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The study of infectious intestinal disease in England: socio-economic impact

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SUMMARY

To assess the socio-economic impact of infectious intestinal disease (IID) on the health care sector, cases and their families, cases of IID ascertained from a population cohort component and those presenting to general practices were sent a socio-economic questionnaire 3 weeks after the acute episode. The impact of the illness was measured and the resources used were identified and costed. The duration, severity and costs of illness linked to viruses were less than those linked to bacteria. The average cost per case of IID presenting to the GP was £253 and the costs of those not seeing a GP were £34. The average cost per case was £606 for a case with salmonella, £315 for campylobacter, £164 for rotavirus and £176 for SRSV. The estimated cost of IID in England was £743m expressed in 1994/5 prices. The costs of IID are considerable and the duration of the illness was found to be longer than previous reports have suggested.

INTRODUCTION

This study is the first prospective assessment of the impact and costs of all infectious intestinal diseases (IID) occurring in the community. Many infections are unreported. These undetected cases, though likely to be less severe, are numerous [1]. This study includes such cases. Studies undertaken in the United States, use a modelling approach to calculate the costs of infectious foodborne disease based on estimated incidence rates [2]. This study provides a prospective assessment of cases including those who do not seek medical intervention and delineates costs to the health sector and to cases and their families.

This study arose in response to the interest in economic implications of IID following the Richmond Committee [3] inquiries that reported costs based on studies of salmonellosis [1, 4]. Data collection was conducted between August 1993 and January 1995, analysis took place during 1996–8 and the report of the study was published in December 2000 [5].

AIMS AND METHODS

The aim of the socio-economic component of the IID study was to estimate the impact of the illness on cases

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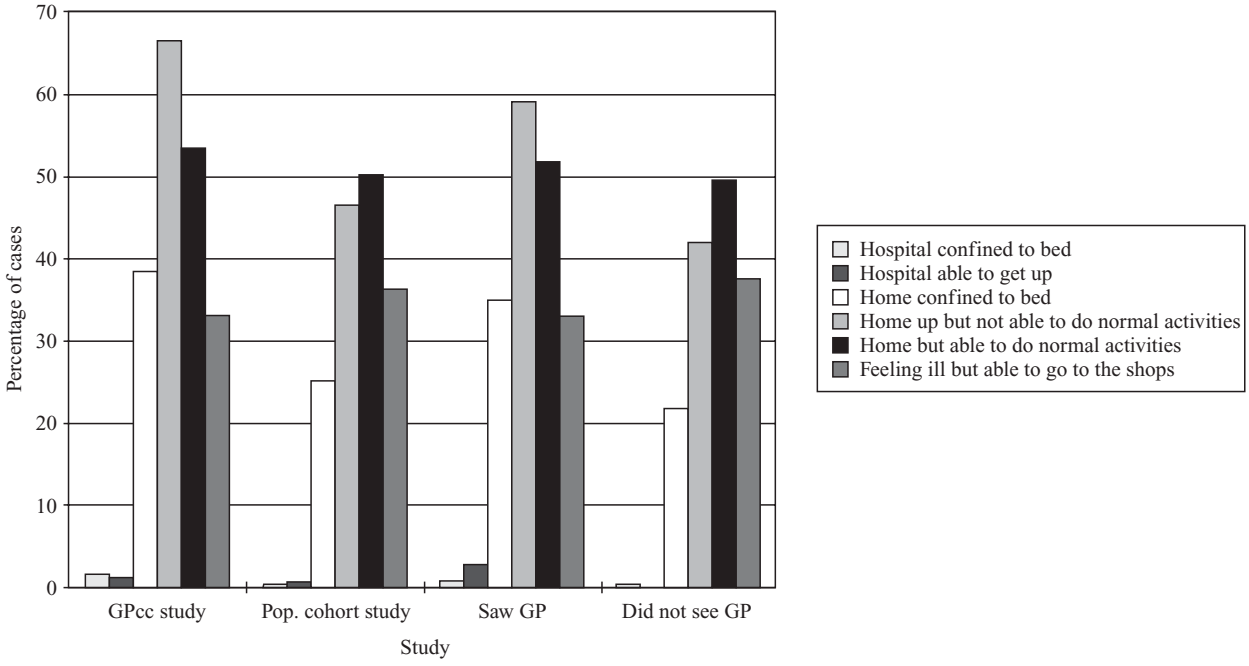
and to identify and cost the resources used. Cases of IID were ascertained from three components: a case control component of patients registered with 34 general practices; and a population cohort component consisting of a sample of selected subjects, from patients' lists in 70 practices, who were sent a risk questionnaire and asked for stool specimens; and an enumeration component of cases from 36 general practices who received routine investigations only. Details of the study design, case definition and testing of stool specimens are presented elsewhere [5–7]. Ethical approval to conduct the inquiry was obtained.

Organism-specific incidence rates were based on data from the case control and population cohort components, as stools of cases in the enumeration study were not tested by the study. The population cohort was also used to estimate the consulting patterns of those who developed IID in the community. In the GP case-control component study and the population cohort component stool specimens were part of the study design. The costs of these were study costs not costs of illness and were thus not included in the cost analysis. The enumeration component was used to assess the normal practice of sending specimens for testing. Details of the methods are provided elsewhere [5, 7, 8]. A socio-economic questionnaire was sent to all cases 3 weeks after the start of the acute episode. Data on age, sex and social class, from the risk factor questionnaire, and the laboratory results were linked to the socio-economic questionnaire data. The results of the socio-economic analysis are reported here for all cases in the GP case-control component and those in the population cohort component. For details of the enumeration component consult the full report [5]. The cases in the population component are analysed in two groups, those who saw a GP and those that did not. The analysis includes all cases of IID and is provided by organisms where there were sufficient numbers for robust cost estimates to be derived: all salmonellas and *S. enteritidis*; all campylobacters and *C. jejuni*; enterovirulent *E. coli* and enteroaggregative *E. coli* (EAggEC); rotavirus and rotavirus group A, *Clostridium difficile*, and small round structured virus (SRSV) [7].

The impact of the illness on the activities of daily living were measured on a scale that began with a hospital admission, where the case was confined to bed, and followed an ordering from most severe to least severe, i.e. from hospitalization to full participation in all normal activities in the home and outside. The use of National Health Service (NHS) resources was identified from the questionnaires. Costs estimates were based on vectors of costs for items of service, e.g. a GP visit, a day spent in hospital or a test sample. The costs of hospital in-patient stay, Accident and Emergency Department (A&E) visits and out-patient visits were estimated based on Chartered Institute of Public Financial Accountants' health data [9] for hospitals having characteristics of those admitting cases of acute infections. Costs of using GP and community services were estimated using data from the Personal Social Services Research Unit data base [10]. As cases were studied over 2·5 years. The costs were aggregated and mid-point estimates were used. Prescription charges were used as a guide to prescription costs as it was not possible to estimate ingredient costs or administration costs precisely as the details of drugs, dose or length of treatment were not reported. As an additional check on this method a small sample of doctors was asked to describe the normal treatment that they would offer for intestinal infectious disease. These responses elicited treatment regimes that varied in price from less than £2 to more than £12.50. Weights for the likelihood of prescribing each item were not available but in so far as the professionals were able to comment they considered that the normal treatment would have been at the lower end of the distribution. Given this uncertainty the prescription charge was used as a surrogate for costs of the prescribed drugs. These costs can be adapted when new material becomes available. Prescription payments from those who were not exempt were deducted from NHS costs and added to patients' costs. Costs of laboratory tests were estimated from a survey of participating laboratories and interpreted in the light of the Audit Commission report [11]. Estimates of direct out-of-pocket expenses were provided by cases responding to the questionnaire who were asked the cost of items purchased because of the illness. Costs to persons who accompanied cases to GP surgeries and hospitals and those staying with children in hospitals were also collected. Time off work was estimated from reported absences and valued using the New Earnings Survey for 1995 [12]. Information on the age of those caring for and accompanying cases was not collected. The estimates of time off work were adjusted for gender and occupational grouping, these were the main determinants of wage differences.

Statistical analysis of a study where two vectors, in this case numbers and costs, are combined presents a problem for estimations of the relevant confidence intervals. For this reason confidence intervals have



Source: Socio-economic survey

Fig. 1. The impact of illness: percentage of cases reporting spending time in the different stages, by study.

been provided for the estimated number of events. Geometric means are given to report the number of events as the data is highly skewed but arithmetic means were used to estimate costs. A sensitivity analysis was applied to the costs, assuming the vectors were increased or decreased by 10, 20 and 50%, to indicate the likely boundaries of costs. The robustness of the estimates was considered in this context.

RESULTS

A total of 4389 cases completed the socio-economic questionnaire. The response rate from the study population was 41% (1652/4026 cases) in the GP case-control component, 80% (555/675 cases) in the population cohort component, and 46% (2182/4744 cases) in the enumeration component. Sixty-three percent in the GP case-control component and 82% of those in the population cohort component returned both a risk questionnaire and a socio-economic questionnaire. The cases returning the socio-economic questionnaire were not significantly different to those in the other components in respect of age, sex, and social class [6].

Characteristics of the cases

A total of 373 (8·5%) were under 1 year old, 859 (19·6%) were under 5; 459 (10·5%) were over 5 and under 16 years old; 1888 (43%) were adults under 60 years of age and 673 (15·3%) adults over 60 years of age. Age was missing for 137 cases. There were more male children under 16, (47% males and 37% females), but more female adults (49%) than males (38%).

The case reported was the only person affected in over 80% of households if the case was an adult but in only 60% of households if the case was a child. The other person in the home most likely person to be ill, if the case was a child, was the mother and if the case was an adult it was the partner of the case.

Characteristics of the illness – activities of daily living

The impact of the illness for each study component for those who did and those who did not consult a GP is shown in Figure 1. Proportionately fewer cases were admitted to hospital from the GP case-control component than those from the population cohort cases who saw a GP (1·8 and 4%, respectively, $P = 0{\cdot}063$). Most adults between 16–60 years of age

reported spending time in bed at home because of illness. A total of 38% of cases in the GP case-control component reported being 'confined to bed' for 3 days and 25% of cases in the population cohort component for nearly 2 days on average. The most frequently reported stages were 'at home but not able to do normal activities' and 'at home able to undertake normal activities'. In the GP case-control component 67 and 53% of cases reported being in these stages for 4·5 days on average. In the population cohort component 47 and 50% of cases reported being in these stages for 2·5 days on average. In the GP case-control component 54% of cases with salmonella and 52% of cases with campylobacter reported being at home 'confined to bed' for 4 days and 3·5 days, respectively. Seventy-six percent of cases with these infections reported being at home 'not able to do normal activities' for an average of 4·5 days.

In the GP case-control component 30% of all IID cases reported losing 6 days from education while 54% of cases with salmonella reported losing 4·5 days. Children reporting time off school reported an average of 4 days and adults, 16 years of age and over, lost an average of 7 days education. In the population cohort component those who saw a GP lost 4 days and those who did not, 2 days.

In the GP case-control component 42% of all adult cases with IID reported losing time off work. This group lost an average of 6 days paid employment (range 1–80 days). Cases with salmonella reported 9 days off work on average (of which those with *S. enteritidis* reported 7 days), campylobacter 6 days, enterovirulent *E. coli* 5 days, rotavirus 4 days and SRSV 3 days. In the population cohort component only 20% of adults reported time off work, those who had seen a GP reported an average of 3 days whilst those who had not 2 days.

In the GP case-control component about 5% of cases reported exclusion from school or work because of the risk of their spreading infection. These cases were away for an average of 6 days. In the population cohort component 3% were excluded from work or school for an average of 2 days.

In the GP case-control component 26% men and 49% women reported not being able to undertake normal household duties. These cases reported being unable to do normal activities for 5 days on average. Fifty percent of salmonella cases reported an average of 7 days, 39% of *Clostridium difficile* and SRSV cases reported 3 days. In the population cohort component 25% of cases reported an average of 2 days.

In the GP case-control component study 724 cases (44%) reported an average of 8 days lost leisure. Cases with salmonella or EAggEC reported an average of 10 days and rotavirus and SRSV cases 7 and 5 days, respectively. In the population cohort component 36% of those who had seen a GP reported 6 days and 34% of those who did not reported 3 days lost leisure.

Use and costs of resources to the NHS

Costs are reported as average costs for all IID cases in the component unless otherwise specified (Tables 1, 2).

Hospital care

A total of 29 cases (1·8%) in the GP case-control component were in hospital for 4 days on average. Of these five children (3·5%) under 1 year of age were hospitalized. In the GP case-control component the cost of hospitalization was £15.66 per IID case. Six cases, (4%) of those who saw a GP, in the population cohort component were hospitalized. The average cost per IID case was £13.18 for those who had seen a GP.

Twenty-three cases (1·4%) in the GP case-control component visited A&E. All those under 1 year of age and those over 60 in the GP case-control component study who visited A&E were admitted to hospital. Six cases (1·1%) in the population cohort component visited A&E, four were admitted. All had seen a GP.

In the GP case-control component 20 cases (1·2%) attended out-patients' on 37 occasions. In the population cohort component 7 cases visited out-patients' on 20 occasions (4·6% of cases seeing a GP).

General practice care

Consultations with GPs took place in the surgery, in the patients' homes and by telephone. All cases in the GP case-control component should, according to the study design, have consulted a GP. In the population cohort component 149 (27%) cases reported consulting a GP.

In the GP case-control component 457 cases (22%) were visited at home. The average cost was £13.59 per case. Eighty-five cases (40%) of those over 60 years of age had home visits. Salmonella cases had the highest cost for GP consultations per case followed by rotavirus cases. In the population cohort component 7% of cases had a GP consultation at home.

In the GP case-control component 87% of cases visited the surgery, 24% made more than one visit. The average cost for those visiting the surgery was

Table 1. *Average cost per case to the NHS by category of cost and study*

Cost category	GP case-control component ($n=1652$)	Population cohort component – those who saw a GP ($n=149$)	Population cohort component – total ($n=555$)
Primary care costs			
GP home visit	13·59	16·72	4·49
GP surgery visit	20·45	18·48	4·96
Transport to GP	0·95	0	0
Phone GP	0·98	0·77	0·21
Nurse home visit	0·61	0·24	0·06
Prescriptions	2·19	2·69	0·72
Total	38·77	38·9	10·44
Percentage	62·12	36·31	36·45
Laboratory costs			
Stool test	5·30	5·30	1·42
Blood test	0·18	0·22	0·06
Urine test	0·58	1·20	0·15
Specimen collection	0·02	·02	0·02
Specimen postage	0·01	·01	0·01
Total	6·09	6·75	1·66
Percentage	9·76	6·30	5·8
Hospital costs			
Hospital admission	15·66	49·00	13·18
A&E visit	0·49	1·09	0·29
OPD visit	1·01	6·30	1·70
Transport to hospital	0·39	5·10	1·37
Total	17·55	61·49	16·54
Percentage	28·12	57·39	57·75
Total	62·41	107·14	28·64

£20.45 per IID case (see Table 1). The children under 1 year of age had the highest proportion of multiple visits, 35% made two or more visits. Surgery visits were highest for cases with *C. difficile*, £23.61 per case (Table 2). In the population cohort component 80% of cases consulting a GP did so at the surgery; 59% visited once. The average cost of visiting the GP at the surgery in this component was £4.96. Most visits were made either by adults under 60 years old or children under 1 year old. In each study component up to 29% of cases telephoned the GP and 2·5% of cases were visited by a nurse.

Investigations

In the enumeration component 33% of cases returning the socio-economic questionnaire had a stool test. This rate was used to estimate costs of routine tests in the GP case-control component and population cohort component studies. Four percent of cases reported having had a blood test, 6% of cases reported having had a urine test.

Treatments

The proportion of cases receiving a prescription was similar in each study component (41–44%) and averaged 1·4 prescriptions per case.

Total NHS

The total cost per case to the NHS was £62.41 for cases in the GP case-control component and in the population cohort component £28.64 for all cases in the cohort and £107.14 per case for cases visiting a GP (see Table 1). The highest cost per case to the NHS by organism was £131.79 for salmonella cases in the GP case-control component (Table 2). Hospital costs represented 30% of the total NHS costs and the highest were for those with salmonella (Table 2).

Table 2. *Average cost per case to the NHS by category of cost and organism GP case-control component*

	No. IID organism ($n=663$)	*Salmonella* sp. ($n=90$)	*S. enteritidis* ($n=59$)	*Campylobacter* sp. ($n=192$)	*C. jejuni* ($n=172$)	*E. coli* ($n=197$)	Enteroaggregative *E. coli* ($n=65$)	*C. difficile* ($n=18$)	Rotavirus ($n=122$)	Rotavirus Gp3 ($n=119$)	SBSV ($n=83$)
Primary care costs											
GP surgery visit	18·72	21·53	19·31	19·39	19·27	21·83	21·97	23·61	20·34	20·57	16·80
GP home visit	11·56	21·41	24·69	16·16	16·12	8·59	10·12	10·44	20·03	20·14	13·02
Transport to GP	0·79	0	0	0·78	0·87	0·38	0	4·17	0·61	0·63	0
Phone GP	0·74	1·59	1·69	1·29	1·23	0·71	0·71	1·13	1·67	1·69	0·80
Nurse home visit	0·51	0·93	1·02	0·69	0·77	0·67	0·18	0	0·89	0·91	0·29
Prescriptions	1·78	1·70	0·94	2·10	1·85	3·15	2·56	1·68	2·80	2·63	2·13
Laboratory costs											
Blood test	0·17	0·20	0	0·07	0·08	0·14	0·23	0·11	0	0	0·05
Urine test	0·77	0·40	0·46	0·09	0·05	0·32	0·28	0	0·37	0·38	0·33
Specimen collection	0·02	0·07	0	0·03	0·03	0·02	0	0·11	0	0	0·01
Hospital costs											
Hospital admission	15·95	81·25	0	8·79	5·89	15·99	0	0	0	0	2·71
A&E visit	0·41	0·60	0	0·28	0·31	0·55	0·83	0	0	0	0·33
OPD visit	1·63	0	0	0·23	0	0·69	0	0	0	0	0·54
Transport to hospital	0·24	2·11	0	0	0	0·48	0	0	0	0	0
Total	53·29	131·79	48·10	49·90	46·47	53·52	36·89	41·14	46·71	46·95	36·99

Table 3. *Average direct costs* (£) *to cases by category of cost, by study*

		Population cohort component	
	GP case-control component ($n=1652$)	Those who reported seeing a doctor ($n=149$)	All those in the case community study ($n=555$)
Primary care costs			
Phone GP	0·38	0·30	0·08
Prescriptions	1·29	0·98	0·26
	1·67	1·28	0·34
Miscellaneous costs			
In hospital	0·13	0·15	0·04
AT OPD	0·01	0·01	0·003
Accommodation in hospital for carer	0·21	0·61	0·16
On holiday when ill	1·08	0·46	0·14
At home when ill	10·81	9·00	5·07
	12·16	10·23	5·41
Transport costs			
To GP	1·00	1·3	0·36
To hospital	0·48	0·53	0·14
To laboratory	0·03	0·04	0·01
	1·51	1·87	0·51
Total	15·42	13·38	6·26

Resource use and direct costs to cases and carers

Average direct expenses to cases were £15.42 per case in the GP case-control component and £13.38 for those in the population cohort component who saw a GP (Table 3). Cases with *S. enteritidis* had the highest cost per case in both the GP case-control component and in the population cohort component: £31.89 and £12.25, respectively. SRSV cases cost £12.11 and £6.67, respectively, similar to cases who had IID but with no target organism identified.

The person staying with children in hospital was the mother in 82% of cases. Those accompanying cases to A&E and out-patients' departments were most likely to include other family members.

The average costs to cases of days lost employment per case was £140 in the GP case-control component, and £52 in the population cohort component for those who saw a GP and £17 for those that did not (Table 4). In the GP case-control component 706 (42%) cases reported that they were cared for at home. These cases were looked after for an average of 8 days. In the population cohort component 211 cases (42%) reported care in the home. These cases were looked after for an average of 4 days. In the GP case-control component the carers' lost work was valued as £36 per case. In the population cohort component carers lost work worth £29 per case for those that saw a GP and £13 for those that did not (Table 4).

Total costs of IID

The cost per IID case was £253.78 in the GP case-control component. In the population cohort component the cost was estimated to be £201.69 for those who had seen a GP and £34.31 for those who had not (Table 4).

The NHS costs represented 25% of total costs in the GP case-control study and 53% of costs in the population cohort component for those who saw a GP. Direct out-of-pocket expenses were a similar proportion of costs in each study component; the absolute costs were highest for salmonella and lowest for SRSV.

Sensitivity test

Geometric means with 95% confidence intervals are given for numbers of visits and contacts with GPs and home nurses, tests, prescriptions and visits to A&E (Table 5). The confidence limits for hospital

Table 4. *Summary of average total cost per case by category of cost and study*

	GP case-control component ($n=1652$)		Population cohort component – those who saw a GP ($n=149$)		Population cohort component – those who did not see a GP ($n=406$)	
Cost category	£	%	£	%	£	%
NHS costs						
Primary care	38·77	15·2	38·90	19·3	0	
Hospital	17·55	7·0	61·49	30·5	0	
Laboratory	6·09	2·4	6·75	3·3	0	
Direct costs to cases and families	15·42	6·0	12·77	6·3	3·72	10·8
Employment costs						
Cases	139·97	55·2	52·82	26·2	17·21	50·2
Carers	35·98	14·2	28·96	14·4	13·38	39·0
Total	253·78		201·69		34·31	

admissions, out-patients and accommodation in hospital were large. The largest variation was for days ill at home and for days ill on holiday. Some variation would be expected because of the diversity of conditions, the range of severity and the small number of cases in some categories, i.e. hospitals admissions. It also reflects the skewed distribution of illness experienced by cases with a small number experiencing prolonged symptoms.

The robustness of these estimates together with the cost vectors used allow us to consider the likely sensitivity of the results. Estimated direct costs to cases and those who looked after them were itemized in some detail and it is considered that these are robust estimates lying within the 10% sensitivity band. If hospitalized cases were under-reported in the general practice cohort component then this would make a substantial difference to costs. Costs of lost employment might also have been higher than those estimated as the time costs of caring for the full period of the illness was not included because adjustments would have been needed for time taken on combined household activities, and these adjustments could not be made without further studies in households.

Estimation of cost of IID in England in 1994

Using the ratios of laboratory reports to cases estimated in this study and applying these to the cases in the population cohort component and applying these in turn to the population estimates [5, 13] enabled some broad calculations of the total costs of IID for England to be made. The cost of illness of the major organisms detected and IID with no target organism was estimated (Table 6). Assuming that the illness experienced by reporting cases reflected the illness estimated in the population cohort component during the study period the total costs of cases of IID, was estimated to be £742.8 million or £78.89 per case. The NHS costs represented 36·5% of these figures. Using an alternative assumption based on the estimated cost for those who did not see a GP in the population cohort component and those who saw a GP in the GP case-control component study the estimated cost was £676.9m.

DISCUSSION

The burden of the illness is predominantly felt in the community but the few cases admitted to hospital represented 58% of the NHS costs in the population cohort cases who had seen a GP and 28% in the GP case control study. Cases with IID use resources that could be used for other patients. The costs are, thus, likely to reflect the opportunity costs of use of scarce hospital resources and GP time. The avoidance of these costs may not result in substantial financial savings in the short term but investment to reduce the incidence of the illness may show savings in the long term if cost-effective prevention strategies can be developed.

In the cases that consulted GPs reported more severe symptoms than those who did not, their illness lasted longer and they incurred more NHS and personal costs. The low costs of those who do not see

Table 5. *Geometric means and 95% confidence intervals for resources used by study*

	GP case-control components			Population cohort component study		
	$n=1652$	Geometric mean	95% confidence interval	$n=555$	Geometric mean	95% confidence interval
Items which contribute to NHS costs	no.			no.		
GP home visits	352	1·19	0·58–2·43	41	1·19	0·59–2·41
GP surgery visits	1329	1·27	0·55–2·91	115	1·26	0·56–2·87
Phone cells to GP	420	1·30	0·57–2·99	34	1·22	0·58–2·55
Nurse home visits	53	1·28	0·49–3·37	3	1	
Blood tests	60	1·36	0·54–3·45	6	1·59	0·52–4·81
Urine tests	82	1·16	0·60–2·23	9	1	
Specimen collection	26	1·20	0·56–2·55	3	1	
Prescriptions	403	1·29	0·53–3·15	46	1·35	0·53–3·43
Items which contribute to direct costs to cases						
Prescriptions	267	1·30	0·54–3·11	20	1·28	0·58–2·83
A&E visit	20	1·37	0·60–3·11	5	1·15	0·63–2·11
Hospital admission	29	2·49	0·38–16·40	6	2·61	0·17–39·97
OPD visit	18	1·59	0·45–5·58	7	2·48	0·72–8·58
Accommodation of parent in hospital	27	2·63	0·43–16·11	5	3·62	0·59–22·20
Ill on holiday	41	14·62	0·88–242·25	7	6·36	0·87–46·47
Ill at home	1194	6·24	0·34–113·23	287	3·83	0·18–82·27

Table 6. *Total costs of IID in England 1994 for all IID and by organism. Estimates based on estimates of costs from the population cohort component and GP case-control component*

Organism	Estimate (million £)	NHS costs General practice	NHS costs hospitals	NHS costs Laboratories	Direct costs to cases and families	Employment costs (cases)	Employment costs (carers)
Estimated total costs for all IID using population cohort component estimate							
All IID	742·8	98·0	157·5	15·6	57·2	251·1	163·4
Estimated total cost for all IID using estimates from Population cohort component for those who did not see a GP and estimates from the GP case-control component for those presenting to a GP							
All IID	676·9	62·5	28·6	9·8	53·6	360	162·4
No target organism	318·5	24·6	13·1	0·7	27·2	174·7	78·0
Salmonella	46·4	3·6	6·4	0·05	2·7	28·2	5·4
Campylobacter	69·6	8·1	1·9	0·04	4·6	48·4	6·5
E. coli	69·3	7·7	3·9	0·1	7·3	27·1	23·2
C. difficile	5·6	0·4	0	0	0·3	1·5	3·4
Rotavirus	18·2	5·1	0	0·04	1·9	2·6	8·5
SRSV	24·4	3·2	0·3	0·04	2·3	7·6	10·9

a GP are striking and do not reflect the normal understanding of these cases gathered from outbreak studies [14]. Lower costs might also be expected because the IID cases in this study include viruses whilst those reported in other studies were associated with bacteria. Illness due to all serotypes of salmonella appeared to last longer and be more severe than illness due to *S. enteritidis*. This is compatible with other studies [14–16].

The costs of IID captured in this study are likely to be an underestimation as no estimate has been made of the impact of IID in institutions, e.g. hospitals, prisons. Also some rare organisms, that are likely to be more expensive to treat, were not found in sufficient

numbers to obtain accurate estimates, e.g. *E. coli* O157 [16, 17]. The estimates of hospital cost may be underestimated, as the 1·8% of cases hospitalized in the GP case-control component was lower than the 3·6% of cases in the enumeration component, and 4% of patients in the population cohort who saw a GP. Some of the more severe cases may not have been ascertained in the GP component because they were either in hospital or too sick to participate [5, 7]. The relationship between IID and other underlying morbidities may have affected the length and severity of the illness but it has not been possible to explore these interactions.

The study does not include a measure of the health status of cases experiencing the illness because there are methodological problems of applying these measures during the acute phase of an illness. Nor are the costs of sequelae included. No value has been placed on loss of life attributable directly or indirectly to IID. Nor has any value been placed on time lost from education or leisure. The hours lost are considerable and could be valued in extended work. The public health costs of monitoring and investigation, apart from the costs of some laboratory tests, have not been included. These are often substantial in outbreaks [14]. No costs to industry other than those associated with time away from work are included.

Comparable costs from other studies are only available for the salmonella and campylobacter cases [2]. The costs estimated appear lower than those estimated elsewhere [1]. This difference is probably explained by the items of costs included and by the case mix, as this study ascertained cases in the population who would not normally present to a GP and many of the previous studies have estimated costs in outbreaks that may include more severe cases and have high public health costs [14]. Costs estimated in studies in the United States are from models and reflect costs in a different health care system [2]. These estimates, particularly the costs attributed to campylobacter, are not directly comparable as they include the costs of sequelae and values for lives lost [18, 19].

Sensitivity analysis indicates that apart from hospitalization and use of out-patient services the estimates appear to be robust. Changes in the estimated distribution of cases attributed to bacteria and viruses would affect aggregate costs. Duration and severity of the illness indicated that duration and severity were significant variables in determining costs although the proportion of costs explained by these variables was low.

The study has demonstrated the severity and high costs of the illness, adding another reason for the development of interventions to reduce IID.

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