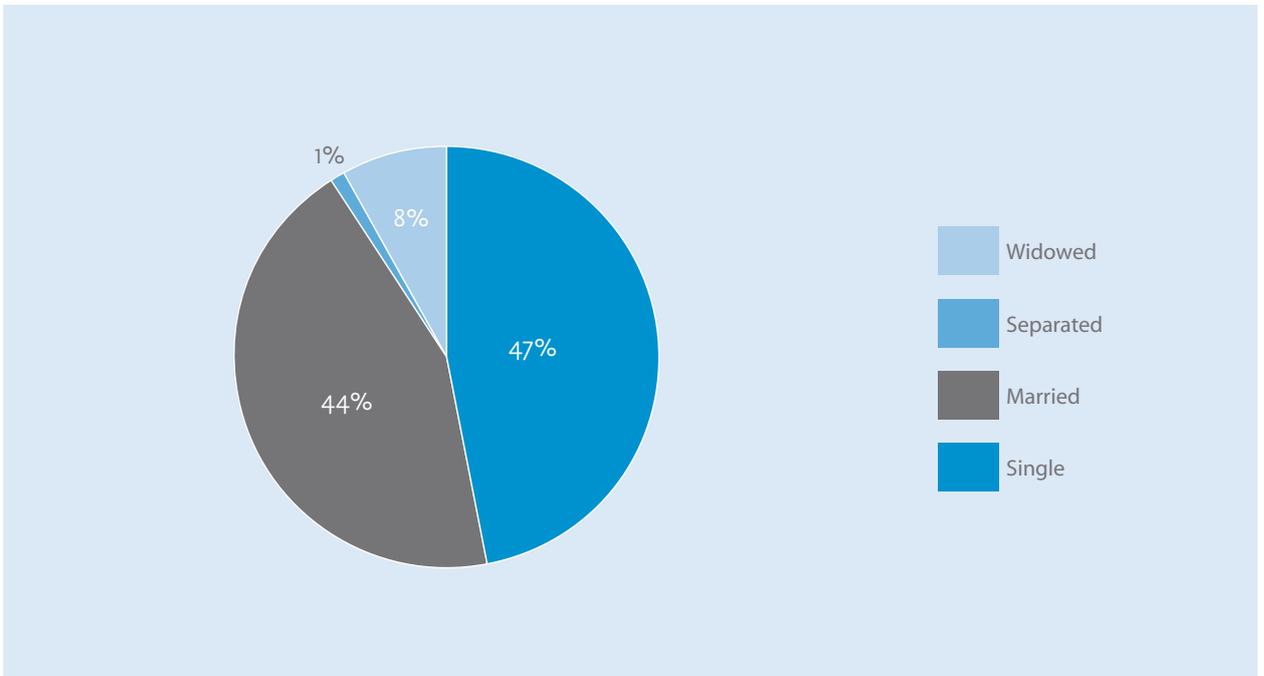


Figure D.6: Respondents' Current Situation

