VALUE IN HEALTH REGIONAL ISSUES 2 (2013) 210–217

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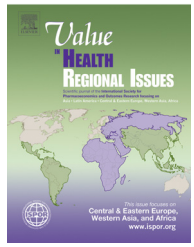

Costs of Medically Attended Acute Gastrointestinal Infections: The Polish Prospective Healthcare Utilization Survey

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ABSTRACT

Objectives: The burden of acute gastrointestinal infections (AGIs) on the society has not been well studied in Central European countries, which prevents the implementation of effective, targeted public health interventions. **Methods:** We investigated patients of 11 randomly selected general practices and 8 hospital units. Each patient meeting the international AGI case definition criteria was interviewed on costs incurred related to the use of health care resources. Follow-up interview with consenting patients was conducted 2 to 4 weeks after the general practitioner (GP) visit or discharge from hospital, collecting information on self-medication costs and indirect costs. Costs were recalculated to US dollars by using the purchasing power parity exchange rate for Poland. **Results:** Weighting the inpatient costs by age-specific probability of hospital referral by GPs, the societal cost of a medically attended AGI case was estimated to be US $168. The main cost drivers of direct medical costs were cost of hospital bed days (US $28), cost of outpatient pharmacotherapy (US $20), and cost of GP consultation (US $10). Patients covered only the cost of outpatient pharmacotherapy. Considering the AGI population GP consultation rate, the age-adjusted societal cost of medically attended AGI episodes was estimated at US $2222 million, of which 53% was attributable to indirect costs. **Conclusions:** Even though AGIs generate a low cost for individuals, they place a high burden on the society, attributed mostly to indirect costs. Higher resources could be allocated to the prevention and control of AGIs.

Keywords: direct medical costs, direct nonmedical costs, gastrointestinal infections, indirect costs, Poland.

Introduction

Acute gastrointestinal infections (AGIs) can be caused by viruses, bacteria, and parasites, as well as through physical or chemical intoxications. Symptoms and high incidence of AGIs may put a substantial burden on patients and the health care system—from medical, social, and economic perspectives. An estimation of the true burden of AGI symptoms on the society, however, is difficult [1]. In developed countries, AGIs are common but usually do not cause severe disease. Sufferers frequently downplay its significance, and doctors often do not trace the causes of individual cases. The majority of AGIs in Poland are not treated at all or are treated with rehydration and/or over-the-counter drugs [2,3]. For these reasons, economic consequences of AGIs are not properly assessed and thus their true burden is underestimated.

Available scarce evidence indicates that the societal cost of the so-called mild gastrointestinal illnesses is considerably higher than the costs associated with acute hospitalized cases [4]. To date, high-quality evidence on burden and costs to the society has been collected mostly for rotavirus-associated AGIs—in relation to both ambulatory care [5,6] and hospital settings [7–9]. Costs for AGIs caused by other pathogens have not been well documented, although recent evidence indicates that costs for AGIs caused by different etiological factors can be similar [10].

Poland, located in Central Europe, with its 38.4 million habitants is the 34th most populous country in the world and the 6th largest country in the European Union. The gross national product per capita is almost US $16,710 [11]. The overall quality of health care provision nationwide, as judged by European standards, is regarded as being high, which is reflected in the nation's average life expectancy, estimated at 71 years for men and 80 years for women [11]. Poland's health care system is based on an all-inclusive social insurance system. An insured person and members of his or her family are entitled to free health services offered by providers who have signed contracts with the National Health Fund. The National Health Fund is a state-owned third-party payer. It finances health services and assures reimbursement of medicines. There is a rapidly growing private sector consisting of private general practitioners' (GPs') and specialists' practices and rarely private clinics and hospitals, paid on a fee-for-service or prepaid basis. The drugs reimbursement system grants unrestricted access to essential drugs and different level of co-payment for the remaining specialty medicines (depending on the

Conflicts of interest: The authors have indicated that they have no conflicts of interest with regard to the content of this article.

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http://dx.doi.org/10.1016/j.vhri.2013.06.011

Anatomical Therapeutic Chemical [ATC] Classification System group, disease, patient's status, etc.).

Currently in Poland, no reliable cost data in health care system are available [12]. These data are not recorded by health care institutions, because GP practices are reimbursed for the number of registered patients and hospital admissions are reimbursed on the basis of discharge codes of the *International Statistical Classification of Diseases, 10th Revision*, not depending on the health care procedures used. Consequently, there are no health care cost databases in Poland that are similar to those in other developed countries, such as the National Health Service database in the United Kingdom [13].

The aim of the present article was to summarize direct medical, nonmedical, and indirect costs related to the management of AGI cases to estimate its societal costs and to enable better planning and monitoring of AGI prevention programs in the future.

Methods

We estimated AGI-related resource use linked to GP consultations and hospitalizations by using a prospective study conducted between May 2008 and September 2009. We have described detailed methods for study site selection and AGI cases recruitment in previous publication [3].

Studied Population

The Polish Prospective Healthcare Utilization Survey was performed in a randomly selected population sample served by 11

Table 1 – List of unit costs generated by AGI cases consulting GPs in Poland between May 2008 and September 2009.

Detailed cost categories	Number	Unit cost per patient (US $)*				Total cost (US $)*	
		Mean	95% CI	Median	95% CI	Paid by payer†	Paid by patient
GP consultation	385/385	10.25	9.64–10.86	8.14	8.05–8.21	3946.54	0.00
Laboratory testing	14/385	19.26	13.91–24.62	19.46	12.40–26.52	269.70	0.00
Complete blood count	10/385	3.52	3.02–4.03	3.74	2.83–4.65	35.22	0.00
Stool sample for microbiological confirmation	9/385	14.17	11.14–17.21	13.51	9.17–17.85	127.57	0.00
Other (blood smear, electrolytes, etc.)	10/385	10.69	7.58–13.79	10.24	6.45–14.03	106.91	0.00
Imaging diagnostics (ultrasonography)	11/385	17.28	14.46–20.10	13.51	6.60–20.43	190.11	0.00
Pharmacotherapy (ATC)	382/385	20.71	19.86–21.55	19.33	18.51–20.15	985.11	6924.65
Rehydration fluids (–)	230/385	6.72	6.18–7.25	5.06	4.76–5.37	442.67	1102.28
Intestinal anti-infectives (A07A)	229/385	5.77	5.53–6.02	4.75	4.02–5.47	0.00	1322.01
Antidiarrheal microorganisms (A07F)	144/385	8.30	8.03–8.57	8.83	–	0.00	1195.4
Other probiotics (–)	89/385	8.97	8.14–9.84	8.03	–	0.00	798.83
Other antidiarrheals (A07X)	127/385	7.59	7.48–7.70	7.53	–	0.00	963.81
Drugs for functional gastrointestinal disorders (A03)	81/385	5.12	4.36–5.89	4.59	4.37–4.81	41.81	373.22
Analgesics and anti-inflammatory products (N02B, M01A)	82/385	4.02	3.28–4.77	1.74	0–3.58	67.32	262.42
Antibacterials for systemic use (J01)	60/385	8.02	6.68–9.35	7.35	6.85–7.85	159.89	320.94
Other pharmaceuticals (A01A, A02B, A07D, A09A, R05C, R06A, V06D, no ATC code)	68/385	10.63	8.82–12.44	8.47	3.32–13.62	273.42	449.19
Materials used	66/385	0.34	0.17–0.51	0.09	0.04–0.14	22.30	0.00
Medical devices (syringes, needles, ports, fluid transfusion sets)	19/385	0.37	0.19–0.55	0.15	0.12–0.28	7.01	0.00
Biological specimen containers	4/385	1.29	0.11–2.46	0.95	0–2.43	5.16	0.00
Other (gloves, swabs, disposable towels, gowns, disinfectants, soaps, etc.)	66/385	0.15	0.10–0.20	0.09	0.04–0.14	10.14	0.00
Emergency department visits	4/115	54.05	–	54.05	–	216.22	0.00
Specialist consultation	7/115	17.78	–	17.78	–	124.45	0.00
Transport (number of kilometers)	82/115	36.96	17.91–56.01	13.00	9.21–16.79	–	–
Cost per kilometer × number of kilometers	82/115	16.84	8.02–25.66	6.32	4.26–8.39	0.00	1380.85
Home care (family, friends, service)	34/115	127.98	64.37–29.42	62.89	36.11–89.66	4,351.30	54.05
Absence from work (number of days off work)	10/115	6.10	3.89–8.31	6.00	3.03–8.97	–	–
Cost per day off × number of days	10/115	511.48	330.91–692.04	503.09	262.75–743.44	5,114.77	0.00

AGI, acute gastrointestinal infection; ATC, Anatomical Therapeutic Chemical Classification System; CI, confidence interval; GP, general practitioner; WHO, World Health Organization.

* US $1 = 1.85 PLN (WHO CHOICE).

† State institution (National Health Fund or social insurance).

Table 2 – List of unit costs generated by AGI cases admitted to a hospital in Poland between May 2008 and September 2009.

Detailed cost categories	Number	Unit cost per patient (US $)*				Total cost (US $)*	
		Mean	95% CI	Median	95% CI	Paid by payer†	Paid by patient
Number of bed days of hospitalization	504/504	4.74	4.41–5.06	4.00	3.86–4.14	–	–
Cost per bed day × number of bed days	504/504	832.63	782.84–882.43	688.84	644.99–732.70	419,647.46	0.00
Laboratory testing	503/504	49.74	47.36–52.10	47.84	44.46–50.95	25,015.72	0.00
Complete blood count	497/504	4.03	3.86–4.19	4.05	3.96–4.15	2,002.53	0.00
Blood smear	384/504	3.27	3.14–3.40	3.24	–	1,254.95	0.00
C-reactive protein	310/504	4.51	4.29–4.72	3.62	2.08–5.16	1,396.70	0.00
Erythrocyte sedimentation rate	479/504	2.34	2.24–2.44	2.16	–	1,120.80	0.00
Electrolytes	494/504	6.57	6.17–6.98	4.59	–	3,248.30	0.00
Urea	308/504	3.24	3.10–3.38	3.24	3.21–3.28	999.24	0.00
Creatinine	385/504	2.76	2.62–2.89	2.16	1.63–2.70	1,062.27	0.00
Glucose	325/504	4.21	3.03–5.39	2.16	2.05–2.27	1,369.04	0.00
Gasometry	149/504	5.13	4.47–5.79	3.24	2.49–3.99	764.65	0.00
General urine examination	467/504	3.7	3.54–3.86	3.78	3.26–4.30	1,728.10	0.00
Stool sample for microbiological confirmation	351/504	13.68	12.89–14.46	9.73	9.26–10.20	4,800.70	0.00
Stool sample	78/504	5.83	5.22–6.43	4.86	–	454.35	0.00
Blood culture	42/504	13.99	10.83–17.15	9.73	9.33–10.13	587.57	0.00
Nasopharyngeal sample for microbiological confirmation	50/504	8.55	7.43–9.67	8.65	5.48–11.82	427.57	0.00
Other	288/504	13.19	12.1–14.28	10.27	8.18–12.36	3,798.95	0.00
Imaging diagnostics	251/504	32.29	28.89–35.69	24.32	23.16–25.49	8,104.74	0.00
Abdominal ultrasonography	178/504	18,00	16.63–19.37	20,00	19.15–20.85	3,204.39	0.00
Chest radiography	96/504	13.19	11.42–14.96	9.73	8.51–10.95	1,266.35	0.00
Electrocardiography	109/504	10.06	8.29–11.84	5.41	2.88–2.52	1,096.91	0.00
Other	84/504	30.21	24.43–35.98	23.94	18.61–29.26	2,537.09	0.00
Pharmacotherapy	504/504	15.57	13.98–17.15	9.70	8.70–10.71	7,798.49	0.00
Rehydration fluids	492/504	5.72	5.25–6.18	4.25	3.69–4.81	2,813.16	0.00
Intestinal anti-infectives (A07A)	163/504	3.09	2.58–3.6	2.19	1.92–2.47	503.55	0.00
Antidiarrheal microorganisms (A07F)	156/504	1.80	1.45–2.15	1.10	0.87–1.32	280.50	0.00
Other antidiarrheals (A07X)	39/504	2.43	1.98–2.87	2.22	1.57–2.87	94.66	0.00
Drugs for functional gastrointestinal disorders (A03)	55/504	1.68	1.30–2.06	1.17	0.83–1.51	92.15	0.00
Analgesics and anti-inflammatory products (N02B, M01A)	136/504	1.36	1.08–1.65	0.63	0.35–0.90	185.37	0.00
Antibacterials for systemic use (J01)	179/504	15.08	13.06–17.09	11.73	10.41–13.05	2,698.90	0.00
Other pharmaceuticals (A02A, A02B, A05B, A06A, A07C, A07D, A07E, A11G, A12B, B05A, H02A, J05A, N03A, N06B, R05C, R06A, V06D, V07A, no ATC code)	338/504	3.34	2.74–3.95	1.71	1.51–1.90	1,130.20	0.00
Specialist consultation	71/504	17.78	15.22–20.33	16.22	15.42–17.02	1,262.16	0.00
Materials used	504/504	30.26	25.99–34.53	12.42	10.72–14.13	15,250.69	0.00
Medical devices (syringes, needles, fluid transfusion sets)	504/504	3.89	3.59–4.19	2.98	2.70–3.25	1,959.83	0.00
Containers and test tubes (urine and other biological specimen containers)	475/504	1.23	1.11–1.36	0.92	0.88–0.97	586.27	0.00

Disinfectants and soaps	501/504	1.93	1.62–2.24	0.70	0.56–0.85	967.55	0.00
Other (gloves, swabs, cotton balls, pampers, disposable towels, gowns, etc.)	504/504	23.29	19.66–26.91	7.37	6.44–8.30	11,737.04	0.00
Direct *medical* costs	504/504	946.59	893.92–999.25	803.70	733.41–873.98	477,079.26	0.00
Transport (number of kilometers)	119/145	126.13	86.76–165.51	50.00	31.15–68.85	–	–
Cost per kilometer × number of kilometers	119/145	57.57	40.10–75.04	22.59	14.34–30.84	0.00	6850.80
Direct *nonmedical* costs	119/145	57.57	40.10–75.04	22.59	14.34–30.84	0.00	6850.80
Home care (family, friends, service)	54/145	356.94	257.05–456.83	251.55	179.19–323.90	19,274.71	0.00
Absence from work (only patients aged 18–65 y)	–	–	–	–	–	–	–
Due to hospitalization	13/145	202.71	141.36–264.06	179.68	120.54–238.82	2,635.24	0.00
After hospitalization	3/145	642.84	329.75–955.93	838.49	329.31–1130.18	1,928.52	0.00
Indirect costs	70/145	360.34	261.30–459.39	251.55	161.06–342.03	23,838.47	0.00

AGI, acute gastrointestinal infection; ATC, Anatomical Therapeutic Chemical Classification System; CI, confidence interval; WHO, World Health Organization.
*US $1 = 1.85 PLN (WHO CHOICE).
† State institution (National Health Fund or social insurance).

ambulatories and an independent population served by 8 hospital units located in 6 Polish voivodships (14.4 million inhabitants, 38% of Poland's population). During the study period, local coordinators recruited patients meeting inclusion criteria. The inclusion and exclusion criteria used in the present study were compatible with the AGI definition proposed by the International Collaboration on Enteric Disease Burden of Illness [14] and used in the recent study of AGI prevalence in the community [15]. The Ethical Committee at the National Institute of Public Health in Warsaw reviewed and accepted the study protocol.

Collection of Data on Costs

For each patient, local coordinators filled a standardized questionnaire on health care resource utilization that was developed specifically for this study. The questionnaire recording information on GP visits consisted of 18 items, which were divided into general demographic information, clinical presentation, use of pharmaceutical preparations, diagnostic tests, materials, and specialist consultations. For each health care resource used, a monetary value was allocated. The hospital resource utilization questionnaire consisted of 26 items, which were divided into general demographic and clinical information as well as patient management at the admission unit and separately at the hospital ward. The local coordinators fill the information on monetary cost incurred on the basis of internal unit prices.

Study coordinators interviewed all consenting patients 2 to 4 weeks after GP visit or discharge from hospital. A structured telephone interview comprised 16 questions related to the current occupation, effect of the disease on daily activities, absence from work, and use of home care and transport in relation to AGIs, further GP or specialist consultations, admissions to the hospital, and use of prescription and over-the-counter medications and diagnostic tests.

Cost Analysis

We obtained reference values for the calculation of costs from official state publications for the period January to December 2009. We summarized detailed use of health care resources separately for GP consultations and hospital admissions. We collected data on type, form, and quantity of pharmaceuticals, medical devices, diagnostic procedures, laboratory tests, referrals to specialists and emergency departments, as well as on hospitalizations and grouped them by using a bottom-up microcosting approach [16]. GP consultation cost and hospital cost of bed day was obtained from a query of studied health care facilities accounting departments by using accounts breakdown [17], dividing cost items into personnel, building, equipment, administration, food, cleaning, laundry, maintenance, and other costs. To calculate the cost of GP consultation, we summed monthly costs pertaining to the maintenance of the GP practice and divided them by the number of physicians working in the health unit and their working time (cost per minute of GP consultation). To calculate the cost of hospitalization bed day, we divided the monthly costs of the hospital ward maintenance by the number of patients admitted to the hospital ward. We obtained costs of pharmaceuticals (ATC coding), medical devices, and other medical materials from purchasing units in hospitals. Emergency department costs were taken from an official diagnosis-related group system. For the imputation of quantitative missing data, we used the mean values from the current study data set or average prices from participating health unit price lists. Missing values for pharmaceutical costs were obtained from the national pharmaceutical formulary [18]. If only international names were provided by respondents, then we would impute the values on the basis of prices of the most commonly used generics. Transportation costs were based on official mileage rates [19]. We calculated indirect costs

related to absence from work and time devoted to care by using a human capital approach based on average wages lost [16]. We did not take into account reduced productivity owing to presenteeism or premature death.

We used three perspectives for cost calculations: household/patient, public payer, and societal. We applied a standard cost division into direct medical, nonmedical, and indirect costs [16]. We estimated separately costs of outpatient and inpatient care, stratified by age group (<4, 5–18, 19–65, and >65 years). For each cost category, we calculated the mean, median, and total cost. For the mean and median, we computed confidence intervals by using 1000 bootstrap percentile replications.

For the estimation of the overall cost of medically attended AGI cases, we weighted the costs related to hospitalization by age-specific proportion of patients referred to the hospital. These figures were based on two recent Polish studies of AGI burden [3,15]. All costs collected in the local currency (PLN) were recalculated into US dollars by using the purchasing power parity exchange rate for Poland [20]. All analyses and data manipulations were done in Stata version 10 (StataCorp LP, College Station, TX) [21].

Estimating Population AGI Burden

For the estimation of AGI monetary costs in the society (total national cost, TNC), we developed a stochastic model by using @RISK 5.0 (Palisade Corporation, Ithaca, NY), a Monte Carlo simulation add-in to Microsoft Excel:

$$\mathrm{TNC} = \sum_{\text{age group}} \mathrm{pop} * I_{GP} * C_{GP} + \mathrm{pop} * I_{HOSP} * C_{HOSP}$$

where age group is either 0 to 17 and 18 years or more, pop is the population, I_{GP} is the rate of GP visits per person-year, I_{HOSP} is the hospital admission rate per person-year, C_{GP} is the societal cost per GP visit, and C_{HOSP} is the societal cost per hospital admission. All parameters are age-group specific.

Our study was designed to collect data on individual costs of AGI cases at different levels, and it was not feasible to derive incidence and follow-up data directly. Therefore, to obtain population estimates of AGI-related GP visits and hospitalizations, we related our data to a population-based survey performed at the same time [15]. We selected this particular survey owing to large sample size, similar time span, and geographic coverage.

Annual rates of AGI-related GP visits and hospital admissions were represented by beta distributions. The cost estimates per GP visit and hospital admission were represented by log-logistic distributions. The distribution parameters were estimated on the basis of sample cost distributions by using maximum likelihood estimators. The national annual cost of medically attended AGIs was calculated by using Monte Carlo simulation with the above-mentioned probability distributions and the 2009 population estimate for Poland. The model was run for 150,000 iterations to stabilize the output distributions. The mean and 95% uncertainty limits were reported.

Results

During the study period, valid questionnaires were collected on 385 GP visits, including 113 follow-up interviews, and on 504 hospital admissions, including 145 follow-up interviews. A detailed description of the selection of study sites and study population is presented elsewhere [3].

Direct Medical Cost

Unit costs related to GP consultations of AGI cases are listed in Table 1. Overall, direct medical costs amounted to US $34 per AGI patient consultation. Prescribed pharmaceuticals, paid in 88% by patients, were the main cost driver in relation to GP consultations. Particularly, pharmaceuticals of the A07 ATC group (antidiarrheal and intestinal anti-inflammatory/anti-infective agents) were not reimbursed. However, an important share of anti-inflammatory and analgesic drugs (M01A, N02B) and antibiotics (J01) costs was reimbursed by the state. The next cost driver in primary care were GP visits' costs, equal to US $11, entirely paid by the state payer. Laboratory testing and diagnostic procedures were relatively cheap for an average AGI patient owing to their rare utilization (US $0.7 and US $0.5, respectively) but substantial in terms of unit cost values (US $19 and US $17, respectively).

Unit costs related to the hospital treatment of AGI cases are listed in Table 2. Inpatient care generated on average US $947 of direct medical costs, including US $833 of bed days (average cost per bed day was US $176). The other cost drivers in inpatient care were costs of laboratory diagnostics, materials, imaging diagnostics, and pharmacotherapy. All direct medical costs were covered by the state-owned third-party payer.

Taking into account the summed costs generated by medically attended AGI cases, direct medical costs were highest for patients aged 5 to 18 years (Table 3). The excess cost was related mostly to the higher cost of hospitalization bed day in pediatric wards than in adult wards (US $226 vs. US $117), and substantially lower probability of hospitalization among 18- to 64-year-old AGI cases.

Direct Nonmedical Costs

The only nonmedical direct cost considered in our study was the cost of transportation in relation to health care services. In outpatient care, the average cost of reaching the service (average distance of 20 km) amounted for US $17 (Table 1). In relation to inpatient care, this cost was higher (mean cost per patient was US $58) (Table 2) owing to longer distance to the hospital and common necessity of several trips to the hospital undertaken by primary carers. The costs of transportation were higher for persons younger than 18 years, which was especially marked in relation to inpatient care-related costs (Table 3). All nonmedical direct costs were covered by the patients.

Indirect Costs

The indirect costs assessed in our study related to home care (average cost per hour was US $10) and absence from work in relation to AGI (average cost of 1 day off work was US $84). In relation to outpatient care, the average cost of home care of 34 patients (on average 13 hours of care) was US $128 and the average cost of absence of 10 patients from work (on average 6 days off work) was US $511 (Table 1). In relation to inpatient care, the average cost of home care of 54 patients was estimated at US $357 and the average cost of absence from work of 13 patients was US $351 (Table 2). Costs of home care were substantially higher for persons younger than 18 years in outpatient care and were highest for persons older than 65 years in relation to inpatient care (Table 3). Costs of absence from work were almost exclusively limited to patients aged 18 to 64 years and were by far the most important cost driver in this age group overall.

Cost Perspectives and Estimated AGI Societal Burden

The average cost of one medically attended AGI case in Poland, taking into account patient management and flow of patients from primary to secondary care observed in population-based studies, was estimated at US $136 from the state-owned third-party payer, US $32

Table 3 – Average societal costs of medically attended AGI cases, by cost category and age group in Poland between May 2008 and September 2009.

Cost category (US $)*	0–4 y	5–18 y	19–64 y	65+ y	All age groups
Outpatient					
Average cost of GP visit	10.94	10.15	9.62	10.42	10.25
Laboratory testing	0.89	0.49	0.78	0.00	0.70
Imaging diagnostics	0.16	0.69	0.73	0.76	0.49
Pharmacotherapy	21.19	19.35	20.71	21.18	20.54
Materials	0.06	0.09	0.05	0.01	0.06
Emergency department visit	0.00	3.86	3.28	0.00	1.88
Specialist consultation	0.67	0.36	0.00	0.00	0.32
Inpatient†					
Average cost of hospitalization	38.56	57.20	4.35	22.56	28.11
Laboratory testing	1.97	3.68	0.36	1.29	1.68
Imaging diagnostics	0.35	0.79	0.14	0.99	0.54
Pharmacotherapy	0.50	0.77	0.15	0.63	0.52
Materials	1.56	1.36	0.21	0.74	1.02
Specialist consultation	0.15	0.21	0.01	0.02	0.08
Total direct medical costs	77.00	99.00	40.39	58.60	66.19
Transport related to GP visit	12.89	10.59	12.80	1.51	12.01
Transport related to hospitalization‡	2.27	3.39	0.06	0.49	1.60
Total direct nonmedical costs	15.16	13.98	12.86	2.00	13.61
Outpatient					
Home care (family, friends, service) related to visit	45.66	51.66	16.52	10.48	38.31
Absence from work related to GP visit	0.00	8.98	147.37	0.00	44.48
Inpatient†					
Home care related to hospitalization	4.77	5.62	0.81	8.97	4.49
Absence from work related to hospitalization	0.00	0.00	2.64	0.00	1.06
Total indirect costs	50.43	66.26	167.34	19.45	88.34
Total cost allocated to one studied patient	142.59	179.24	220.59	80.05	168.15
Of which direct	92.16	112.98	53.25	60.60	79.81
Of which indirect	50.43	66.26	167.34	19.45	88.34

AGI, acute gastrointestinal infection; GP, general practitioner; WHO, World Health Organization.
* US $1 = 1.85 PLN (WHO CHOICE).
† Inpatient costs weighted by age-specific proportion of GP patients referred to the hospital.
‡ Based on the number of kilometers.

from household, and US $168 from societal perspective (Table 4). The majority of this cost is paid by the state. The estimated societal cost of medically attended AGI episodes amounted to US $2222 million (95% uncertainty interval was US $734 to US $6367 million).

Discussion

The costs of medically attended AGI episodes in Poland were examined in primary and secondary care, from state, household, and societal perspectives, in terms of direct and indirect costs. We did not assess separately costs attributed to AGI etiological agents because the evidence from the literature showed that their direct costs are in a similar range [10]. When weighting the inpatient costs by age-specific probability of hospital referral by GPs, we estimated the societal cost of a medically attended AGI case amounting to US $168. In terms of direct medical costs, the main cost drivers were cost of hospital bed days, cost of GP consultation (both paid by the state-owned third-party payer), and cost of outpatient pharmacotherapy, covered in majority by patients. Overall, indirect costs prevailed over direct costs (US $88 vs. US $80), which was mostly pronounced among adults in the productive age, where 76% of the costs were attributed to indirect costs. Based on the GP consultation rate estimated in a parallel population-based telephone survey [15], the estimated age-adjusted societal cost of medically attended AGI episodes would be US $1681 million.

International comparisons of economic costs between countries are difficult from the methodological point of view. The societal costs of AGI cases depend on the disease prevalence, differences in health-seeking behaviors, and health care system organization. Historically, different AGI case definitions were used, different currency exchange rates were applied, and different cost categories were taken into account in the cost calculations. Estimates of AGI costs referring to the general population are sparse. The societal costs of medically attended AGI cases were estimated to be US $3510 million in the United States [22], which, considering a conservative assumption of 2% annual discounting until June 30, 2009, would give US $688 for a medically attended AGI case. Another study estimated the societal costs of all AGI cases in New Zealand at NZ $89 million [23], which would be equivalent to US $359 per AGI episode, as of 2009. Straightforward comparisons with developing countries are difficult because only estimates of costs for AGI hospitalization costs were published. The societal cost of rotavirus hospitalization ranged from US $36 in Vietnam [24], US $77 in Uzbekistan [25], US $81 in one center in India [10] to US $87 in Kyrgyzstan [26]. The study on the hospital cost of bacterial diarrhea in Thailand showed similar numbers: US $77 per inpatient episode [8]. The above figures are much lower compared with our estimate of US $1078 per hospital admission. These differences reflect the important disparities in the cost of health care services between the developed and developing world and are concordant in great extent with World Health Organization estimates for different World Health Organization regions [20].

Table 4 – Average costs of medically attended AGI cases, by cost category and cost perspective, in Poland between May 2008 and September 2009.

Cost category (US $)*	Patient	Payer	Societal
Outpatient			
Average cost of GP visit	0.00	10.25	10.25
Laboratory testing	0.00	0.70	0.70
Imaging diagnostics	0.00	0.49	0.49
Pharmacotherapy	17.99	2.56	20.54
Materials	0.00	0.06	0.06
Emergency department visit	0.00	1.88	1.88
Specialist consultation	0.00	0.32	0.32
Inpatient†			
Average cost of hospitalization	0.00	28.11	28.11
Laboratory testing	0.00	1.68	1.68
Imaging diagnostics	0.00	0.54	0.54
Pharmacotherapy	0.00	0.52	0.52
Materials	0.00	1.02	1.02
Specialist consultation	0.00	0.08	0.08
Total direct medical costs	*17.99*	*48.21*	*66.19*
Transport related to GP visit	12.01	0.00	12.01
Transport related to hospitalization†	1.60	0.00	1.60
Total direct nonmedical costs	*13.61*	*0.00*	*13.61*
Outpatient			
Home care (family, friends, service) related to visit	0.47	37.84	38.31
Absence from work related to GP visit	0.00	44.48	44.48
Inpatient†			
Home care related to hospitalization	0.00	4.49	4.49
Absence from work related to hospitalization	0.00	1.06	1.06
Total indirect costs	*0.47*	*87.87*	*88.34*
Total cost allocated to one studied patient	*32.07*	*136.08*	*168.15*
Of which direct	31.60	48.21	79.81
Of which indirect	0.47	87.87	88.34

AGI, acute gastrointestinal infection; GP, general practitioner; WHO, World Health Organization.
* US $1 = 1.85 PLN (WHO CHOICE).
† Inpatient costs weighted by age-specific proportion of GP patients referred to the hospital.

In our study, indirect costs constituted 53% of all costs attributed to AGI cases. The predominance of indirect costs over direct costs generated by AGI cases was seen in all studies performed in developed countries. Indirect costs represented 64% of total AGI-related costs in the United States [22], 70% in Israel [6], and 87% in New Zealand [23].

In Poland, AGIs are perceived as low public health priority, which is probably related to typical mild and self-resolving symptoms. Control measures are limited to the investigation of foodborne outbreaks, and *Salmonella* control program in poultry flocks mandated by the European Commission resolution since 2003 [27]. Rotavirus vaccination is also not considered as priority by the national advisory group for immunization. Currently, the cost of etiological investigation for selected pathogens (most commonly *Salmonella* and *Shigella*) is free of charge only if performed in the course of an outbreak investigation. As a result of this situation, most AGI cases reported to surveillance have unknown etiology [15], which prevents implementation of efficient interventions.

Our study indicates that AGIs place a high burden on the society. Out-of-pocket spending for an average patient with AGI in Poland seems to be relatively small, amounting only to US $32 for a medically attended case. Even coupled with indirect costs associated with absence from work and home care equal to US $88, the burden to the individual patient may be regarded as relatively low as equivalent to 7% of mean monthly income of a Polish citizen. Similarly calculated monetary burden on an affected household was estimated to be 25% in Malaysia [28] and 40% in Taiwan [29]. If we considered the impact of AGIs on Poland's economy, the ratio of estimated AGI societal cost to GDP would be 0.3% and the ratio to the total expenditure per capita would be equal to 4.3%. Considering the estimate of 81% of the societal cost attributable to the public payer, AGIs clearly constitute a high burden on the national health care system. A similar comparison performed in New Zealand found that the ratio of foodborne illness cost to GDP was 0.1% [23].

Our study has a number of limitations. First, restricting the study to health care facilities did not allow the estimation of costs of AGI episodes not consulting GPs. The follow-up interviews provided some insight into self-medication practices and indirect costs of home care. These data are however not sufficient to extrapolate to the general population estimates of AGI cases that were not medically attended. Second, noninclusion of third-level reference hospitals led to the underestimation of our cost estimates because it included only the costs generated by uncomplicated AGI cases treated in general hospitals located near patients' residence. Cases with severe complications, although rare, would lead to higher direct as well as indirect costs of treatment. Third, we did not include private sector health care units in our study. In the private practices and private hospitals, patients are paying for each service. By not including private health care units, we probably underestimated the AGI management cost. However, the calculation of the actual costs incurred in the health care units would lead to the approximation of general health care costs, as the private sector units compete for the same patients with the public sector health care and have to calculate their services accurately.

Conclusions

These data may imply that much higher resources could be allotted to the prevention and control of acute gastroenteritis, even when considering only their direct medical costs. For better targeting of public health interventions, it would be necessary to understand the relative importance of different transmission routes as well as the relative burden placed by different pathogens in Poland. An appropriate prioritization of interventions, in turn, would enable improvement in their cost-effectiveness. These results can also impact health care planning, as the prevention of nosocomial transmission of AGI pathogens may lead to substantial savings.

Source of financial support: The Polish Prospective Healthcare Utilization Survey was jointly funded by two European Commission Sixth Framework Programme projects—POLYMOD (SSP22-CT-2004–502084) and the Network of Excellence MED-VET-NET (FOOD-CT-2004-506122)—and cofinanced by the Polish Ministry of Science and Higher Education.

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