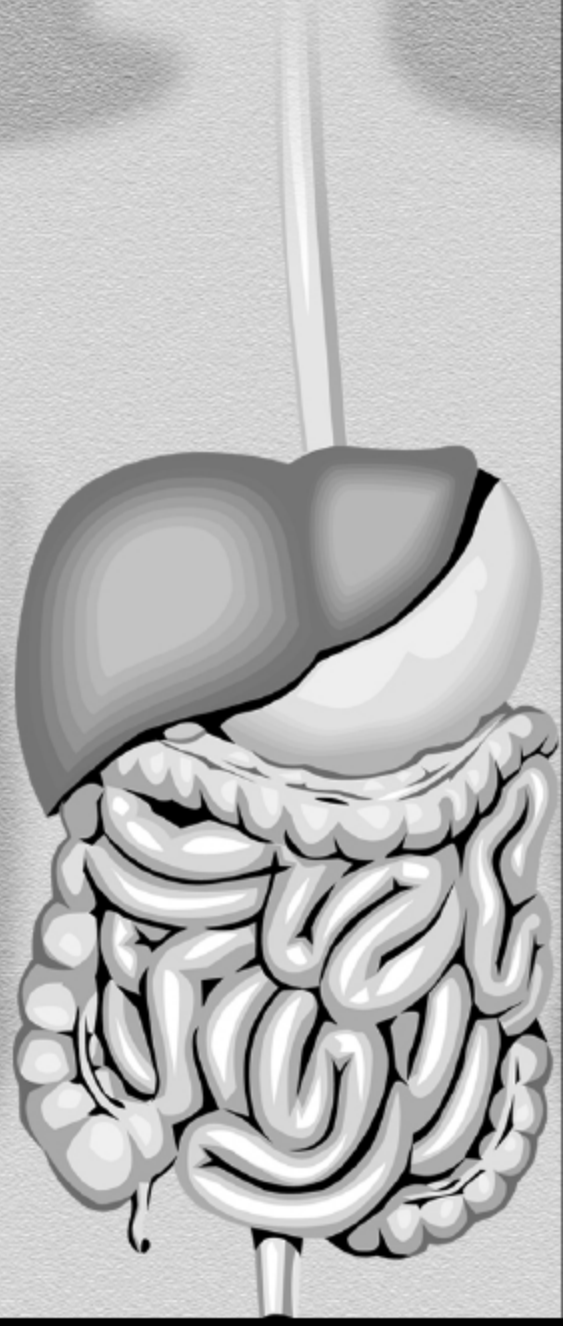
The Burden of Gastrointestinal Diseases



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FOREWORD

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EXECUTIVE SUMMARY

Gastrointestinal disease inflicts extensive harm and heavy burdens upon the health and well-being of Americans, with enormous economic consequences for the nation. The incidence of many serious gastrointestinal diseases is on the rise. This study, sponsored by the American Gastroenterological Association (AGA), was undertaken to estimate the prevalence and annual economic burden of common gastrointestinal (GI) disorders from a societal perspective.

This study provides current information on the prevalence and cost impact across a large group of common GI diseases. The full range of GI diseases was too great to cover adequately within the scope of this report. Therefore, this report examines a selection of GI diseases based upon the severity and frequency of their effects on the U.S. population, the availability of recent reliable data, and the clinical opinions of the AGA advisory panel for this study. Although the literature concerning clinical and epidemiological aspects of GI diseases is generally abundant, recent information on the economic burden of this group of diseases is sparse.

Prevalence and cost estimates for the selected GI diseases were determined using data from two types of sources. Publicly-available national datasets and other proprietary databases were analyzed in order to derive current estimates of the burden of the selected illnesses. The published literature was used to estimate prevalence and resource utilization when data from these primary sources were found to be insufficient or inconsistent with prevailing well-recognized estimates.

The total cost for each disease consists of estimates of both direct and indirect costs. Direct costs include those related to goods or services associated with treatment including physician care, inpatient hospital care, outpatient hospital care, emergency (urgent) care, and pharmaceutical therapy. Indirect costs were broadly defined to include costs such as work loss, as measured by time away from work as a consequence of GI disease. However, given the scarcity of reliable information on indirect costs, the estimates for these indirect costs tend to be conservative, relying on data for time away from work due to consumption of health care.

As measured by prevalence, direct cost, and indirect cost, the burden of the 17 GI diseases studied are summarized in Table E.1. Based on 1998 data, the most prevalent of these diseases are: non-foodborne gastroenteritis and other GI infections, foodborne illness, gastroesophageal reflux disease (GERD), gallbladder disease, and irritable bowel syndrome (IBS). The total direct and indirect costs of these diseases ranges from $0.37 billion (Barrett's esophagus) to $9.8 billion (GERD) in 1998 dollars.

In terms of total direct and indirect costs, the five most costly diseases are: GERD ($9.8 billion), gallbladder disease ($6.0 billion), colorectal cancer ($5.0 billion), peptic ulcer disease ($3.3 billion), and diverticular disease ($2.5 billion). The pattern of relative contributions of direct and indirect costs to total costs is revealing of the type of economic burden of these diseases and the role of advances in health care, e.g., minimally-invasive procedures and pharmaceuticals, in alleviating or redistributing population-wide disease burdens.

Table E.1. Prevalence and Direct and Indirect Costs of Selected Gastrointestinal Diseases

	1998				2000*
Disease	**Prevalence (in thousands)**	**Direct Cost ($ in millions)**	**Indirect Cost*** ($ in millions)**	**Total ($ in millions)**	**Total ($ in millions)**
GERD	18,600	9,325	479	9,804	10,070
Gallbladder Disease	20,500	5,755	294	6,049	6,467
Colorectal Cancer	422.3	4,846	106	4,952	5,294
Peptic Ulcer Disease	6,730	3,059	201	3,260	3,441
Diverticular Disease	2,254	2,357	141	2,498	2,667
Diseases of Pancreas**	1,151	2,123	212	2,335	2,492
Non-foodborne Gastroenteritis and Other Intestinal Infections	135,000	1,598	505	2,103	2,238
Chronic Liver Disease and Cirrhosis	5,490	1,421	222	1,642	1,752
Irritable Bowel Syndrome	15,396	1,353	205	1,558	1,658
Liver Cancer	10	1,266	78	1,344	1,518
Pancreatic Cancer	18	1,225	30	1,255	1,370
Foodborne Illness	76,000	887	233	1,119	1,192
Crohn's Disease	359	707	75	781	826
Chronic Hepatitis C	2,530	693	51	744	758
Chronic Diarrhea	3,080	493	129	622	661
Ulcerative Colitis	619	388	36	423	443
Barrett's Esophagus	808	351	22	372	389
TOTAL****	----	36,310	2,817	39,197	41,816

*Inflated to year 2000 dollars using Medical CPI

** Excludes diabetes mellitus

***Indirect cost estimates include only lost days of work due to consumption of health care. Estimates based on other studies in the literature are mentioned throughout the study.

****Total cost estimate does not include costs of Barrett's esophagus, chronic hepatitis C, and chronic diarrhea due to double counting (Barrett's esophagus is included in GERD, chronic liver disease and cirrhosis are often caused by hepatitis C, and chronic diarrhea is often a symptom of irritable bowel disease). These diseases represent only a portion of all GI diseases, hence this estimate does not represent the cost of GI diseases overall, but rather this group of diseases only.

The top five diseases in terms of direct costs are: GERD ($9.3 billion), gallbladder disease ($5.8 billion), colorectal cancer ($4.9 billion), peptic ulcer disease ($3.1 billion), and diverticular disease ($2.4 billion). The top two diseases in terms of indirect costs are non-foodborne gastroenteritis and other GI infections ($505 million) and GERD ($479 million), followed by gallbladder disease ($294 million), foodborne illness ($233 million), and chronic liver disease and cirrhosis ($222 million). It is important to note the limited scope of indirect cost estimates; they include only lost days of work due to consumption of health care. For certain diseases, the literature provided other estimates of indirect costs (based on epidemiological studies designed to measure productivity loss); these estimates are described throughout this report.

Although the methods used to measure the burden of these diseases were as rigorous as the data allowed, these cost figures represent conservative estimates for several reasons. Estimates exclude important categories of direct or indirect costs due to lack of data in the literature and in datasets. For many diseases, the scope of direct costs does not include that of long-term care, such as nursing home care or home health care. The datasets available for this study did not allow for estimates from federal facilities (e.g., Armed

Forces hospitals, Veterans Health Administration facilities). Some data sources are older than others, and while adjustments can be made for inflation, they cannot be made for trends in prevalence, costs, or other relevant parameters over time. The indirect cost estimates for the diseases, in which indirect costs were a function of work loss while consuming health care, greatly underestimate total indirect costs of many of these diseases. If more reliable data sources were available to adequately capture other segments of indirect cost (e.g., reduced productivity while working, lost unpaid labor, lost leisure time), it is probable that overall cost estimates would be significantly greater, with a greater share attributable to indirect costs. There are insufficient data for productivity losses due to mortality, to illness other than time lost in receiving health care, and to family members and caretakers. Losses due to pain, suffering, and diminished quality of life, known as "intangible costs," are considerable yet also unmeasured for many of these diseases.

People who suffer from these diseases, but do not have the health insurance coverage or other resources at their disposal to access health care services, are under-diagnosed and under-treated. As some of these diseases are inversely correlated with socioeconomic status, there is likely to be considerable under-reporting of these diseases.

The great health and economic burden of GI disease in the U.S., as well as abroad, calls attention to the need for research into the etiology, epidemiology, prevention, and treatment of these diseases. While research expenditures on GI disease were approximately $1.4 billion in 2000, a substantial commitment that was evenly divided between the public and private sectors, this magnitude of effort is significantly less than the research commitment to other diseases with lower health and economic burdens in the U.S.[1]

Other investigators have explored the relationship between burden of disease and National Institutes of Health funding. Gross et al.[2] found that research funding for HIV/AIDS, breast cancer, and dementia was much greater than other diseases with similar disability-adjusted life-years.[3] That study suggested that the health impact of disease does not coincide with the level of public research funding. However, that study used hospitalization as a surrogate for the economic impact of disease and therefore systematically underestimated the true economic burden of diseases studied.

The present report extends certain aspects of that inquiry to GI diseases by quantifying hospitalization as well as outpatient care, pharmaceuticals, and losses to productivity in economic terms. As such, this provides a broader picture of the health and economic impact of GI disease, and helps to highlight the relative economic burden to the nation of direct and indirect costs of these conditions. In particular, the economic impact of losses to productivity due to certain diseases, including IBS, GERD, various types of GI infections, and peptic ulcer disease, might not be considered in setting human health R&D priorities.

In weighing R&D funding priorities and considering policies that otherwise affect R&D spending, policy makers must examine both federal and industry commitments to the types of R&D and the magnitude of allocations to these. In doing so, it is essential to account

[1] Research expenditure estimate was based on the PAREXEL's Pharmaceutical R&D Statistical Sourcebook 2000 and the NIH Office of Budget, NIDDK, NCI and NIAID Budget Office information.

[2] Gross CP, Anderson GF, Powe NR. The relation between funding by the National Institutes of Health and the Burden of Disease. N Engl J Med 1999;340:1881-7.

[3] One disability-adjusted life-year was defined as the loss of one year of healthy life to disease.

for the health and economic impacts of disease, including their burdens to the nation in terms of both direct and indirect costs.

The considerable costs of GI diseases documented in this report cannot be overlooked in national policy making on R&D investment, health care delivery, and other national health care priorities. The estimates of the health and economic burdens of disease represent a challenge to policy makers, clinicians, researchers, and others concerned with how to reduce these burdens. The causes of many of these diseases, including Crohn's disease, pancreatic cancer, and others, remain undetermined. The necessary scientific and public health endeavors to address GI diseases require informed priority setting and adequate funding.

CHAPTER 1: INTRODUCTION

Gastrointestinal diseases encompass a diverse group of conditions that have a major impact on health in the U.S. and represent a significant economic burden. The associated direct health care costs including hospital, physician and nursing care, pharmaceutical and other services are considerable. Although often inadequately represented, indirect costs caused by lost wages are as significant as the direct costs. The present study, commissioned by the American Gastroenterological Association (AGA), was undertaken to develop an estimate of the annual burden, which includes estimates of the prevalence and annual economic costs of 17 gastrointestinal (GI) diseases. The findings of this study will contribute to a better understanding of the nature and magnitude of these diseases and their costs, as well as increase the overall awareness of their impact on society.

Although the focus of this study is on epidemiology and cost, it must be recognized that these diseases impose a significant impact on quality of life. While data on morbidity, mortality, and costs are available with varying degrees of reliability for the 17 GI diseases, the impact on quality of life at the disease level is not well defined in the literature or databases. It should be noted that a number of the diseases studied are chronic and debilitating in nature and can severely affect the quality of life of individuals as well as their families.

Selection of the diseases for inclusion in this study was based on several factors. The goal was to include the most prevalent and measurable diseases affecting the gastrointestinal system. There are a great many diseases that fall into this range. The choice of diseases for inclusion was determined by input from the AGA, as well as the existence of relevant studies in the literature or availability of sufficient information from other data sources to allow for reliable cost calculation. As such, it was not practical to include all GI diseases in this study, and the exclusion of any particular disease is no indication of its clinical or economic importance relative to others.

There have been several studies over the years that estimate the economic burden of gastrointestinal diseases. The study by Brown and Everhart that estimated the cost of digestive diseases in the United States for the year 1985 employed the human capital approach as the framework for developing the cost of gastrointestinal diseases. Direct costs were estimated by summing all resource payments for patient services. Indirect costs represented forgone earnings due to hospitalization, premature death, and work-loss associated with acute GI diseases. Brown and Everhart found that the total cost of GI diseases was $56.1 billion in 1985. Of the total, $41.5 billion was attributable to the direct costs and $14.6 billion to indirect costs. It is important to note that the study by Brown and Everhart was more comprehensive than the present study because it included all GI diseases, and it based its calculation on charges, a measure considerably larger than costs.

For this study, estimates were developed of the costs of GI diseases using data from two types of sources. The first source of information used was a detailed review of the literature on the costs and epidemiology of the diseases under study. The second source of information used were estimates of the annual burden of illness from various national databases generated by the federal government, including the:

- National Health Interview Survey (NHIS)
- National Hospital Discharge Survey (NHDS)
- National Hospital Ambulatory Medical Care Survey (NHAMCS)
- National Ambulatory Medical Care Survey (NAMCS)
- Medical Expenditure Panel Survey (MEPS).

Drug utilization was estimated from the Scott Levin Source Prescription Audit (SPA), and the Physician Drug and Diagnosis Audit (PDDA). Data sources and methods are described in greater detail in Methods chapter.

A nosology was developed for classifying the diverse group of diseases included in the study. The intent of this approach was to retain clinical coherence and to enable meaningful aggregation and disaggregation of the available data.

There were several types of limitations to developing estimates of the cost of GI diseases. The lack of prior studies in the literature, uncertain or divergent prevalence estimates, and omissions of some diseases and cost categories from the publicly available data posed a challenge to accurate cost estimation. These limitations should be considered when reviewing the results of this study. In particular, estimates of indirect costs may be understated for many of the diseases. Due to the specific nature of many of the 17 diseases under study, data were often limited for individual diseases. These data constraints necessitated a very limited scope of indirect costs. Thus, for a majority of the diseases, indirect costs were calculated by the valuation of time away from work while receiving medical care. This study did not estimate the costs of caretaker time, costs associated with lost or impaired ability to work or enjoy leisure activities due to morbidity; or lost future earning potential due to premature death. In sum, due to the unavoidable exclusion of a few GI diseases and certain categories of direct and indirect cost, the results tend to understate the actual costs of GI diseases.

This report is organized into eight chapters. The chapter on methods presents an introduction to the study and reviews the techniques, data sources, and assumptions used. The subsequent chapters on each of acid-related GI diseases, chronic intestinal disorders, hepatobiliary and pancreatic disorders, GI cancers, and infections of the GI tract present detailed reviews of the literature and data analyses by disease group. The final chapter summarizes the study findings. Appendix 1 presents a bibliography of articles reviewed; Appendix 2 contains summary tables to support information in the text.

CHAPTER 2: METHODS

This chapter reviews the methods used to develop the estimates of the prevalence and cost of the GI disorders that are presented in the subsequent chapters. In brief, this study incorporated data both from the medical literature as well as from databases of health status, health services utilization, and expenditures. Diseases and corresponding ICD-9 codes were identified to be included in the study. Appropriate databases were then evaluated and selected to obtain prevalence and cost estimates for the specific diseases of interest. An extensive review of the medical literature was conducted in parallel to the database evaluation and selection to provide estimates where the data were weak or unavailable and to validate findings. Once the data from secondary sources were aggregated and analyzed, the diseases were classified into clinically similar groups in order to analyze the data and present findings in a meaningful manner. These methods are described in greater detail below.

Selection of Diseases for Inclusion

The numerous diseases of the GI system are a varied group. The wide variety of GI disorders are caused or exacerbated by diverse factors, ranging from dietary habits to stress to genetic predisposition. Diseases were selected for this study based upon their degree of health and economic burden (as determined based upon existing literature) and the insights and recommendations of an advisory panel of gastroenterologists and epidemiologists assigned by the AGA to this study. Table 2.1 lists the diseases included in the study in order of their corresponding ICD-9 codes used in the database analyses.

Table 2.1. Digestive Disease Categories by Diagnostic Codes

Disease	ICD-9 Codes
Non-foodborne Gastroenteritis and Other Intestinal Infections	001-009 (subset), 558.9
Foodborne Illness	001-009 (subset), 558.9, 070.0, 070.1
Chronic Hepatitis C	070.54
Colorectal Cancer	153, 154, 197.5, 230.3, 230.4
Liver Cancer	155.0, 155.2, 197.7, 230.8
Pancreatic Cancer	157, 197.8, 230.9
GERD	530.1, 530.2, 530.3, 530.81
Barrett's Esophagus	530.2
Peptic Ulcer Disease	531, 532, 533, 534
Crohn's Disease	555
Ulcerative Colitis	556
Diverticular Intestine	562
Irritable Bowel Syndrome	564.1, 564.5, 564.8, 564.9
Chronic Liver Disease and Cirrhosis	571
Gallbladder Disease	574, 575
Diseases of Pancreas	577
Chronic Diarrhea	787.91

Resource Utilization and Cost Analysis

To develop an accurate estimate of health care resource utilization and corresponding costs, a thorough list of variables was compiled to ensure accurate and systematic data extraction from the various data sources. Utilization was measured for each major type of service including physician care, inpatient hospital care, outpatient hospital care, emergency (urgent) care, and pharmaceutical therapy. For each variable the relevant cost components were identified. The following table lists the health care resources and corresponding cost components included in the study.

Service/Resources	Cost Components
Physician office visits	Physician costs
Inpatient hospitalization	Facility costs associated with inpatient stays, physician costs for inpatient physician services
Outpatient hospitalization	Facility costs associated with outpatient visits, physician costs for hospital outpatient physician services
Emergency care	Emergency room costs, physician costs for emergency room services
Pharmaceutical therapy	Pharmaceutical costs as determined in the Source Prescription Audit
Work loss	Indirect costs or valuation of work loss secondary to receiving health care

Literature Review

An extensive review of the literature was conducted on the cost and epidemiology of 17 gastrointestinal diseases. An extensive search was performed of MEDLINE, HealthSTAR, and PubMed in order to identify literature published within the last 10 years pertaining to costs and epidemiology of the study diseases. The MeSH (Medical Subject Headings) terms and other keywords used to search the bibliographic databases included: GI disease and cost, GI disease and indirect cost, GI disease and productivity/work loss, GI disease and utilization, and GI disease and prevalence. When applicable, the references cited in these publications were also obtained and used as sources. In addition, the AGA advisory panel to the study was consulted to identify any seminal studies that are generally recognized as reporting reliable estimates of disease prevalence and/or cost of disease.

In total, more than 125 articles were identified that contained information on the epidemiology or cost of the gastrointestinal diseases of interest. The articles are catalogued in Appendix 1. Each article was evaluated for reliability of its data and relevance to current treatment patterns (if an economic study). Studies with inadequate sample sizes or obviously flawed study designs were not used as data sources or to validate the study findings.

The literature was the primary source for disease prevalence only when the study diseases were clearly over- or under-represented in the national databases. That is, a disease was under-represented, for example, when the sample size of the population data captured in a national database was too small for deriving dependable estimates of prevalence or costs. A disease was over-represented when, for example, it was apparent that patient data for the disease were aggregated with patient data for one or more other diseases that may have been similar, but were still defined differently for purposes of this study. Of the 17

diseases studied, four diseases (foodborne illness, hepatitis C, GERD, and gallbladder disease) were judged to be significantly under-reported in the national databases and two (Crohn's disease and ulcerative colitis) were judged to be over-represented in the databases. For each of these six diseases, well-designed, peer-reviewed articles served as the main data source for descriptive epidemiology.

Databases

Certain publicly available surveys on health status, health care utilization and expenditures were integral to this study. The goal of the database analyses was to develop estimates for prevalence, health care utilization, and costs for each of the diseases included in the study. Comparable data from the literature were used to validate findings from the database analyses.

The primary data source for disease prevalence and utilization of health care services were the national databases produced by the National Center for Health Statistics (NCHS), part of the Centers for Disease Control and Prevention (CDC). However, these datasets do not include information on costs or charges. Therefore, data on average costs and charges were obtained from other datasets in order to assign monetary values to the health care resources identified in the NCHS databases.

1995 National Health Interview Survey (NHIS)

Administered by the National Center for Health Statistics, the NHIS is an annual nationwide survey of civilian households with a sample based upon interviews of approximately 100,000 persons from 40,000 households. All information collected in the survey is from face-to-face interviews of responsible family members residing in the household. Proxy responses are accepted for family members who are not at home and are required for all children and for all family members who are physically or mentally incapable of responding for themselves. Illnesses are coded using a slight modification of the ninth revision of the *International Classification of Diseases*. The 1995 NHIS was the primary data source for the period prevalence of the majority of diseases. Wherever the data allowed, the epidemiological information was broken out by age, gender, and race. NHIS was also used to calculate estimates of indirect costs via work-loss days; however, low unweighted cell counts prohibited the use of these estimates for some diseases.

The NHIS sample is divided into six representative subsamples. In 1995, one of these subsamples was administered a questionnaire on digestive system conditions, from which respondents were asked the questions: During the past 12 months, did anyone in the family have: a) gallstones? b) any other gallbladder trouble? c) cirrhosis of the liver? d) fatty liver? e) hepatitis? f) yellow jaundice? g) any other liver trouble? h) an ulcer? i) a hernia or rupture? j) any disease of the esophagus? k) gastritis? l) frequent indigestion? m) any other stomach trouble? n) enteritis? o) diverticulitis? p) colitis? q) a spastic colon? r) frequent constipation? s) any other bowel trouble? t) any other intestinal trouble? u) cancer of the stomach, intestines, colon, or rectum? and v) any other condition of the digestive system? Other questions relevant to this study pertained to limitation and restriction of activities due to the condition. For each disease condition reported, respondents were asked to

recall, over the past two weeks, the number of restricted activity days, bed days, work-loss days, and school-loss days due to the condition.

The primary shortcomings of NHIS are that the data are somewhat old (1995 for NHIS vs. 1998 for most of the other databases used in this study), and the disease occurrences are self-reported. Although most other databases used in this study reported data for 1998, the most recent available year for NHIS data necessary for this study is 1995. (The 1995 prevalence rate was applied to the 1998 U.S. population estimate to estimate 1998 prevalence.) Although a considerable effort is made to ensure accurate reporting, information from both proxy and self-respondents may be under-reported because the respondent is unaware of relevant information, has forgotten it, or does not wish to reveal it to an interviewer. As such, the self-reported nature of NHIS likely results in underestimates of prevalence.

Although the NHIS sample size is quite large (102,000 persons), it nevertheless is unable, in many cases, to capture useful levels of data on some of less prevalent gastrointestinal diseases involved in this study. Therefore, to improve statistical accuracy, the use of this database was limited to diseases in which the unweighted cell count (i.e., the unweighted frequency count of a given disease) was equal to or greater than 30. Another shortcoming of the NHIS pertains to coding of the data. After subjects were asked if they suffered from the particular disease, coders first classified the response to a modified version of the ICD-9-CM diagnosis codes and subsequently grouped these codes into larger classifications (condition recodes). This method presents a possibility for introducing error with respect to disease identification.[4]

Because of these limitations inherent in NHIS, estimates of prevalence and of restricted activity days were supplemented by data from other sources. However, unless noted otherwise in the text, all estimates of prevalence for each disease were obtained from NHIS.

1998 National Hospital Discharge Survey (NHDS)

Another NCHS dataset used for this analysis is the National Hospital Discharge Survey (NHDS). The NHDS is a national survey of inpatient utilization in non-federal short-stay hospitals, children's hospitals, and general hospitals. The database comprises medical records from a nationally representative sample of 270,000 inpatient records drawn from the 500 non-federal hospitals covered in the NHDS. This dataset was used to identify inpatient hospitalization information, including number of hospitalizations, average length of stay per disease, and the total number of days of care by each disease. As is the case for other NCHS datasets, NHDS does not provide cost or charge information. Therefore, other databases were used to estimate costs.

[4] According to NCHS, the information is reliable for its condition recodes (at a 3-digit level), but may be less reliable for more specific, individual diagnosis codes (at the 4-digit level). The fact that producing estimates for each of the 17 diseases required identifying conditions on the diagnosis code level--and not on the more reliable, albeit less specific, condition recode level--means that in some cases the estimates for the four-digit disease codes are less reliable.

1998 National Ambulatory Medical Care Survey (NAMCS)

The National Ambulatory Medical Care Survey (NAMCS), also a NCHS dataset, is a survey of office visits made by ambulatory patients to a nationally representative sample of approximately 1,500 non-federally employed physicians. The settings included in this survey are: free standing private, solo, or group office; free standing clinic; neighborhood health center; privately operated clinic; local government clinic; and health maintenance organization or other prepaid practice. The total number of records (i.e., visits) is about 23,400. As with the other NCHS datasets, an algorithm prepared by NCHS allows the raw counts to be weighted up to an estimate for the entire nation. The dataset provides information regarding physician office visits for each disease, including number of visits, and demographic data. Visits to physicians in the specialties of anesthesiology, pathology, and radiology are excluded from the survey. An assumption was made that for a given patient, one day of treatment constituted one visit. (This assumption also applies to the NHAMCS dataset, described below).

1998 National Hospital Ambulatory Medical Care Survey (NHAMCS)

The National Hospital Ambulatory Medical Care Survey (NHAMCS), also part of the NCHS series, includes two separate files: a hospital emergency department file (ED file) and a hospital outpatient department file (OPD file). Each file has a sample size of 29,400 records (i.e., visits). From these files, data were obtained on the number of emergency department and outpatient department visits for each disease, as well as patient demographic data.

The hospital outpatient department is defined as outpatient clinics within a hospital. Clinics are determined to be eligible for NHAMCS if ambulatory medical care is provided under the supervision of a physician, under the auspices of the hospital. Clinics where only ancillary services are provided, or where physician services are not provided, are not included in the survey. Further, ambulatory surgery centers, both those in hospitals as well as free-standing centers, are not included in NAMCS or NHAMCS.

1997 Nationwide Inpatient Sample (NIS)

The Nationwide Inpatient Sample (NIS) Release 6 is part of the Healthcare Cost and Utilization Project (HCUP), administered by the Agency for Health Research and Quality (AHRQ). The NIS approximates a 20% sample of U.S. community hospitals, defined by the American Hospital Association as "all non-federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions" for 1997. Included among community hospitals are specialty hospitals such as obstetrics-gynecology, ear-nose-throat, short-term rehabilitation, orthopedic, and pediatric. Excluded are long-term hospitals, psychiatric hospitals, and alcoholism/chemical dependency treatment facilities. NIS Release 6 is based on a stratified probability sample of hospitals, with sampling probabilities proportional to the number of U.S. community hospitals in each stratum. NIS Release 6 is drawn from 22 states and contains information on all inpatient stays from over 1,000 hospitals, totaling about 7.1 million records in 1997. This database was used to estimate the average facility cost per hospital day for each given disease. This value,

along with the total days of hospital care per disease (from the 1998 NHDS) was used to calculate the total facility costs associated with hospital inpatient stays.

1996 Medical Expenditure Panel Survey (MEPS)

AHRQ's longitudinal household dataset, the Medical Expenditure Panel Survey (MEPS), provides information, collected in three rounds, on a nationally representative sample of the civilian non-institutionalized population of the U.S. The 1996 household survey contains information on 23,200 unweighted persons, weighted to a nationally-representative total of 268.9 million persons. MEPS collects self-reported information on respondents' health care utilization and expenditures, and then links these data with additional information collected from the respondents' medical providers, employers, and insurance providers. MEPS contains specific information about direct medical resource utilization (the number of physician visits, inpatient hospital stays, emergency room visits, and prescribed medications) and the corresponding costs (amount paid by insurer type, amount paid out-of-pocket, etc.) for given conditions. MEPS details diagnoses to only the 3-digit level. For the gastrointestinal diseases fully defined by 3-digit ICD-9 diagnosis codes (see Table 2.1) and where sufficient disease counts were found, the 1996 MEPS file was used to calculate average costs for all physician office visits and for hospital outpatient visits, including physician services.

1998 Medicare Standard Analytic Files (SAF)

The SAF contains all medical claims of 5% of Medicare beneficiaries. These files contain final action, adjustment-resolved claims, and are updated each July with data from the previous calendar service year. Provider numbers and beneficiary claim numbers are encrypted in the 5% files to protect the privacy of individuals. SAF includes the following files: Inpatient (Part A), Hospital Outpatient, Home Health Agency, Hospice, Skilled Nursing Facility, and Physician/Supplier (Part B). The 1998 Medicare Standard Analytic Files (SAF) served as the primary source for all utilization and cost data for the three cancers included in the study. The SAF was required for the cancers because it most accurately measures all types and settings of care among this patient population.

1997-99 Group Health Cooperative of Puget Sound Claims Database

The Group Health Cooperative of Puget Sound, in Seattle, Washington includes approximately 450,000 covered lives from a mixed-model HMO. These claims data contain information on fully allocated costs per claim. When precise or reliable estimates were not found in the above-mentioned databases, utilization rates and unit costs were obtained from these claims data, which span all settings of health care. For many diseases, this database was used to estimate average cost per physician office visit, average physician cost per day in the hospital, average facility and physician cost per outpatient hospital visit, and average facility and physician cost per emergency room visit.

2000 Scott Levin Source Prescription Audit (SPA) and the Physician Drug and Diagnosis Audit (PDDA)

The Scott Levin Source Prescription Audit (SPA), drawn from a nationwide sample of pharmacies, served as the source for drug expenditures for each disease. Approximately 35,400 retail pharmacies, 63% of the entire retail pharmacy universe in the U.S., are surveyed on a monthly basis, and 72% of all dispensed prescriptions are captured. A shortcoming of this data is that it does not capture drugs administered in physician offices. Disease-specific utilization of drugs, used to determine the proportion of spending that is attributable to a given disease, was measured through the Scott Levin Physician Drug and Diagnosis Audit. This audit monitors patient visits and associated treatment regimens among approximately 365,000 office-based physicians in 29 specialties across the nine U.S. census regions. It tracks patient drug requests, drug switching, and prescribing volume. Diagnosis activity is organized by ICD-9 codes.

Measuring Utilization in the Databases

The NHDS, NAMCS, and NHAMCS (ED and OPD files) datasets were used as the primary source for estimating utilization figures for inpatient hospital stays, physician office visits, emergency room visits, and hospital outpatient visits, respectively. In addition to stays and visits, the average length of stay and total days of care by disease were obtained from these databases, which were used in calculating indirect costs (as described below, in **Estimating Costs**). To increase the statistical reliability in the estimates, the data were used only when there was an unweighted cell count equal to or greater than 30 cases. The Group Health Cooperative of Puget Sound claims database was used for utilization estimates when the other databases lacked representativeness or the AGA advisory panel identified inconsistencies between the results and the published literature. This claims database is extensive and reliable, but was used as a secondary data source primarily because the enrollees are limited to the Pacific Northwest region of the U.S.

Estimating Costs

Direct Costs

For each type of service and for each disease, unit costs were applied to the total utilization figures in order to calculate total direct costs. Where data allowed, both utilization and average cost estimates were differentiated by whether the disease appeared as the first-listed (i.e., primary) diagnosis or as one of the second-listed (i.e., secondary, tertiary, etc.) diagnoses. When the disease appeared as a first-listed diagnosis, 80% of the costs of the claim were attributed to this disease. When the disease appeared as a second-listed diagnosis, 20% of the costs of the claim were attributed to the disease. This method has been applied in past burden of gastrointestinal illness studies.[5] In the relatively few cases

[5] Brown D and Everhart JE. Cost of digestive diseases in the United States. In: Everhart JE, editor. Digestive diseases in the United States: epidemiology and impact. US Department of Health and Human Services, Public Health Service, National Institutes of health, National Institutes of Diabetes and Digestive and Kidney Diseases. Washington DC: US Government Printing Office, 1994; NIH publication no. 94-1447 (pp. 55-82).

when the disease appeared as both a first- and second-listed diagnosis, 100% of the costs of the claim were attributed to the disease.

Inpatient Hospital Costs

The cost of inpatient hospitalizations is comprised of two components: 1) hospital inpatient facility costs; and 2) physician visits and procedures to inpatients in the hospital. For most diseases, average hospital facility costs were obtained from NIS, and inpatient physician costs were obtained from the Group Health Cooperative of Puget Sound claims database.

The 1997 Nationwide Inpatient Sample was used to calculate hospital inpatient facility costs. The NIS reports total facility billed charges for each record (i.e., discharge) in the dataset. Charges include a hospital's markup over costs (including profit and bad debt) and hence overstate the economic resources used in patient care. To account for this, the study converted—for each record (i.e., discharge) in NIS--the monetary value of inpatient facility charges to inpatient facility costs. For each discharge record in the 1997 Nationwide Inpatient Sample, the total charge value was multiplied by a hospital-specific 'cost-to-charge ratio' determined by Medicare Cost Reports.[6] For most diseases, this estimated daily cost figure from 1997 Nationwide Inpatient Sample was used to calculate average daily inpatient facility charges, by primary diagnosis, secondary diagnosis, and both. For each disease, these three average daily facility cost figures were adjusted to 1998 dollars and then applied to the appropriate utilization figure (i.e., total number of inpatient days by primary vs. secondary vs. both) calculated from the 1998 NHDS. The sum of these three products represents the total facility costs for that disease in 1998 dollars.

The costs of physician services associated with inpatient hospital stays were calculated from the Group Health Cooperative of Puget Sound claims database. This database lists physician visits and procedures in the form of CPT/HCPCS codes, a classification that obviates the need for separating physician visits from physician procedures, as done in previous burden of illness studies.[7] These average daily costs were then applied to the utilization estimates (i.e., total number of inpatient days) from NHDS. As noted above, all utilization and cost data pertaining to the three cancers were acquired from the Medicare SAF.

It is important to note that, due to the methodology employed, hospital costs may be somewhat overstated for certain diseases. For all diseases, 80% of the cost of a hospital claim is attributed to the primary diagnosis, while 20% is applied to a secondary diagnosis. To the extent that a secondary diagnosis contributes to 20% of inpatient resource use (e.g., more physician time, prolonged hospitalization), this methodology results in a clear reflection of hospital costs. For prevalent diseases that are predominantly symptomatic and hence usually appear as a secondary diagnosis, (e.g., chronic diarrhea or GERD), this methodology might result in an overestimation of related inpatient costs if, in fact, these

[6] HFCA Form 2552-96, Worksheet S-2 for Cost Reporting Periods Beginning on or After October 1, 1996

[7] Brown D and Everhart JE. Cost of digestive diseases in the United States. In: Everhart JE, editor. Digestive diseases in the United States: epidemiology and impact. US Department of Health and Human Services, Public Health Service, National Institutes of health, National Institutes of Diabetes and Digestive and Kidney Diseases. Washington DC: US Government Printing Office, 1994; NIH publication no. 94-1447 (pp. 55-82).

diseases do not contribute to 20% of total inpatient resource use when listed as a secondary diagnosis.

Outpatient Hospital Costs, Emergency Care, and Physician Office Visits Costs

The Group Health Cooperative of Puget Sound claims database was used to estimate average cost per physician office visit, average facility and physician cost per outpatient hospital visit, and average facility and physician cost per emergency room visit. These average costs were applied to the utilization figures (i.e., visits by primary diagnosis, secondary diagnosis, and both) from NHAMCS (ED and OPD files) and NAMCS, respectively, to estimate the total costs by setting of care for each disease.

The Scott-Levin SPA and PDDA were used for information on prescription and over-the-counter (OTC) medications. The total cost of a drug for a particular disease was calculated by applying the diagnosis value factor for the disease to the total drug acquisition cost. Diagnosis value is a share of a given drug's use for a particular disease weighted by strength and total extended units.

Indirect Costs

Indirect costs, sometimes referred to as productivity costs, typically include three categories of time costs: 1) costs related to consumption of medical care, requiring the time of the patient, family, or other caretakers; 2) costs associated with lost or impaired ability to work or enjoy leisure activities due to morbidity; and 3) lost future earning potential due to premature death. Given the scarcity of reliable data sources, this study addressed productivity losses due to time away from paid labor resulting from consumption of health care. It did not attempt to estimate the value of foregone future earnings due to premature death, nor did it attempt to estimate the value of foregone non-paid labor or leisure time.

The specific nature of these diseases under study resulted in very low unweighted cell counts for work-loss days in NHIS; therefore, for a majority of the diseases, indirect costs were calculated by the valuation of time away from work while seeking medical care. For example, one inpatient hospital day for a person of working age (16-64 years) was assumed to represent one day of missed work. The corresponding assumptions for ambulatory visits were two hours for physician office, four hours for emergency room visits, and eight hours for hospital outpatient department visits. These assumed hours were then applied to the total utilization estimates (i.e., days in hospital, ambulatory visits) to estimate days lost from work in those settings. In valuing the work-loss while seeking medical care, the National Statistical Abstract (2000) was used to obtain information on average daily wage, broken down by gender and age. These average daily wage figures were applied to gender- and age-specific utilization estimates from the NCHS datasets.

Another aspect deserving consideration is that when many people miss work they do not actually "lose" their wages, as a certain number of sick days are allowable for persons on salary. For the purpose of this study, the equivalent of lost wages was used to value the lost productivity resulting from time away from work.

The low NHIS cell counts also prohibited the estimation of work loss in sub-populations that did not seek medical care. However, productivity loss data was

obtainable from the literature for four diseases. The original studies supporting these estimates were more reliable than data from NHIS and will be described in more detail in the subsequent chapters.

Assessment and Revision of Estimates

After completing all analyses from the individual datasets, the reliability and validity of the data was assessed. The unweighted cell count for each variable, the overall geographic and age distribution of the dataset, and the methods used in sampling the population were all considered in selecting the definitive source for a given data point. As previously noted, when the unweighted cell count for an individual disease fell below 30 in a database, a secondary data source was used (e.g., instead of NAMCS for physician office utilization, the Group Health Cooperative of Puget Sound claims database was used). Further, the exact phrasing of the questions asked of the sample population in the NHIS was considered in order to determine if there was any possibility of mis-coding or misinterpretation.

CHAPTER 3: ACID-RELATED GASTROINTESTINAL DISEASES

This chapter presents estimates of the costs of acid-related diseases. Included in the group of acid-related diseases are gastroesophageal reflux disease, peptic ulcer disease, and Barrett's esophagus.

Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) is a common digestive disorder that occurs when the lower esophageal sphincter (the muscle connecting esophagus with the stomach) is weak or relaxes inappropriately, allowing the stomach's contents to flow up into the esophagus. The most common symptom of GERD is heartburn, or acid indigestion, and is often exacerbated by eating. Some physicians believe that a condition called hiatal hernia causes some people to suffer from GERD. Hiatal hernia occurs when the upper part of the stomach moves up into the chest through a small opening in the diaphragm, resulting in retention of acid as well as other contents that reflux easily into the esophagus. GERD is seen in different age groups at similar rates. Other factors that may contribute to GERD are related to dietary and lifestyle choices: certain foods, smoking, obesity, and pregnancy may all trigger GERD. It is believed that genetics plays a role; a recent study indicates that a family member of someone with GERD is four times more likely to experience the disorder than someone who has no family history of GERD.[8] Another study found that obesity is an independent factor for developing GERD,[9] although this has not yet been validated by other studies. There is a possibility that genetic predisposition towards obesity is a factor influencing the genetic predisposition towards GERD. Again, this area requires further research.

In most cases, GERD symptoms can be managed by lifestyle changes and the use of antacids. However, for people with chronic reflux and heartburn, certain medications-such as proton pump inhibitors--are recommended.

The ICD-9 diagnosis codes included in the study of GERD are: 530.1 (Esophagitis); 530.2 (Ulcer of esophagus); 530.3 (Stricture and stenosis of esophagus); 530.81 (Esophageal reflux).

Epidemiology

GERD is rarely life-threatening; in fact, the crude mortality rate was 0.48 deaths per 100,000 in 1998, according to the CDC.

The prevalence estimates for GERD vary drastically from one data source to another. Analysis of the NHIS database indicates there were approximately 4.6 million prevalent cases in the U.S. in 1998. However, this may be a significant underestimate given that

[8] Romero Y. Familial body mass and epidemiology of GERD. Program and abstracts of Digestive Disease Week; May 21-24, 2000; San Diego, California. Session 531.

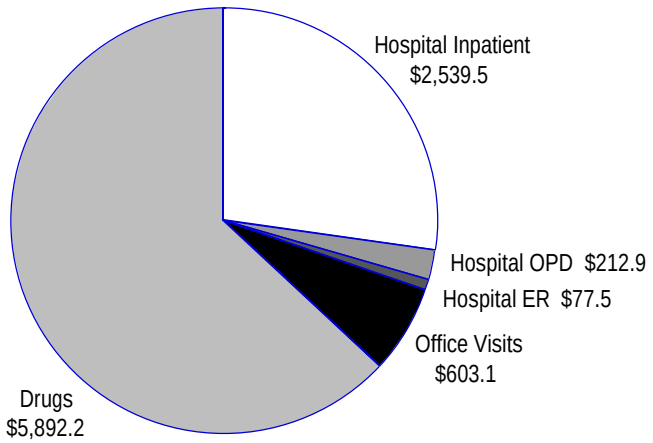
[9] Lagergren J, Bergstrom R, Nyren O. Association between body mass and adenocarcinoma of the esophagus and cardia. Ann Intern Med. 1999;130:883-890.

NHIS did not ask a question that may be sensitive to GERD. (The most appropriate question regards the frequency of indigestion.) According to a 1999 survey of 10 major U.S. cities, prevalence was estimated at 18.6 million.[10] Prevalence of GERD is typically higher among the Caucasian population as compared to African-American and Hispanic groups. According to the analysis of NHIS, the prevalence of GERD among the white population is approximately 556 cases per 100,000, almost twice the rate among African-Americans (288 cases per 100,000) and more than 10 times the prevalence among Hispanics (48 cases per 100,000). NHIS also indicates that approximately 74% of all GERD cases occur in women, and over 90% of GERD sufferers are over the age of 25.

Direct Costs

The high direct costs associated with GERD reflect its high prevalence. The physician's office was the primary site of service for this disorder, according to analysis of the 1998 NAMCS database. There were 9.1 million visits in which GERD was one of the top three diagnoses; in approximately 4.6 million of these visits, it was the primary diagnosis (see Table 3.1 at the end of this chapter). The total cost of physician office visits was $603.1 million (see Figure 3.1 below).

Figure 3.1. Direct Cost of Gastroesophageal Reflux Disorder (in millions)



The inpatient hospital setting was also a common setting of care for GERD patients. According to 1998 NHDS, nearly one million hospital inpatient visits were related to GERD, however, in 87% of these visits, GERD was a secondary diagnosis. The average length of inpatient hospital stay for a GERD patient (defined as having a primary diagnosis of GERD) was 3.4 days and the median length of stay was 2.0 days, while the total days of inpatient hospital care for all GERD-related visits was over 4.8 million days. The total costs related to inpatient treatment of GERD, including physician services

[10] Frank et al. Upper Gastrointestinal Symptoms in North America. *Digestive Diseases and Sciences,* Vol 45. No.4, (April 2000).

($548.7 million) and facility costs ($2.0 billion), is estimated at $2.5 billion (See Figure 3.1).

The hospital outpatient setting also served a large number of GERD patients, accounting for roughly 800,000 visits by patients with GERD. The total cost of these visits was $212.9 million. There were close to 500,000 emergency room visits related to GERD, at a cost of $77.5 million.

As is the case with many GI diseases, lifestyle changes such as dietary adjustments and stress reduction can be successful measures for reducing GERD symptoms. However, the ready availability of safe and effective medications has led to increasing use of drugs as treatment for GERD. The cost of treating GERD with these medications has expanded rapidly in recent years. According to the 2000 Scott-Levin dataset, the total cost of GERD medications was roughly $5.9 billion dollars.

The total direct costs of GERD, including all physician services, facility costs, and drug costs, reached $9.3 billion in 1998. The rate of inflation for medical services was determined to be 1.0697% between 1998 and 2000. This inflator does not account for any trends in the prevalence or treatment of this disease; it simply uses the medical consumer price index (CPI) to weight up the monetary cost to 2000 dollars. Inflated to year 2000 dollars using CPI, the total direct cost is projected at $9.6 billion. It is important to note that this figure does not represent any adjustment for disease, population, or treatment trends; it is simply an inflated monetary figure.

Indirect Costs

Although rarely life-threatening, the symptoms and complications of GERD are often temporarily disabling. The indirect costs related to GERD were measured by analysis of consumption of health care and the lost days of work associated with each setting of care. As described above, the available data for determining productivity losses likely results in an underestimate of the impact of this disorder.

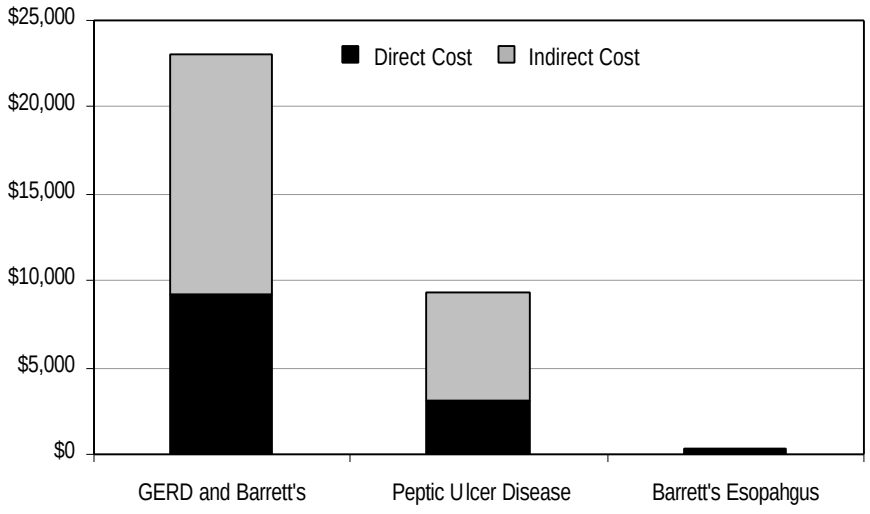
Using only lost days of work due to consumption of health care as a proxy for indirect cost, as was done for all the study diseases, the estimated indirect cost of GERD in 1998 is $479 million. However, for this disease, a more comprehensive indirect cost was calculated using different methods. This was made possible due to more comprehensive available data. An estimate of work loss costs due to GERD was obtained from the literature. The study estimated that $237 per case was lost every three months.[11] As GERD has a high rate of recurrence, and does not resolve quickly, this figure was multiplied by four in order to estimate the annual cost.[12] Therefore, $948 in productivity losses per person, as valued by lost wages, are accumulated annually. The number of working-age persons with GERD was determined through the NHIS estimate of working-age persons in the U.S., which was applied to the prevalence of GERD, or 18.7 million cases. The total number of working-age persons with GERD therefore is estimated at 14.5 million. After multiplying by $948 of per person productivity loss, the total annual cost of

[11] Henke, CJ. Levin TR, et al. Work loss due to peptic ulcer disease and gastroesophageal reflux disease in a health maintenance organization. *American Journal Gastroenterology*, 2000: 95 (3), ppg. 788-92.

[12] Acid Related Diseases: Biology and Treatment. Editors: Sachs G and Modlin I. Schentzor-Verlag GmbH Konstanz, 1998, ppg. 293-195.

lost productivity resulting from GERD equals $13.8 billion. (See Figure 3.2 for comparison of direct vs. indirect cost.) Inflation to year 2000 dollars increases this estimate to just over $14.6 billion.

Figure 3.2. Direct and Indirect Cost of Acid-Related Diseases (in millions)



Barrett's Esophagus

Barrett's esophagus is a condition manifested as a severe change in the lining of the esophagus, typically in patients who suffer from GERD. In a person with Barrett's esophagus, the normal squamous cells that line the esophagus turn into specialized columnar cells, which are more similar to intestinal cells. Symptoms of Barrett's esophagus include vomiting, blood in vomit or stool, waking during the night due to heartburn pain, and difficulty swallowing. However, some people with Barrett's esophagus do not present with symptoms. Consequently, Barrett's esophagus often goes undiagnosed. As with GERD, the organic cause of the disease is unclear, although chronic reflux certainly plays a role. Persons who are obese, male, or Caucasian have increased risk for Barrett's esophagus. Current research suggests patients with Barrett's esophagus are at greater risk for developing esophageal cancer, although the degree of risk is not clearly defined.[13]

Presently there is no cure for Barrett's esophagus. The goal of current treatment is to prevent further damage to the cell lining by stopping acid reflux from the stomach. The treatment consists of medications such as H2 receptor antagonists and proton pump inhibitors. In severe cases, surgery is necessary to remove damaged tissue. Regular endoscopic screening (every two-to-three years) is strongly recommended for patients with Barrett's esophagus.

The ICD-9 diagnosis code for Barrett's esophagus is 530.2 (Ulcer of esophagus).

[13] National Digestive Diseases Information Clearinghouse: NIH Publication No. 99-4546. May 1999.

Epidemiology

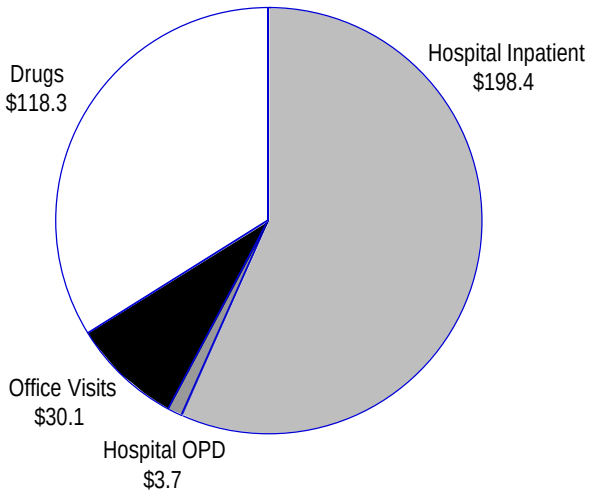
Barrett's esophagus is a small subset of GERD. (As such, the ICD-9 code for Barrett's esophagus is 530.2, which is included under the broader code for GERD.) The mortality rate associated with Barrett's is even lower than that of GERD: just 0.04 deaths per 100,000 in 1998, according to the CDC.

The prevalence of Barrett's esophagus is less than 20% of the GERD patient population. According to NHIS, in 1998 there were approximately 808,000 prevalent cases of Barrett's esophagus in the U.S.; this is a rate of 300 cases per 100,000 persons. According to the NHIS dataset, Barrett's esophagus appears to be more prevalent among African-Americans than white Caucasians (144 cases per 100,000 and 86 cases per 100,000, respectively). It was not possible to obtain adequate prevalence data from NHIS for other ethnic groups.

Direct Costs

The physician's office was the primary site of service for patients with Barrett's esophagus. In 1998, there were just over 230,000 visits to the physician office related to Barrett's esophagus (see Table 3.1 at the end of this chapter). The total cost of physician services were determined to be roughly $30.1 million in 1998 (see Figure 3.3).

Figure 3.3. Direct Cost of Barrett's Esophagus (in millions)



The inpatient hospital setting was another frequently utilized source of care for patients with Barrett's esophagus. In 1998 there were roughly 61,000 inpatient stays related to Barrett's esophagus, although 75% were for a secondary diagnosis of Barrett's esophagus. The visits accounted for $198.4 million in cost, including $160.0 million for facility costs and $38.4 million in physician services.

The outpatient hospital setting was not highly utilized by patients with Barrett's esophagus. In 1998, there were nearly 10,000 visits to the hospital OPD for this condition. The total cost, including facility costs and physician services, was approximately $3.7 million. There were no recorded visits to the hospital emergency departments for Barrett's esophagus in 1998, according to NHAMCS.

The databases used to analyze utilization indicate that across all settings of care, the white Caucasian population consumed the most services per capita, as well as in total. Although racial representation varies somewhat among databases, this is an important point to note in light of the NHIS data, which indicate the disease is more prevalent among the African-American population.

As is the case for GERD more broadly, lifestyle changes are recommended for alleviating Barrett's esophagus. However, this disease can manifest severe complications requiring more aggressive treatment. According the Scott-Levin PDDA and SPA data, $118.3 million was spent on drugs to treat Barrett's esophagus in 2000.

The total direct cost of Barrett's esophagus in 1998, incorporating the figures for the physician office, and hospital inpatient and outpatient settings, along with total drug costs, was $350.5 million. Incorporating only the effects of inflation yields a figure of $366.5 million in direct cost for the year 2000.

Indirect Costs

The indirect costs of Barrett's esophagus were difficult to capture. The lost wages due to consumption of care in all settings served as an estimate of indirect cost. The average length of inpatient hospital stay for a patient with Barrett's esophagus as a primary diagnosis was 4.6 days and the median length of stay was 4.0 days, while a total of just over 340,000 days of care were given to Barrett's patients in the hospital setting. As discussed earlier in the Methods chapter, one inpatient hospital day for a person of working age was assumed to represent one day of missed work. The corresponding assumptions for ambulatory visits were two hours for physician office, four hours for emergency room visits, and eight hours for hospital outpatient department visits. These assumed hours were translated into portions of days. These portions were then applied to the total utilization figures (days) to estimate days lost from work in those settings. Applying average wage figures from the National Statistical Abstract, the estimate for the lost wages as a result of Barrett's esophagus is $21.8 million (see Figure 3.2). As with the other diseases in this study, this estimate of indirect costs is an underestimate. Accounting for inflation alone indicates the total indirect cost for the year 2000 is $23.0 million.

Peptic Ulcer Disease

Peptic ulcer disease (PUD) is a common digestive disorder, typically presenting with persistent stomach pain, weight loss, poor appetite, bloating, nausea, and vomiting. Peptic ulcer is a loss of an area of the mucosal lining of the stomach or duodenum. It is believed that one causal factor in PUD is *H. pylori* infection; less common causes of peptic ulcer include long-term use of non-steroidal anti-inflammatory agents, such as aspirin and ibuprofen, as well as the presence of cancerous tumors in the stomach and pancreas.

Most peptic ulcers are diagnosed by an upper gastrointestinal series or an endoscopy. If an ulcer is found, a test for *H. pylori* is often performed. Peptic ulcers caused by *H. pylori* are treated with special combinations of antibiotics and acid-suppressing drugs, such as H2 receptor antagonist and proton pump inhibitors.

The ICD-9 diagnosis codes used in the data analysis of PUD include 531 (Gastric ulcer); 532 (Duodenal ulcer); 533 (Peptic ulcer, site unspecified); 534 (Gastrojejunal ulcer).

Epidemiology

Peptic ulcer disease is often caused by the *H. pylori* bacteria, which can be spread via human saliva, food, and water, among other suspected carriers. Men and women are at equal risk for developing PUD; the overall lifetime risk for both genders is 10%. PUD is uncommon in children, but risk increases with age. In fact, over 70% of all PUD cases occur in persons between the ages of 25 and 64, according to analysis of NHIS. According to past studies, prevalence is higher among African-Americans and Hispanics than in white Caucasians. It has been suggested that this is more of a socioeconomic influence as opposed to a racial influence. In the NHIS database, the prevalence appears similar between the three groups. Smokers also have a higher risk of PUD than do non-smokers.[14]

Prevalence of PUD is lower in the U.S. than in other nations, in large part because the overall standard of living is much higher in the U.S. Still, according to the literature there were 6.5 million prevalent cases of PUD in 1995. In 1998, this is estimated to be 6.7 million cases, representing a prevalence rate of 2,490 cases per 100,000 persons. Prevalence of *H. pylori* infection is even higher, but not all infected persons develop PUD.[15] According to the CDC, the crude mortality rate of PUD in 1998 was 1.74 deaths per 100,000 persons.

Direct Costs

Given the high prevalence of PUD, it follows that the associated costs are also great. The primary site of service for PUD in 1998 was the physician's office, where there were more than 2.6 million PUD visits. The total cost associated with these visits, based upon physician time and services, was $196.3 million in 1998 (see Figure 3.4). The inpatient hospital setting was the second most common setting of care, although there were comparatively fewer visits, at nearly 470,000. It is important to note that 66% of these visits were related to a secondary diagnosis of PUD. The cost of facility and physician services totaled more than $1.8 billion, including $1.6 billion in facility costs and $155 million in physician services.

More than 250,000 PUD-related visits were paid to hospital outpatient departments in 1998. In this setting, the total cost of care was $370.2 million in 1998, including the costs for associated facilities and physician services. Additionally, there were nearly 190,000 visits to the hospital emergency department for PUD in 1998. Including the costs for

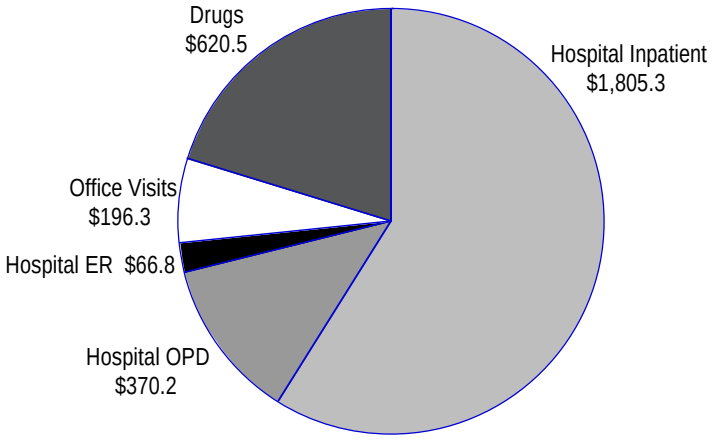
[14] National Digestive Diseases Information Clearinghouse. NIH Publication No. 97-4224, January 1998.
[15] Sonnenberg A, Everhart JE. The Prevalence of Self-Reported Peptic Ulcer Disease in the United States. *American Journal of Public Health*: 1996 (86)2; ppg. 200-05.

associated facilities and physician services, the cost of PUD in hospital EDs was $66.8 million. Detailed information pertaining to utilization across all settings, for all diseases in this category, is presented in Table 3.1.

After adjusting for the larger size of the white Caucasian population in the U.S., utilization rates between this group and the African-American population are similar, which corresponds to the similar between-group prevalence rates observed in NHIS.

According to Scott-Levin, the cost of drugs to treat PUD was roughly $620.5 million in 2000. This figure includes prescription and OTC medications used specifically to treat PUD.

Figure 3.4. Direct Cost of Peptic Ulcer Disease (in millions)



Across all four settings, and including the total drug costs, the total direct cost of PUD is close to $3.1 billion per year. Using the medical CPI to account only for inflation, the estimated direct cost for the year 2000 is over $3.2 billion. Again, this figure does not report any changes due to trends in prevalence or in treatment costs.

Indirect Costs

The indirect cost associated with lost work days due to consumption of health care as a result of PUD is estimated at $201 million. This figure is a gross underestimate, but a more comprehensive estimate was developed using similar methodology to that for GERD. The indirect costs of peptic ulcer disease can be estimated by using an approximation of lost productivity from the literature. Over a three-month period, the per-person lost productivity is estimated at $606.[16] Because PUD typically requires six months to resolve, we multiplied this figure by two in order to come up with an annual estimate of $1,212 per person per year. According to NHIS data, approximately 76.5% of the PUD population is

[16] Henke et al. Levin TR, et al. Work loss due to peptic ulcer disease and gastroesophageal reflux disease in a health maintenance organization. *American Journal Gastroenterology*, 2000: 95 (3), ppg. 788-92.

of working age (ages 18-65); therefore, over 6.9 million working-age persons with PUD incur productivity losses estimated at $6.2 billion (see Figure 3.2). In 2000 dollars this estimate is $6.6 billion.

The average length of hospital stay for a PUD patient with a primary diagnosis was 5.3 days, and the median length of stay was 4.0 days. The total days of care received by all PUD patients in 1998 was greater than 2.9 million days.

Table 3.1. Health Care Utilization for Acid-Related GI Disorders

Disease	Inpatient Hospital Stays	Inpatient Hospital Stays (Primary Diagnosis Only)	Outpatient Hospital Visits	Emergency Room Visits	Physician Office Visits
GERD	968,341	175,725	829,848	459,719	9,114,361
Barrett's	60,906	18,863	9,756	N/A	230,770
Peptic Ulcer Disease	469,857	189,465	255,991	188,363	2,651,884

CHAPTER 4: CHRONIC INTESTINAL DISORDERS

This chapter addresses several major types of motility disorders and other chronic intestinal diseases: irritable bowel syndrome, Crohn's disease, ulcerative colitis, diverticular disease, and chronic diarrhea.

Irritable Bowel Syndrome

Irritable bowel syndrome (IBS) is a disorder of motility of the entire GI tract that produces cramping, abdominal pain, constipation, and/or diarrhea. Some patients with IBS experience passing of mucus in bowel movements. In IBS, the GI tract is highly sensitive to many stimuli, including one or more of the following: emotional stress, diet, drugs, hormones, distension from gas, or various minor irritants. Among dietary suspects are high-fat or other high-calorie meals, dairy products, wheat, citrus fruits, coffee, and tea. IBS is caused by spasms of the colon muscle, in response to these stimuli. During an episode, GI tract contractions become stronger and more frequent, and the resulting rapid motility may lead to diarrhea. When colon motility is reduced, bowel movements do not occur regularly, resulting in constipation. Cramping appears to be induced by strong contractions and increased sensitivity of pain receptors in the large intestine.

Persons who suffer from IBS tend to have more sensitive and reactive colons, so that IBS is triggered by stimuli that may not affect persons without IBS. Stress can increase or intensify symptoms due to communications between the central nervous system and the nervous system of the small and large intestines.

IBS can cause great physical discomfort and embarrassment to many of its sufferers. It has not been shown to cause long-term damage to the intestine, and is not associated with cancers of the GI tract.

There is no consensus currently as to an organic cause of the disease. Upon physical examination, there generally appears to be no sign of disease except for tenderness over the large intestine. Physicians perform blood tests, stool examination, and sigmoidoscopy to rule out inflammatory bowel disease and other conditions that share certain symptoms of IBS.

Many people with IBS can control their symptoms to some degree through changes in their diet. If this does not relieve symptoms, fiber supplements or occasional laxatives can be used. Among the drugs prescribed for symptom relief are antispasmodics and drugs that slow the function of the GI tract, along with antidiarrheals, mild tranquilizers, and antidepressants.

The ICD-9 diagnosis codes used in studying IBS were 564.1 (Irritable bowel syndrome); 564.5 (Functional diarrhea); 564.8 (Other specified functional disorders of intestine); and 564.9 (Unspecified functional disorders of the intestine).

Epidemiology

Females are more likely to suffer from this disorder than males. According to data from NHIS, over 80% of all IBS sufferers are female. Females are more likely to experience symptoms during menstruation, suggesting the existence of a relationship between IBS and reproductive hormones. More than 75% of IBS cases occur in persons between ages 25 and 64 years old. According to data from the CDC, the crude mortality rate of IBS was 0.03 cases per 100,000 persons in 1998.

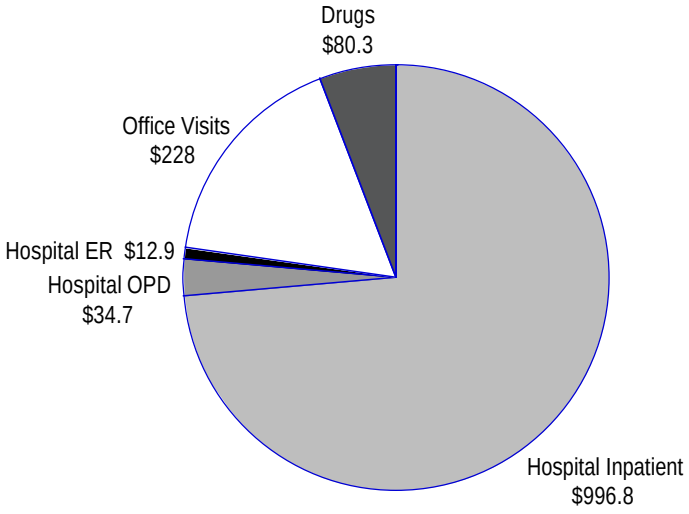
According to analysis of 1995 NHIS, the prevalence rate of IBS in the U.S. adjusted to 1998 was 5,700 cases per 100,000 persons. At that time, there were roughly 15.4 million prevalent cases. Further analysis of NHIS indicates that the prevalence in IBS is considerably higher among the white Caucasian population than in other ethnic groups, with 1,485 cases per 100,000 in the white population, 318 per 100,000 in Hispanics, and 173 per 100,000 among African-Americans. The magnitude of this difference remains unexplained.

Direct Costs

The high prevalence of IBS contributes to its substantial national costs. The total direct cost of IBS, including costs of inpatient and outpatient health services utilization and prescription medication, was greater than $1.6 billion in 1998 (see Figure 4.1). Adjusting for inflation increases this amount to nearly $1.7 billion in year 2000 dollars.

IBS is treated primarily in the physician's office, where there were 3.65 million visits for this disease 1998. (See Table 4.1 at the end of this chapter.)

Figure 4.1. Direct Cost of Irritable Bowel Syndrome (in millions)



By contrast, there were fewer than 500,000 hospital inpatient stays for IBS (in 69% of these visits IBS was a secondary diagnosis), fewer than 150,000 hospital outpatient visits, and 87,000 visits to the emergency department as a result of IBS.

The total cost for all physician office visits for IBS patients in 1998 was $228.0 million, while the total cost of all inpatient stays was close to $996.8 million. This figure includes $148.4 million in physician services and $848.4 million in facility costs. Hospital inpatient stays accounted for approximately 73% of total direct costs of IBS. The cost of outpatient hospital visits for IBS patients in 1998 was not insignificant. Outpatient hospital physician services and facility costs, based on extrapolation of figures from the GHC/Puget Sound claims database, was $34.7 million. The utilization and cost of ER services were the least among the four settings of care. The total cost of ER services, comprising inpatient facility and ER services, was approximately $12.9 million. According to 2000 Scott-Levin data, pharmaceuticals prescribed for IBS cost $80.3 million annually.

Indirect Costs

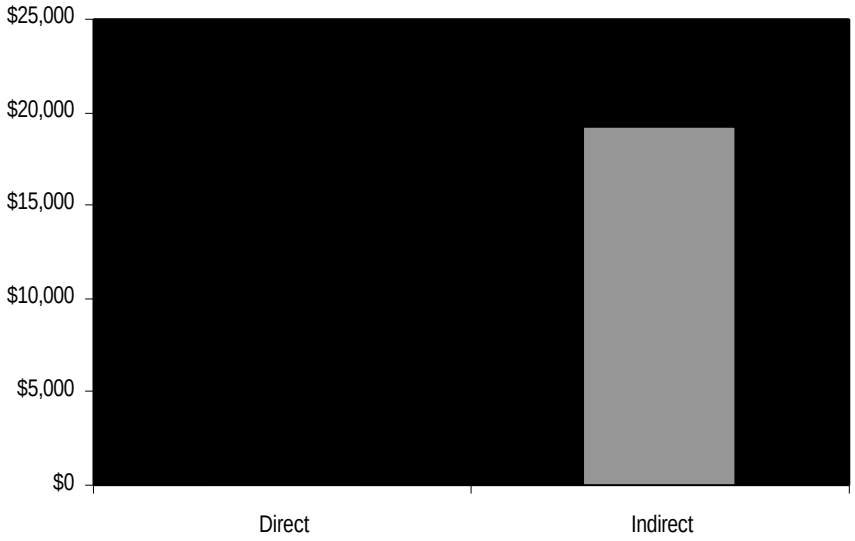
A significant cost of IBS is lost productivity due to inability to work. However, it is difficult to capture reliable estimates of absenteeism and related indirect costs, as employees may be reluctant to cite IBS as the reason for their absence due to the sensitive nature of the disease. The estimated indirect cost, based solely upon lost days at work due to consumption of health care, is $205 million.

A more comprehensive estimate of indirect cost was developed using different methods. The average length of inpatient hospital stay for an IBS patient in 1998 was 3.0 days, median length of stay was 2.0, and total days of care equaled 1.9 million. According to a large epidemiological study, the average IBS patient missed 13.4 days of work or school due to illness.[17] Applying the average daily wage figures from the National Statistical Abstract to the NHIS finding that 78.7% of persons with IBS were of working age, revealed that work loss as a result of IBS cost $19.2 billion in 1998. When adjusted for inflation using the medical CPI, the total indirect cost was approximately $20.2 billion in 2000 dollars.

The direct and indirect costs resulting from IBS are displayed in figure 4.2.

[17] Drossman, DA et al. US Householder Survey of Functional Gastrointestinal Disorders. Digestive Diseases and Sciences, 1993: 38(9) ppg. 1569-1580.

Figure 4.2. Direct and Indirect Cost of Irritable Bowel Syndrome (in millions)



Crohn's Disease

Along with ulcerative colitis, Crohn's disease is one of two major types of inflammatory bowel disease (IBD). Crohn's disease is a chronic inflammation of the intestinal wall. It typically affects the outer, middle and inner layers of the intestinal wall. While it usually affects the large intestine and the lower part of the small intestine, it can affect any segment of the GI tract. Some people recover fully from a single episode of the disease, but most people with Crohn's disease experience periods of remission and relapse. The most common symptoms of Crohn's disease include pain in the abdomen, diarrhea, and weight loss. Rectal bleeding and fever may also occur. The cause of the disease is unknown, but research has implicated one or more of immune disorders, viral or bacterial infection, and diet. There is also evidence of genetic predisposition to the disease. Because its symptoms are similar to those of other intestinal disorders, such as IBS and ulcerative colitis, Crohn's disease can be difficult to diagnose. A thorough physical exam and a series of tests may be required in order to diagnose Crohn's disease. If left undiagnosed and untreated, Crohn's disease can lead to complications, including blockage of the intestine and nutritional deficiencies. Individuals with long histories of the disease may be at higher risk for cancer of the GI tract.

At present, treatment of Crohn's disease is focused on symptom management, as there is no cure for the underlying cause. The standard treatment of Crohn's disease usually includes drugs containing mesalamine, which helps control inflammation. Broad-spectrum antibiotics may relieve symptoms, particularly in people with abscesses and fistulas. Corticosteroids can have dramatic effects on many symptoms of Crohn's but their long-term use has serious side effects and they are not helpful in maintaining remission. Immunosuppressants also are effective against many symptoms and can help to maintain long periods of remission, but usually take several months to achieve these effects and can produce their own serious side effects. The drug infliximab has been shown to be effective

in healing the intestinal lining and fistulas by blocking one cytokine that contributes to inflammation.[18] When these treatments fail to relieve symptoms and when obstructions, abscesses, or fistulas persist, surgery may be required to remove diseased sections of the intestine. This relieves symptoms for varying periods of time in patients, but does not cure the disease. Inflammation tends to return to the area near where a section of the intestine was removed, and repeat surgery is needed in nearly half of the cases.

The ICD-9 code used in this study of Crohn's disease was 555 (Regional enteritis).

Epidemiology

Crohn's disease affects males and females equally, and is not limited to particular age or ethnic groups, though it usually starts during the teenage years and early adulthood. There appears to be a genetic component to the disease, for which there is a higher risk among Jews and persons with family history of any type of IBD. The prevalence of the disease appears to be increasing in Western countries and among developing nations.

According to NHIS, in 1998 there were 2.2 million prevalent cases of Crohn's disease (830 cases per 100,000), comprising slightly more than 60% of the total IBD population in the U.S. The AGA Advisory Panel believed that this representation was too high, concluding that too many diseases are incorrectly classified as Crohn's disease by NCHS coders. Therefore, this study relied on data from the Olmsted County, Minnesota study.[19] This study suggests that incidence is slightly higher among women. The overall prevalence rate is 133 cases per 100,000, with variation across ethnic/racial differences. Analysis of NHIS indicates higher prevalence rates among African-Americans (374 per 100,000) than white Caucasians (184 per 100,000). The available data was not sufficient enough to allow analyses of prevalence among other ethnic groups. Reliable mortality data was not available for Crohn's disease.

Direct Costs

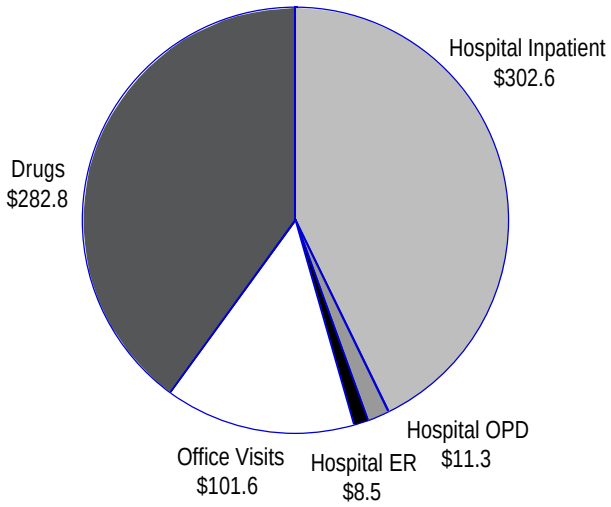
The physician office was the most utilized setting for managing Crohn's disease, with nearly 1.2 million visits accounting for an estimated $101.6 million in 1998 (see Table 4.1 at the end of this chapter and Figure 4.3).

In 1998, there were some 85,000 inpatient hospital visits related to Crohn's disease, though 55% were for secondary diagnoses of Crohn's disease. Based on the 1997 NIS data, which were inflated to 1998 cost, inpatient hospital facility costs were $255.0 million, and physician services (from GHC/Puget Sound) cost $47.6 million, for a total of $302.6 million in 1998. There were nearly 70,000 hospital emergency department visits related to Crohn's disease in 1998, for which the physician services and hospital facility costs amounted to $8.5 million in 1998 dollars.

[18] Garnett WR, Yunker N. Treatment of Crohn's disease with infliximab. Am J Health Syst Pharm 2001;58(4):307-16.

[19] Loftus EV, Silverstein MD, et al. Crohn's disease in Olmsted county, Minnesota, 1940-1993: incidence, prevalence, and survival. Gastroenterology 1998;114:1161-1168.

Figure 4.3. Direct Cost of Crohn's Disease (in millions)



With approximately 51,000 visits, the site of service with the fewest number of visits related to Crohn's was the hospital outpatient department, at a cost of $11.3 million.

The cost of treating this disease with medications is significant, due in part to the availability of novel, effective treatments, including infliximab, which was approved in 1998 for the treatment of Crohn's disease. In 2000, $282.8 million was spent on prescription and OTC medications to treat Crohn's disease.

Across the four sites of service and the cost of medications, the total direct cost of treating Crohn's disease is estimated at $706.8 million in 1998. Using the medical CPI to inflate this figure to year 2000 dollars the estimated direct cost is $736.4 million.

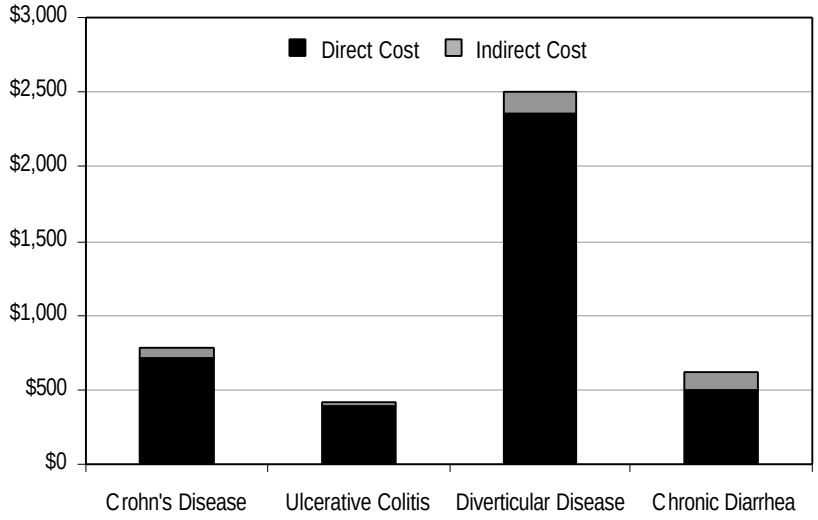
Indirect Costs

For most sufferers, Crohn's disease requires medical care over an extended period of time, with regular follow-up visits. The indirect costs associated with this treatment are great, both for patients and families. The average length of stay in a hospital for a Crohn's disease patient was 5.9 days, median length of stay was 4.0 days, and Crohn's patients utilized approximately 490,000 total days of care in the inpatient hospital setting in 1998. Including the time associated with using health care across all sites of service, the total indirect cost associated with Crohn's disease based on the equivalent of lost wages is $74.6 million in 1998 (see Figure 4.4). Using the medical CPI to adjust this figure to 2000 dollars, the estimated indirect cost is $78.8 million.

Based on data from the NHIS survey and the dollar value of wages for days of work missed due to the illness, where the individual may or may not have sought medical attention, the productivity loss due to Crohn's disease was approximately $885,000. This figure is not included in the above estimate because the NHIS data is based on a small sample and is not reliable, due to a small unweighted cell count. It is also critical to note

that there is significant morbidity associated with Crohn's disease, although it is not captured in this estimate of indirect cost.

Figure 4.4. Direct and Indirect Cost of Crohn's Disease, Ulcerative Colitis, Diverticular Disease, and Chronic Diarrhea (in millions)



Ulcerative Colitis

The other major type of IBD is ulcerative colitis, in which the lining of the large intestine becomes inflamed and ulcerated. The most common symptoms of ulcerative colitis include abdominal cramps, bloody diarrhea, and fever. Some people may also experience fatigue, weight loss, loss of appetite, rectal bleeding, and loss of body fluids and nutrients. The cause of ulcerative colitis remains unknown, but an immune disorder--perhaps in response to a viral or bacterial infection--and heredity may be contributing factors. People with ulcerative colitis have immune system abnormalities, though it is unclear whether the abnormalities are a cause or a result of the disease. People with long-standing, extensive ulcerative colitis are at increased risk of colon cancer.

Given their similar symptoms, it is often difficult to distinguish ulcerative colitis from Crohn's disease, IBS, and other intestinal disorders. Diagnosis of ulcerative colitis may require a thorough physical exam and a series of tests, including stool analysis, blood tests, sigmoidoscopy, barium enema x-ray, and colonoscopy. Treatment for ulcerative colitis is intended to control inflammation, and is a function of severity of the disease. Dietary modification and iron supplements to offset anemia are tried in many patients. Anticholinergics and other drugs are prescribed to control diarrhea, along with some combination of corticosteroids and mesalamine, or sulfasalazine, and other anti-inflammatories. Immunosuppressants are given to some patients who do not respond to corticosteroids. Surgery is required in patients with unresponsive disease that would leave patients incapacitated or dependent on high doses of corticosteroids, for patients with toxic colitis, or with colon cancer or precancerous conditions.

The ICD-9 code used to define ulcerative colitits is 556 (Ulcerative colitis).

Epidemiology

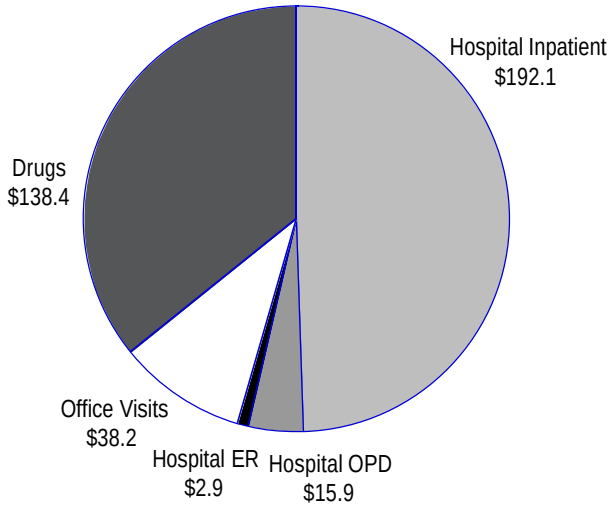
Ulcerative colitis most often affects persons between 15 and 40 years of age, though a smaller group of people are first affected after age 50. The Olmsted County, Minnesota study indicated that increased incidence rates were associated with younger age as well as the male gender.[20] There may be some correlation with family history. In 1998, the crude mortality rate associated with ulcerative colitis was 0.17 deaths per 100,000 persons, according to CDC data.

The estimated prevalence of ulcerative colitis from the Olmsted County study is 229 cases per 100,000. Analysis of 1995 NHIS reveals that ulcerative colitis is most common among Asians and white Caucasians (293 cases per 100,000 and 291 cases per 100,000, respectively), the prevalence for are considerably higher than those for African-Americans (89 per 100,000) and Hispanics (48 per 100,000).

Direct Costs

The physician office setting was the most frequently utilized site of service by patients with ulcerative colitis. The cost of nearly 500,000 physician office visits pertaining to ulcerative colitis in 1998 was approximately $38.2 million (see Table 4.1 at the end of the chapter and see Figure 4.5).

Figure 4.5. Direct Cost of Ulcerative Colitis (in millions)



[20] Loftus EV, et al. Ulcerative colitis in Olmsted County. Minnesota, 1940-1993; incidence, prevalence and survival. Gut, 2000; 46, 336-43.

In 1998, the 47,000 inpatient visits (53% were for primary diagnoses of ulcerative colitis) to the hospital accounted for $35.5 million in physician fees and $156.6 million in facility costs.

The hospital outpatient department and hospital emergency department combined for roughly 90,000 visits related to ulcerative colitis in 1998. The outpatient department cost was $15.9 million, and the ER cost was $2.9 million.

The cost of treating ulcerative colitis with pharmaceutical products was $138.4 million in 2000, according to the Scott Levin SPA.

The total direct cost of treating ulcerative colitis across health care settings, including pharmaceuticals, was $387.8 million in 1998. Adjusting to year 2000 dollars using the medical CPI, the total cost is $404.9 million.

Indirect Costs

Ulcerative colitis patients consumed nearly 280,000 total days of care in the inpatient hospital setting, with an average length of stay of 6.3 days and a median length of stay of 5.0 days. The value of the total lost time at work while in the hospital and physician office for patients with ulcerative colitis was $35.8 million in 1998 (see Figure 4.4). Using the general CPI to adjust for inflation yields a year 2000 cost of $37.8 million.

The NHIS survey provided some information regarding persons who reported missing work as a result of ulcerative colitis, but who may or may not have sought health care. The total value of wages during this time lost to illnesses is approximately $5.5 million. However, as it is unclear how much overlap exists with the figures presented above on time lost while getting health care, figures from the 1995 NHIS are not included in the total. As with Crohn's disease, significant morbidity is associated with ulcerative colitis. As productivity loss due to morbidity is not included in the indirect cost estimate, the figure notably underestimates the indirect cost related to this disease.

Diverticular Disease

Diverticular Disease includes both diverticulosis and diverticulitis. Diverticulosis is a condition due to diverticula, which are saclike outpouchings of the GI tract, usually in the large intestine. Intestinal spasms and the excess pressure required to move the stool through the colon causes the weak spots of the colon to protrude, and become diverticula. When waste matter becomes trapped in diverticula, there may be bleeding, inflammation, and infection, resulting in diverticulitis. Low-fiber diets appear to contribute to diverticular disease. The lack of dietary fiber causes the stool to become hard, and passage through the colon becomes more difficult.

Diverticulosis is usually symptom-free; however, some people may experience mild cramps, bloating, and constipation. Because most people do not present with symptoms, diverticulosis is often found through tests ordered for other diseases.

The most common symptom of diverticulitis is abdominal pain and tenderness. Other symptoms may include fever, nausea, vomiting, cramping, and constipation. Diverticulitis

can lead to complications, such as inflammation of the intestinal wall, abscesses, intestinal blockages, perforations, fistulas between the large intestine and bladder other organs and bleeding. For patients known to have diverticulosis, diagnosis of diverticulitis can be based on symptoms, although a CT scan may be conducted to confirm this.

Diverticulosis is usually managed with a high-fiber diet. In its mild form, diverticulitis can be managed with rest, liquid diet, antibiotics, and mild pain medications. In more severe cases, patients are hospitalized and treated with intravenous fluids and antibiotics. Surgery is required for fistulas and complications such as perforation and peritonitis.

The ICD-9 diagnosis code used to categorize this disease is 562 (Diverticula of intestine).

Epidemiology

Diverticulitis occurs in 10-25% of patients with previously diagnosed diverticulosis, and the risk increases over time. Diverticular disease primarily occurs in the elderly, particularly in industrialized countries where low-fiber diets are common. The disease is uncommon in persons under 40 years of age, but increases steadily with age, and most very elderly people have many diverticula. According to NHIS, over 60% of diverticular disease patients are over age 65.

According to the NHIS, there were 2.3 million prevalent cases of diverticular disease in the U.S. in 1998; or about 834 cases per 100,000. Females are at higher risk, as the data indicate that 75% of sufferers of diverticular intestine are female. Although there is little discussion in the literature on racial disparity of the disease, the NHIS data indicate a noticeable disparity, with a higher prevalence among white Caucasians (1,471 per 100,000) than among Hispanics (609 per 100,000) and African-Americans (373 per 100,000). Reliable mortality estimates are not available for this disease.

Direct Costs

The physician office setting is the most common site of service for patients with diverticular disease, where there were more than 2.2 million visits involving a diagnosis of diverticular disease (see Table 4.1 at the end of this chapter). Among these visits, diverticular disease was the primary diagnoses in less than half. The total cost for diverticular disease related to these physician office visits was $176.6 million in 1998. This was calculated by applying the unit cost for treatment of diverticular disease in the physician office (obtained from 1996 MEPS, and then inflated to 1998 dollars with the medical CPI) to the more than 2.2 million physician office visits involving this diagnosis in 1998 (see Figure 4.6).

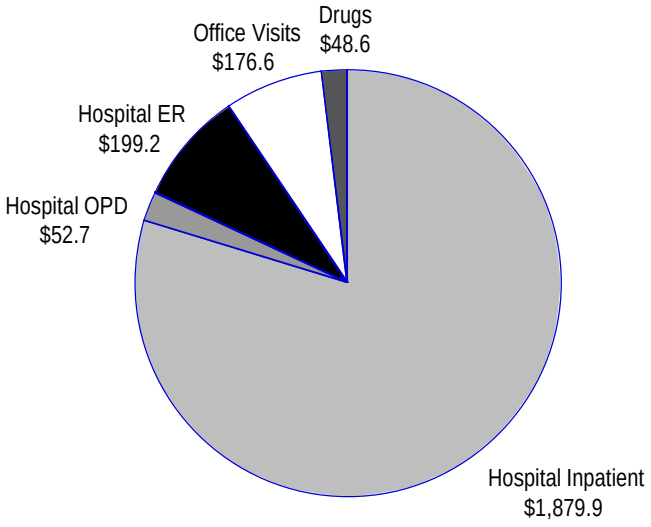
The inpatient hospital setting was also a widely used resource for diverticular disease, with more than 455,000 inpatient stays (45% for primary diagnoses) at a cost of $1.9 billion. This figure was determined by extracting the unit costs from 1996 MEPS and applying it to the utilization figures obtained from NHDS to calculate the total cost of physician services related to hospitalization, $301.1 million. The facility costs, obtained from 1997 NIS, were $1.6 billion. These were standardized to year 1998 dollars by inflating with the medical CPI. Diverticular disease patients consumed a total of 2.8 million days of

inpatient hospital care, with an average length of stay of 5.4 days and median length of stay of 4.0 days.

The combined number of visits in the hospital outpatient department and emergency department settings for diverticular disease was just over 300,000, at a cost of $252.0 million in 1998. As was done for deriving the cost of the physician office visits, the unit cost for treatment in the hospital outpatient setting (extracted from 1996 MEPS) was applied to the total utilization figure.

Despite the high prevalence of diverticular disease, the total cost of its pharmaceutical treatment was just $48.6 million in 2000. This may be explained by the fact that many persons with diverticular disease remain asymptomatic for extended periods of time, and often the disease is only diagnosed when tests are performed for other diseases. The total direct cost of diverticular disease in 1998 was $2.4 billion. Inflated to year 2000 dollars, this figure is over $2.5 billion.

Figure 4.6. Direct Cost of Diverticular Disease (in millions)



Indirect Costs

The utilization figures for the physician office, emergency department, and hospital outpatient department, stated in the previous section, were the basis for estimating the productivity losses due to diverticular disease. The values of wages associated with lost time for receiving health care was approximately $140.5 million for 1998 (see Figure 4.4). Adjusted for inflation, this is $148.5 in 2000 dollars.

According to the NHIS survey, approximately $5.6 million in lost wages was incurred by persons who missed work due to diverticular intestine. As this may overlap somewhat with time for receiving medical care, this figure is not included in the total estimate.

Chronic Diarrhea

Diarrhea is an increase in the volume, fluidity, and frequency of bowel movements. It typically lasts one to two days before resolving without any specific treatment. However, chronic diarrhea lasting more than three weeks is usually a sign of an underlying condition, such as irritable bowel syndrome, celiac disease, or inflammatory bowel disease. Diarrhea may be accompanied by cramping abdominal pain, bloating, nausea, or an urgent need to excrete wastes from the body. It can cause general discomfort, embarrassment, and disruption of daily life. Severe diarrhea can lead to dehydration and loss of electrolytes, which, if unabated, can cause a loss in blood pressure with fainting, heart arrhythmias, and other serious health threats. Among the common types or causes of diarrhea are: osmotic diarrhea, secretory diarrhea, malabsorption syndromes, exudative diarrhea, altered intestinal transit, and bacterial overgrowth. In diagnosing patients with persistent diarrhea, physicians may use a variety of tests including stool samples, sigmoidoscopy, and biopsy.

Diarrhea is a symptom, and its treatment depends on the underlying condition. In many cases, treating the underlying disease involves a change in diet or discontinuing the use of a drug. However, regardless of the underlying condition, replacement of lost fluids and electrolytes is the first and most common step in the treatment of chronic diarrhea. Among the drugs used to treat diarrhea are loperamide, diphenolxylate, and bismuth. Bulking agents are used in some patients. Hospitalization may be necessary for severe diarrhea, along with fluid replacement with intravenous water and salts.

The ICD-9 diagnosis code for chronic diarrhea is 787.91 (Diarrhea).

Epidemiology

Diarrhea occurs with similar frequency across all age groups, both sexes, and racial groups. However, because children can die from dehydration within only a few days, diarrhea poses a much greater risk to younger patients. The mortality resulting from chronic diarrhea is believed to be very low, though reliable estimates are unavailable.

From GHC/Puget Sound, the estimated prevalence of chronic diarrhea was 3.1 million in 1998 (1,140 cases per 100,000). However, according to a 1992 study in Olmsted County, Minnesota, prevalence of chronic diarrhea was 7,300 cases per 100,000.[21] Some limitations of the study were that the population surveyed consisted only of persons age 30-64 years of age, and the sample size was only 690 randomly surveyed residents of one county. The validity of extrapolating from Olmsted County to the U.S. population is questionable. It is also important to note that the survey defined chronic diarrhea in a manner somewhat inconsistent with previous literature. Namely, the survey addressed the issue of frequency and consistency of bowel movements, but did not address the issue of duration of frequent bowel movements.

[21] Talley, Nicholas et al. Onset and Disappearance of Gastrointestinal Symptoms and Functional Gastrointestinal Disorders. *Am J Epidemiol* 1992; 1336: 165-77.

Direct Costs

Chronic diarrhea is most often a symptom of an underlying disorder, and therefore is rarely recorded as the primary diagnosis of a physician visit or hospital stay. Of the 165,000 inpatient visits in 1998 in which chronic diarrhea was a diagnosis, it was the primary diagnosis in fewer than 900 cases (see Table 4.1 at the end of this chapter). This case is one in particular where the use of the 80-20 split (80% of costs attributed to primary diagnosis and 20% of costs attributed to secondary diagnosis) enhances the accuracy of the data. The total cost related to these inpatient visits in 1998 was $216.7 million, including $23.5 million for physician services and $193.2 million for facility costs (see Figure 4.7).

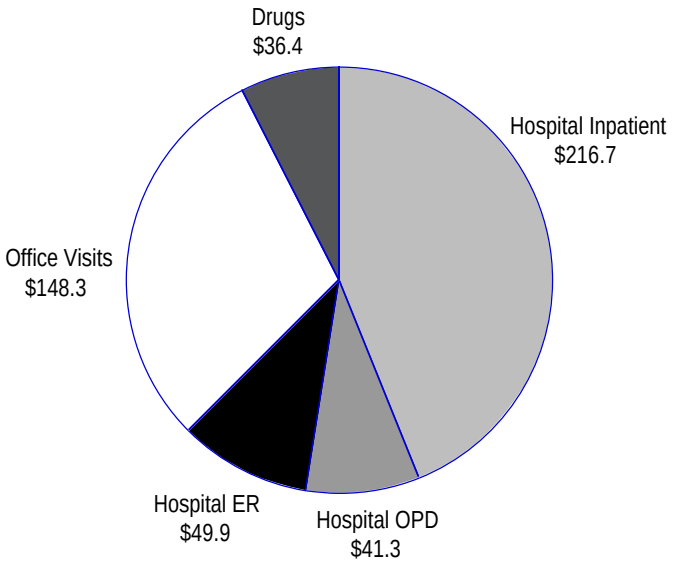
Out of a total of 2.2 million physician office visits in 1998 in which chronic diarrhea was a diagnosis, 1.3 million were for primary chronic diarrhea. Applying cost data from GHC/Puget sound, the total cost of physician services in the office setting reached $148.3 million in 1998.

With more than 455,000 visits, hospital emergency departments were a common point of health care access for patients with chronic diarrhea. The physician and facility costs totaled an estimated $49.9 million in 1998. The hospital outpatient department added another 210,000 visits for chronic diarrhea at a cost of $41.3 million.

The cost of treating diarrhea with medications was relatively high, considering that drugs are not always recommended as first-line treatment for chronic diarrhea. Still, according to Scott-Levin SPA, $36.4 million was spent on chronic diarrhea medications in 2000.

The total direct cost of chronic diarrhea thus amounted to $492.6 million in 1998. Adjusting for inflation using the medical CPI, brings the direct cost estimate to $524.4 million in 2000 dollars.

Figure 4.7. Direct Cost of Chronic Diarrhea (in millions)



Indirect Costs

The indirect costs that result from chronic diarrhea are difficult to accurately measure, because they may overlap with other conditions such as IBS or IBD. On average, patients with a primary diagnosis of chronic diarrhea stayed in the hospital for 2.2 days, while median length of stay was 2.0 days. All chronic diarrhea patients consumed a total of 830,000 inpatient days of care. Incorporating the days lost due to total days of hospital care, physician office visits, and emergency department visits, the value of wages during the work time lost to health care is $129.3 million (see Figure 4.4). The standard CPI was used to inflate this figure to $136.6 million in 2000 dollars.

Table 4.1. Health Care Utilization for Chronic Intestinal Disorders

Disease	Inpatient Hospital Stays	Inpatient Hospital Stays (Primary Diagnosis Only)	Outpatient Hospital Visits	Emergency Room Visits	Physician Office Visits
Irritable Bowel Syndrome	475,409	194,269	144,925	86,963	3,657,623
Crohn's Disease	84,622	37,196	51,265	69,768	1,180,354
Ulcerative Colitis	46,630	23,447	64,952	25,672	469,692
Diverticular Disease	455,914	230,058	147,785	165,343	2,216,519
Chronic Diarrhea	165,298	863	210,390	455,328	2,210,094

CHAPTER 5: HEPATOBILIARY AND PANCREATIC DISORDERS

This chapter presents estimates of the burden of the hepatobiliary and pancreatic diseases. This group includes chronic liver disease and cirrhosis, chronic hepatitis C, gallbladder disorder, and diseases of the pancreas.

Chronic Liver Disease and Cirrhosis

Chronic liver disease is an ongoing injury to the cells of the liver, resulting in inflammation that lasts longer than six months. Its causes are numerous, including viruses, metabolic or immunologic abnormalities, and medication side effects. Cirrhosis of the liver is a chronic liver disease in which normal liver cells are damaged and replaced by nonfunctioning scar tissue, which blocks the flow of blood through the organ and prevents normal function of the liver.

Cirrhosis of the liver has many causes, of which hepatitis C and alcoholism are the most common. Alcohol cirrhosis typically develops after 10 years or more of heavy drinking, although the practical definition of "heavy drinking" varies from one person to another. Chronic hepatitis C is another leading cause of chronic liver disease and cirrhosis. Heredity appears to play only a minor role in cirrhosis. There are usually no symptoms in the early stages of disease. As the liver damage increases, one may experience symptoms such as exhaustion, fatigue, loss of appetite, nausea, and weight loss. However, in some people the first sign of disease may be complications including edema and ascites (fluid accumulation in the abdomen), bruising or bleeding, jaundice, gallstones, and sensitivity to medication. Portal hypertension, a form of high blood pressure resulting from pressure in the veins running from the intestine to the liver, can cause the formation of esophageal and gastric varices, which can cause life-threatening bleeds. Along with poor liver function, portal hypertension can result in ascites. Other complications of cirrhosis include liver encephalopathy, coagulopathy, and jaundice. The diagnosis is usually made on the basis of symptoms, laboratory tests, and physical examination. Ultrasound and liver scans using radioactive isotopes may be used. Microscopic examination of liver biopsies are used to make a definitive diagnosis. Many people are diagnosed at later and more complicated stages of the disease. Patients with cirrhosis due to hepatitis B or C, hemochromatosis (iron overload), and long-standing glycogen storage disease are at higher risk of liver cancer. Liver damage from cirrhosis cannot be reversed, but treatment can stop or delay further progression and reduce complications. Treatment usually involves withdrawal of alcohol or other toxic agents, proper nutrition, and managing complications of the disease. If the underlying cause of the disease can be altered, patients with advanced cirrhosis may benefit from liver transplantation.

The ICD-9 diagnosis code used to for this disease was 571 (Chronic liver disease and cirrhosis).

Epidemiology

Using 1995 NHIS data and adjusting to 1998, this study found there were over 5.5 million prevalent cases of chronic liver diseases and cirrhosis in the U.S., a rate of 2,030 cases per

100,000. There appears to be little variation in prevalence among white Caucasian, African-American, and Hispanic groups. However, there are differences by gender, as evidenced by NHIS data which indicates that over 60% of chronic liver disease and cirrhosis patients are male. Over 80% of patients are between the ages of 25 and 64.

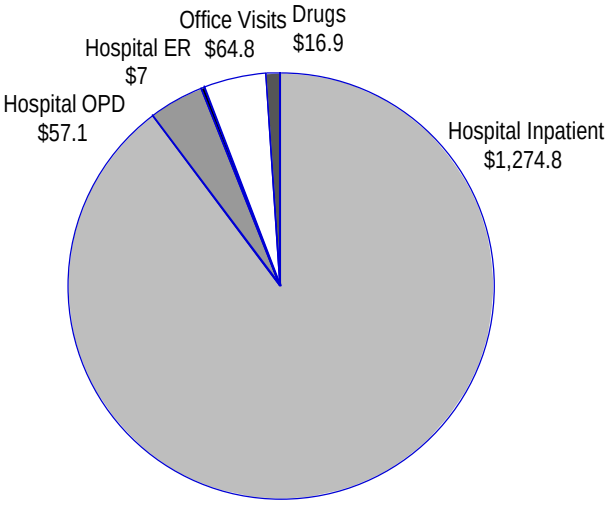
Cirrhosis is responsible for approximately 25,000 deaths (9.3 deaths per 100,000 population) annually, and is one of the leading causes of death in the U.S., according to the National Digestive Diseases Information Clearinghouse. Almost 50% of cirrhosis-related deaths in the U.S. are associated with alcohol.

Direct Costs

The sizable direct cost attributed to chronic liver disease stems in large part from the 357,000 hospital inpatient stays, though in 77% of cases chronic liver disease was a secondary diagnosis (see Table 5.1 at the end of this chapter). These visits were responsible for $134.0 million in physician fees and $1.1 billion in facility costs (see Figure 5.1). The 758,000 visits to physician offices resulting from chronic liver diseases accounted for $64.8 million in 1998. Hospital outpatient departments saw 186,000 cases, at a cost of $57.1 million. Hospital emergency departments provided more than 55,000 visits at a cost of $7.0 million. The cost of medications used to treat chronic liver diseases and cirrhosis contributes another $16.9 million to the total direct cost of this disease group.

The total direct cost of treating chronic liver diseases and cirrhosis is over $1.4 billion, more than 90% of which arose in the hospital inpatient setting. Adjusting for inflation using the medical CPI yields an estimate of more than $1.5 billion in direct cost in year 2000 dollars.

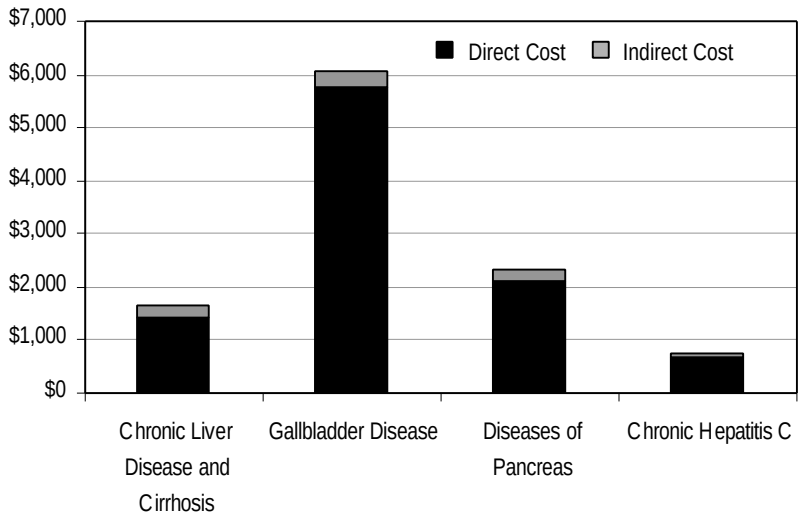
Figure 5.1. Direct Cost of Chronic Liver Disease and Cirrhosis, Exclusive of Hepatitis C (in millions)



Indirect Costs

The estimated total work-loss due to medical care for these diseases of the liver is quite large, due to the prevalence of acute disease and the level of health care services consumed by these patients. Patients with chronic liver diseases were hospitalized for over 2.3 million days, with an average length of stay of 5.9 days, and a median length of stay of 4.0 days. This translates into $185.9 million in the value of lost wages resulting from hospital stays for person of working age. Including the time associated with visits to physician offices, hospital emergency departments, and outpatient departments, total indirect costs amount to $221.5 million annually (see Figure 5.2). Adjusting for inflation, this comes to $234.0 million in 2000 dollars.

Figure 5.2. Direct and Indirect Cost of Hepatobiliary and Pancreatic Disorders (in millions)



Chronic Hepatitis C

Hepatitis C is one of several hepatitis viruses. Chronic hepatitis C varies greatly in its course and outcome. About 80% of people with acute hepatitis C develop chronic infection. Of these, 20-30% will go on to develop cirrhosis of the liver or liver cancer. Hepatitis C virus is spread primarily by contact with blood and blood products in transfusions and among drug users who share needles. The groups at highest risk for hepatitis C are people who had blood transfusions prior to 1992, injection drug users, and infants born to HCV-infected mothers.

Many people with chronic hepatitis C have no symptoms of liver disease. If symptoms are present, they are usually mild and nonspecific. They may include: fatigue, nausea, poor appetite, muscle and joint pains, and mild discomfort or tenderness in right-upper quadrant. The disease is diagnosed with liver function tests, serologic evaluation of blood, and liver biopsy. Chronic hepatitis C is most readily diagnosed when anti-hepatitis C virus (HCV) is present and serum aminotransferase levels remain elevated for more than six

months. The diagnosis is confirmed by the finding of HCV RNA in serum. However, diagnosis is problematic in immunosuppressed patients who cannot produce anti-HCV. Treatment of chronic hepatitis C consists of either monotherapy with alpha interferon, or combination therapy with alpha interferon and ribavirin; however the combination therapy is typically the therapy of choice due to its superior efficacy. Many patients go on to develop cirrhosis and health care must be provided for complications such as ascites or encephalopathy, although it is not clear exactly how many affected patients develop serious sequelae.

ICD-9 diagnosis code used to identify hepatitis C was 070.54 (Chronic hepatitis C without mention of hepatic coma).

Epidemiology

The estimated prevalence of hepatitis C was determined by applying ratios from the literature to the 1998 U.S. population. The seroprevalence of Hepatitis C in the U.S. is about 1.8%,[22] and approximately 80% of these patients actually are chronic carriers of the virus. However, only 65% of this group presents with clinical manifestation of the disease.[23] Applying these percentages to the U.S. population yields approximately 2.5 million prevalent cases of chronic hepatitis C. Incidence has fallen in the U.S. over the past 10 years, from 180,000 cases to approximately 35,000 last year, primarily due to screening for HCV in the blood supply. The highest incidence of acute hepatitis C occurs in persons aged 20 to 39 years, and men have slightly higher rates of disease. Disease progression is generally slow with near end stage or end stage chronic liver disease emerging three decades or more after initial infection. Reliable mortality data was unavailable for hepatitis C.

Direct Costs

The pattern of direct costs of hepatitis C by site of service reflects the fact that this prevalent disease often goes undiagnosed for many years. But once it is diagnosed, hepatitis C can require intensive health care resources and generate very high costs, particularly in patients with severe disease.

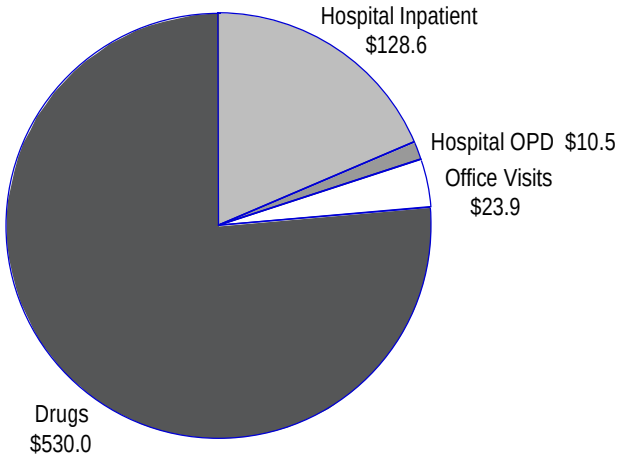
The physician's office is the most frequently utilized site of service for treatment of hepatitis C. In 1998 there were 317,000 visits, which, based on utilization cost data from GHC/Puget Sound, accounted for $23.9 million in physician services in the U.S. (see Figure 5.3). Although the hospital was not a highly utilized site of service, inpatient visits for hepatitis C accounted for high per patient costs, most likely due to the high cost of liver transplantation and care associated with other sequelae of the disease such as encephalopathy and decompensated cirrhosis. The 61,000 inpatient stays, 91% of which were for secondary diagnoses of hepatitis C, generated $20.7 million in physician fees and $107.9 million in facility costs, for a total of $128.6 million. Hospital outpatient departments experienced lower utilization (46,000 visits) and costs ($10.5 million).

[22] Alter, M. (1999). The prevalence of hepatitis C infection in the United States, 1988 through 1994. N Engl Med: 341 (8), 556-62.

[23] CDC, US Department of Health and Human Services. (1998, October 16). Recommendations for prevention and control of Hepatitis C virus (HCV) infection and HCV-related chronic disease. MMWR: Vol 47, No. RR-1.

According to the NHAMCS, there were no recorded visits to the emergency department for hepatitis C in 1998.

Figure 5.3. Direct Cost of Hepatitis C (in millions)



Prescription and OTC medications are the single largest factor in direct costs related to hepatitis C. Hepatitis C data capture was inadequate in Scott-Levin SPA. Instead, the reported sales of Rebetron® (combination of interferon alfa-2a and ribiviron) for the year 1999 were used as a proxy for the cost of hepatitis C medications. Total sale was reported to be $530 million.[24] Rebetron® is used exclusively for the treatment of chronic hepatitis C and considered to be the gold standard. The total cost of treating hepatitis C across health care settings and including pharmaceutical therapy comes to $693.0 million. Adjusted solely for inflation, this totals $704.3 million in 2000 dollars.

Indirect Costs

Patients with hepatitis C were hospitalized for nearly 390,000 days, with an average length of stay of 5.8 days and a median length of stay of 4.0 days. This translates into $39.7 million in the value of lost wages resulting from hospital stays for persons of working age (see Figure 5.2). Including the time associated with visits to physician offices, hospital emergency departments, and outpatient departments, total indirect costs amount to $50.7 million annually. Adjusting for inflation, this comes to $53.6 million in 2000 dollars.

Gallbladder Disorder

Gallbladder disease is a very common digestive disorder, typically presenting with severe pain in the upper abdomen. As a result of gallbladder disease, bile in the gallbladder becomes concentrated and thickens. The precipitation of either cholesterol or calcium

[24] Med Ad News Top 500 Brand Name Drugs. May 2000.

bilirubinate from bile leads to gallstone formation. The major component of most gallstones is cholesterol, although some are made up of calcium salts. Not all gallstones result in disease, and the great majority of people with gallstones live without symptoms. The end result of the disease progression is inflammation (cholecystitis) or stones (cholelithiasis). An acute gallbladder disease episode occurs when a gallstone blocks the flow of bile from the gallbladder and causes severe pain in the right side, often manifested in the shoulder. The pain is characterized as being as severe as the pain of the heart attack. The presence of gallstones in the bile duct can lead to severe infection of the bile ducts (cholangitis), which may spread via the blood stream to other parts of the body, or may cause inflammation of the pancreas (pancreatitis).

Diagnosis of gallbladder disease is based on a patient's description of symptoms and physical exam. Among the techniques that are used in the diagnostic process are blood tests, abdominal ultrasound, computed tomography, and various x-ray techniques. Accuracy in the diagnosis of gallbladder disease is very important, because gallstone symptoms are similar to those of heart attack, pancreatitis, hepatitis, and irritable bowel syndrome. People with silent (asymptomatic) gallstones do not require treatment. Those with intermittent pain may try reducing intake of fatty foods. However, if gallstones continue to cause attacks, surgery may be required. Surgical removal of the gallbladder is the most widely used treatment for gallbladder disease.

The ICD-9 diagnosis codes used in identifying gallbladder disorder were 574 (Cholelithiasis); 575 (Other disorders of gallbladder).

Epidemiology

Multiple risk factors contribute to the development of gallstones, including old age, obesity, Western diet, and genetic predisposition. Gallbladder disease is also far more likely to occur in persons over age 60 than in younger persons, and in females, especially those who have given birth to children or taken estrogen replacement therapy. This implicates excess estrogen as a risk factor. There are established links between each of high-fat diets and sugar intake and gallstones. Careful monitoring of dietary habits can allow someone with gallstones to live a normal, symptom-free life.

According to a study published in 1999, there are 20.5 million prevalent cases of gallbladder disease, a rate of 7,585 cases per 100,000,[25] and of these, 14.2 million are women. These findings were extrapolated to the national population from a survey sample of over 16,000 persons. According to NHIS data, approximately 77% of gallbladder disease patients are between the ages of 25 and 64 years. The prevalence data for each ethnic group from NHIS is inconsistent with the trends reported in other data sources. For example, data from NHIS suggests that prevalence is highest in the white Caucasian population (1,334 cases per 100,000), followed by the African-American population (1,050 cases per 100,000) and the Hispanic population (882 cases per 100,000). However, the literature indicates that Hispanics and Native Americans are higher-risk groups.[26] This apparent discrepancy may be due to sampling error within NHIS, and there

[25] Everhart, J. et al. Prevalence and ethnic differences in Gallbladder disease in the United States. Gastroenterology 1999; 117; 632-639.
[26] Ibid.

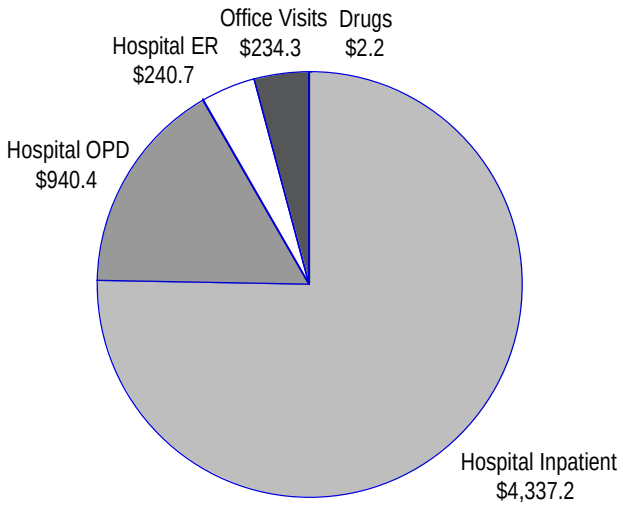
may not be enough statistical power to make these numbers valid for smaller population groups such as Native Americans.

The 1998 crude mortality rate associated with gallbladder disease was 0.42 deaths per 100,000 persons.

Direct Costs

The single largest contribution to direct costs pertaining to gallbladder disorders comes from hospital inpatient utilization. There were close to 675,000 inpatient stays in 1998 (see Table 5.1 at the end of this chapter), though only 49% were for primary diagnoses of gallbladder disorder, at a cost of $827.5 million for physician services, and $3.5 billion for facility costs (see Figure 5.4). The figure for physician charges was calculated by applying MEPS unit costs for inpatient physician fees to the total utilization for this disease. The figure for average facility costs was extracted from 1997 NIS.

Figure 5.4. Direct Cost of Gallbladder Disorder (in millions)



The hospital emergency and outpatient departments also accounted for a total of just over 1.2 million visits and just under $1.2 billion in direct costs in 1998. The cost figure for emergency departments is a product of the unit costs from MEPS and the number of visits to that setting, as extracted from NHAMCS. The outpatient department figure was taken from GHC/Puget Sound.

The most frequently utilized site of service for gallbladder disease was the physician office setting, where there were nearly 1.7 million visits related to this condition. The total estimated cost of these visits was approximately $234.3 million in 1998. This figure was calculated in a manner similar to the estimates for the other settings; unit costs for the physician office were obtained from MEPS and applied to the utilization figures from NAMCS.

Drugs used to treat gallbladder disease account for a mere fraction of a percent of the direct costs of this illness, which is consistent with the fact that surgery is the most common type of treatment. Approximately $2.2 million was spent in 1999 on prescription and OTC medications. The total direct cost of treating gallbladder disorder in 1998 was $5.8 billion; in year 2000 dollars, inflated with the medical CPI, this estimate reaches $6.2 billion.

Indirect Costs

At 3.8 days, the average length of inpatient hospital stay for gallbladder patients is not quite as long as for other conditions, due in part to the widespread use of minimally-invasive gallbladder removal surgery. (The median length of stay was 3.0 days.) However, the sheer volume of cases comprises a considerable burden on indirect costs. Persons with gallbladder disease missed a total of 3.3 million days of work due to hospitalization in 1998. This translates into $179.9 million in the value of lost wages resulting from hospital stays. Including time associated with visits to physician offices, hospital emergency departments, and outpatient departments, total indirect costs amount to $294.4 million annually (see Figure 5.2). Adjusting for inflation, this comes to $311.0 million in 2000 dollars.

Diseases of the Pancreas (Excluding Diabetes Mellitus)

Excluding diabetes mellitus, the most common disorders of the pancreas are acute and chronic pancreatitis. Pancreatitis occurs when the pancreas becomes inflamed. The acute form occurs suddenly and may be a mild or life-threatening illness with many complications. It appears that acute pancreatitis results from blockage of the pancreatic duct, e.g., by a gallstone (which normally passes into the intestinal tract), and a resulting back-up of pancreatic enzymes in the pancreas, causing severe inflammation. Damage to the pancreas may enable the pancreatic enzymes to enter the bloodstream or abdominal cavity, causing further irritation and inflammation. Gallstones and alcoholism, in which ethanol is thought to cause secretion of proteins that block the pancreatic duct, account for nearly 80% of the cases; among the other causes are high calcium levels, high triglyceride levels, abdominal trauma, certain prescription medication, viral infections, and other abnormalities of the pancreas or intestine. Additional causes of chronic pancreatitis are a hereditary disposition and obstruction of the pancreatic duct from narrowing of the duct or pancreatic cancer. The cause is unknown in about 15% of acute cases. About 20% of acute cases are classified as severe.

Acute pancreatitis is diagnosed when high levels of amylase or lipase are present in the blood, and by changes in blood levels of calcium, glucose, hemoglobin, and bicarbonate. Diagnostic tools for acute and chronic pancreatitis include blood tests, x-rays, ultrasound and CT scans, and endoscopic retrograde cholangiopancreatography in some instances. The treatment for acute pancreatitis depends on the intensity of the attack. It typically consists of supportive measures such as withholding food by mouth, bed rest, and pain management with opioid analgesics, unless complications occur. Severe pancreatitis caused by gallstones can be treated by endoscopic or open surgery. Surgery may be needed in severe acute pancreatitis caused by an injury, or to remove infected, nonfunctioning pancreatic tissue. Infections are treated with antibiotics and attempts at

drainage. The treatment for chronic pancreatitis focuses on nutritional and metabolic problems and management of pain. For continuing pain and no complications, surgery may be used on the pancreatic duct or to remove part of the pancreas.

The ICD-9 diagnosis code used for this disease was 577 (Diseases of pancreas).

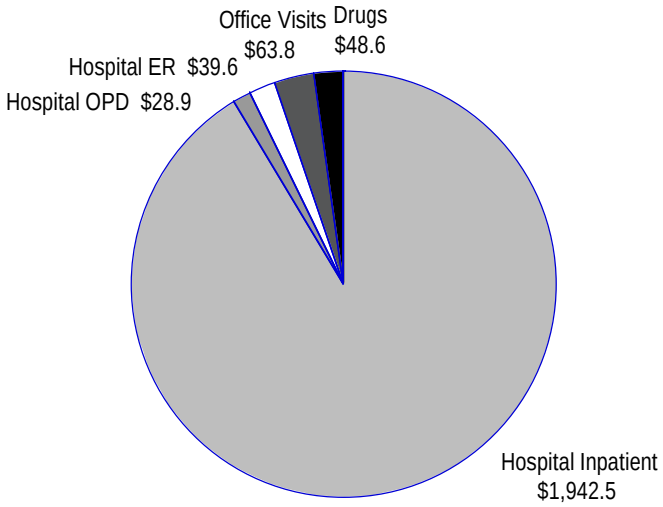
Epidemiology

According to NHIS data, in 1998 there were 1.2 million prevalent cases of diseases of the pancreas. (430 cases per 100,000). Prevalence does not seem to vary greatly by sex or race, though there is some indication that older age may be a factor. Women are about 50% more likely than men to experience acute pancreatitis due to gallstones, while men are about six times as likely to experience it due to alcoholism. Prevalence data is confirmed by NHIS, which also indicates no statistically significant difference by race. Reliable mortality data for this disease was not available.

Direct Costs

The largest contribution to the total direct cost of acute and chronic pancreatitis stems from the hospital inpatient care received by these patients. The 327,000 inpatient visits (42% were for secondary diagnoses of diseases of the pancreas) generated $255.7 million in costs for physician services and $1.7 billion for hospital facility costs (see Table 5.1 at the end of this chapter and Figure 5.5 below). There were fewer than 200,000 visits to the hospital emergency department, but this site of service was responsible for $39.6 million in physician fees and facility charges. Because the symptoms of the disease often begin as less serious problems, the most frequently sought type of service is physician care. There were more than 530,000 physician office visits for these diseases in 1998, at a cost of $63.8 million. There were 78,000 visits related to diseases of the pancreas in the hospital outpatient department in 1998, at a cost of $28.9 million.

Figure 5.5. Direct Cost of Pancreatic Disease (in millions)



The drug development boom of recent years has contributed many new and effective treatments for this indication, which is reflected in the rising cost of drugs that treat this disease. In the year 2000, according to Scott-Levin data, approximately $48.6 million was spent on drugs to treat these diseases.

The total direct cost, including all settings of care and drug expenditures, for diseases of the pancreas is $2.1 billion in 1998. Adjusting for inflation, the estimated direct cost in year 2000 dollars is $2.3 billion.

Indirect Costs

Diseases of the pancreas are debilitating conditions. As reported previously, a large proportion of these patients seek care in the inpatient hospital setting, and on average, their length of stay is 6.5 days, while the median length of stay is 4.0 days. These patients accounted for a total of more than 2.3 million days of inpatient hospital care.

After applying the average wages, as reported in the National Statistical Abstract, the total lost productivity due to hospitalization was estimated to be $183.8 million. Including the lost productivity due to consumption of health care in other settings, the total indirect cost reaches $211.9 million annually (see Figure 5.2). Adjusting for inflation yields a total indirect cost of $223.9 million in year 2000 dollars.

Table 5.1. Health Care Utilization for Hepatobiliary and Pancreatic Disorders

Disease	Inpatient Hospital Stays	Inpatient Hospital Stays (Primary Diagnosis Only)	Outpatient Hospital Visits	Emergency Room Visits	Physician Office Visits
Chronic Liver Disease and Cirrhosis	356,667	89,781	186,237	55,082	757,793
Chronic Hepatitis C	60,638	6,160	46,311	N/A	316,920
Gallbladder Disease	673,762	434,127	669,700	564,364	1,682,581
Diseases of Pancreas	327,474	211,802	78,460	195,341	531,792

CHAPTER 6: GASTROINTESTINAL CANCERS

This chapter presents estimates of the costs of gastrointestinal cancers. This group includes colorectal cancer, liver cancer, and pancreatic cancer. In contrast to other diseases in this study, the utilization and cost estimates for these three cancers were obtained through analysis of Medicare claims data.

Colorectal Cancer

Colorectal cancer arises in the colon or the rectum. The exact causes of colorectal cancer are not known, though it is thought that most cases arise from malignant changes of an adenomatous polyp. Certain factors increase a person's risk of developing colorectal cancer, including age over 50 years, history of adenomatous polyps, family history of colorectal cancer or polyps, other hereditary factors, and a personal history of IBS. There is controversy whether high-fat/low fiber diets increase the risk of colorectal cancer, although diets high in fruits and vegetables (though apparently not cereal fiber) may be protective. Most patients are asymptomatic. Common symptoms of colorectal cancer include the following: changes in bowel habits, blood in the stool, or stools that are narrower than usual. Unchecked, colon cancer spreads to nearby lymph nodes, after which it usually metastasizes to the liver.

Colorectal cancer develops slowly and usually takes years before expressing symptoms. It is during this early stage when it is most curable. Consequently, regular screening for colorectal cancer is very important, especially for people over 50 years of age. There are several types of screening tests, including fecal occult blood test, sigmoidoscopy, and colonoscopy. The latter two tests not only detect colorectal cancer in early, curable stages, but may prevent future cancer by permitting removal of adenomatous polyps. Blood tests, e.g., of carcinoembryonic antigen and other similar antigens, can contribute to diagnosis in patients known to have cancer and may help detect recurrences after treatment. Treatment for colorectal cancer depends on the size, location, and extent of the metastases of the tumor. Surgery to remove the affected segment of intestine and associated lymph nodes is conducted in the approximately 70% of patients who have treatable lesions and can tolerate general anesthesia. Depending upon the stage of the disease, chemotherapy and radiotherapy are used to improve survival.

The ICD-9 diagnosis codes used to identify colorectal cancer were 153 (Malignant neoplasm of colon); 154 (Malignant neoplasm of rectum, rectosigmoid junction, and anus); 197.5 (Secondary malignant neoplasm; Large intestine and rectum); 230.3 (Carcinoma in situ of digestive organs; Colon); 230.4 (Carcinoma in situ of digestive organs; Rectum).

Epidemiology

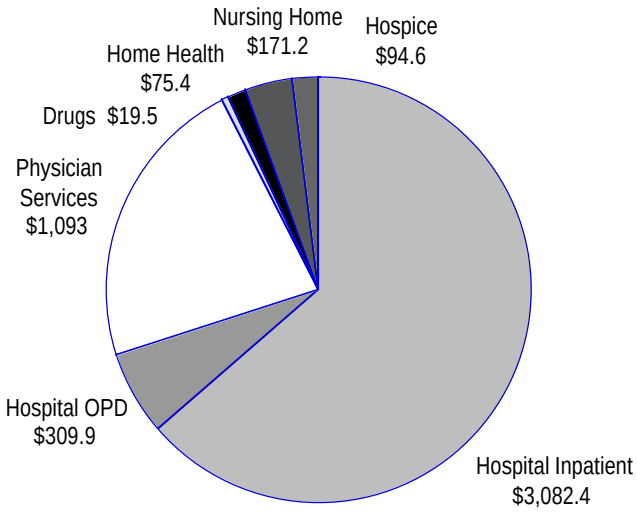
Colorectal cancer is the second leading cause of death due to malignancy for males and females in the U.S. About 5% of Americans will develop colorectal cancer, and 40% of this population will die of the disease. Men and women are equally affected by colorectal cancer, according to data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database, although colon cancer is more common among women

and rectal cancer is more common among men. The incidence of colorectal cancer tends to increase at about age 40, and is most prevalent between the ages of 60 and 75, after which the rate drops somewhat. There are about 134,000 new cases and 55,000 deaths due to the disease per year, or 19.5 deaths per 100,000 persons. The high mortality is due in part to low screening rates for colorectal cancer. Long-term survival for stage 0 or 1 cancer is greater than 90%. According to SEER, the point prevalence of colorectal cancer in the U.S. on January 1, 1997, was more than 422,000 cases, equivalent to 155 cases per 100,000. NHIS data indicate that prevalence is considerably higher in the white Caucasian population (451 cases per 100,000) than any other group. Hispanics have a rate of 223 cases per 100,000, while the Asian and African-American populations have even lower rates (93 cases per 100,000 and 84 cases per 100,000, respectively).

Direct Costs

In 1998 there were 267,000 hospitalizations among colorectal cancer patients, which cost nearly $3.1 billion (see Table 6.1 at the end of this chapter and Figure 6.1 below). In approximately 66% of these cases colorectal cancer is the primary diagnosis. Costs for home health care, hospice care, and skilled nursing facilities (SNFs) contributed an additional $341.0 million; this care is primarily utilized by late-stage patients. There were nearly 1.8 million physician office visits related to colorectal cancer. The total cost of these visits is $1.1 billion, which includes physician fees across all settings. As noted in the methods section, the data for the cancers was drawn from the Medicare 5% Sample (SAF), which captures data in a different format from the other databases. These costs for physician services also include chemotherapeutic drugs and other medications commonly taken in conjunction with chemotherapy (e.g., anti-vomiting medications) that are administered by physicians. There were 50,000 emergency room visits for colorectal cancer and more than 350,000 visits to the hospital outpatient department, accounting for a total of $309.9 million.

Figure 6.1. Direct Cost of Colorectal Cancer (in millions)



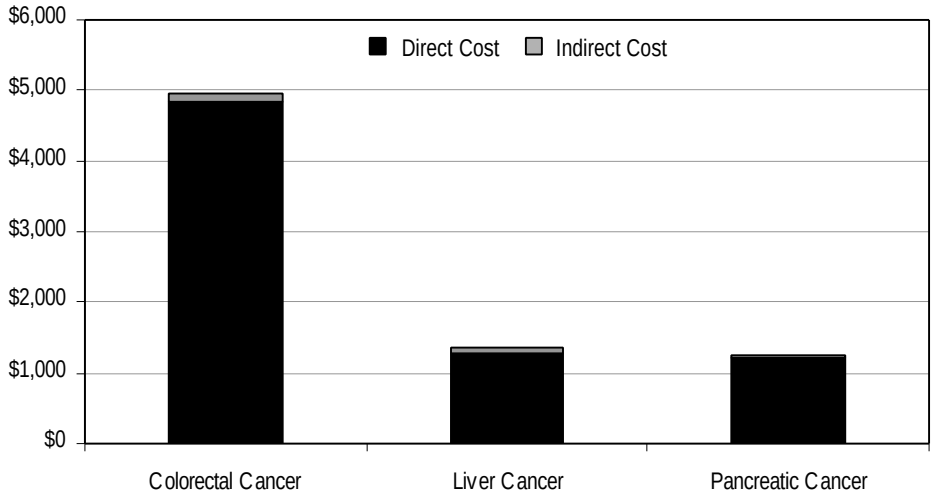
Based on Scott-Levin data for 2000, the cost of drugs to treat colorectal cancer is estimated to be approximately $19.5 million; however, this does not capture the greatest contribution to the cost of pharmaceuticals used in treating colorectal cancer, i.e., the costs of chemotherapeutic agents administered in the physician office setting. These costs are included instead in the estimate for physician services.

Summing all of these types of direct costs, the direct cost of treating colorectal cancer amounted to $4.8 billion in 1998; adjusted for inflation, this figure comes to nearly $5.2 billion in 2000 dollars.

Indirect Costs

The magnitude of colorectal cancer prevalence has a great impact on the indirect costs of the disease. With an average length of stay of 8.7 days and median length of stay of 7.0 days, colorectal cancer patients were hospitalized for 2.3 million days during 1998, for a work loss equivalent of $70.9 million in lost wages among the working-age population. The total indirect cost in 1998, using the value of wages to account for time away from work due to care in all settings, equals $106.1 million. After adjusting for inflation, the year 2000 total indirect cost is estimated at $112.1 million. Lost productivity due to morbidity, which may account for significant additional indirect cost, is not captured by this estimate.

Figure 6.2. Direct and Indirect Cost of Cancers (in Millions)



Liver Cancer

Cancer that originates in the liver is called primary liver cancer. The most common types of primary liver cancer are hepatomas (hepatocellular carcinomas). Cancer that originates elsewhere in the body and spreads to the liver is called metastatic liver cancer.

In North America and Europe, most people with hepatomas have chronic viral hepatitis or are alcoholics with long-standing cirrhosis. Also, certain carcinogens cause hepatomas. About 5-10% of persons with cirrhosis will eventually develop liver cancer, and about 10-20% of persons infected with hepatitis B virus will develop liver cancer. In addition to alcohol consumption and the hepatitis B and C viruses, certain forms of malnutrition and carcinogens (e.g., aflatoxins) are implicated in liver cancer. Other, less common types of primary liver cancer include cholangiocarcinoma, which occurs in people with long-standing ulcerative colitis or sclerosing cholangitis; hepatoblastoma, which occurs in infants and children; and angiosarcoma, a rare cancer that originates in the blood vessels of the liver and may be caused by certain carcinogens. Metastatic liver cancer usually originates from cancers in the lung, breast, colon, pancreas, and stomach. Leukemia and lymphomas may involve the liver as well.

Liver cancer is difficult to detect at an early stage because its first symptoms are usually nonspecific. As primary liver cancer progresses, symptoms such as pain in the upper abdomen, abdominal swelling, weight loss, feeling of bloating, fever, nausea, and jaundice may develop. In some cases, the first symptoms are acute abdominal pain and shock caused by bleeding or rupture of the tumor. In metastatic cancer, other symptoms may include enlarged and hardened liver, enlarged spleen, distended abdominal cavity, and jaundice when the cancer is blocking the bile ducts. Patients may become confused or drowsy as toxins build up in the brain. Diagnosis of liver cancer can be made by numerous methods: testing the level of tumor marker alpha-fetoprotein in the blood, x-rays of chest and abdomen (including hepatic arteriography), abdominal ultrasound, CT, and MRI. The presence of liver cancer is confirmed by biopsy. Liver cancer is very difficult to control, and the prognosis is usually poor because of late detection of the tumor. Treatment usually consists of symptom management and may include surgery, chemotherapy, radiation therapy, or a combination of these methods. While chemotherapy can temporarily shrink the tumor and prolong survival, it is not curative. Radiation may reduce severe pain. A small percentage of patients with small tumors do well after surgical removal of their tumors.

The discussion below concerns primary cancer of the liver and cancer that is metastatic to the liver. The ICD-9 diagnosis codes used to classify liver cancer for this study are 155.0 (Malignant neoplasm of liver, primary); 155.2 (Malignant neoplasm of liver, not specified as primary or secondary); 197.7 (Secondary malignant neoplasm of liver, specified as secondary); 230.8 (Carcinoma in situ of digestive organs; Liver and biliary system).

Epidemiology

In North America and Europe, most liver cancers are metastatic. As noted above, most people in these parts of the world with hepatomas have long-standing cirrhosis associated with alcohol abuse or suffer from chronic viral hepatitis. According to SEER, the prevalence rate for liver cancer is estimated to be 3.49 cases per 100,000. Among males, the prevalence rate is 5.5 cases per 100,000; among women it is 3.0 cases per 100,000. Liver cancer is most prevalent among persons over age 60, according to SEER. Ethnicity may play a role, as evidenced by the significantly higher prevalence rates among Asians (239 per 100,000) compared to the white Caucasian population (46 per 100,000), although these differences may be due to dietary variations or other environmental exposures. Incidence is also high among Asians, particularly Vietnamese males, largely due to the

high prevalence of viral hepatitis in this group.[27] There were 9,529 prevalent cases of cancer of the liver in the U.S. on January 1 1997, according to SEER. Incidence of liver cancer is 4.3 new cases per 100,000 persons. The mortality rate is 3.7 deaths per 100,000 persons.

Direct Costs

The direct costs associated with cancer of the liver are considerable ($1.3 billion). One reason for these high costs lies in the fact that cancers originating in other parts of the body are more likely to metastasize to the liver than to other organs. The cost estimates obtained from the Medicare 5% Sample (SAF) include costs resulting from cancers metastatic to the liver, in addition to cancers originating in the liver. Although metastatic liver cancer appears almost exclusively as a secondary diagnosis, the relative occurrence (and associated resource utilization) of metastatic liver cancer to primary liver cancer is high. Analysis of the 1998 NHDS indicates that of all days of hospital inpatient care consumed by liver cancer patients, approximately 90% was consumed by patients with cancer metastatic to the liver. Similarly, an analysis of the 1997 NIS revealed that the inpatient facility costs associated with primary liver cancer comprised only 3% of the inpatient facility costs associated with all (i.e., primary and metastatic) liver cancer. The Medicare cost estimate, therefore, is a gross overestimate of the direct costs associated with *primary* liver cancer, despite efforts to account for the difference in attributable costs between primary and secondary diagnoses (via the 80%/20% split). Additionally, recurrence is frequent among liver cancer patients, especially those with cirrhosis of the liver. Also contributing to the high costs is the fact that liver cancer malignancies are often multi-focal, meaning that surgery is more radical and intensive. The result of these dynamics is that liver cancer patients utilize medical resources very intensively.

The 196,000 hospitalizations resulting from this disease cost $877.5 million in facility costs (see Figure 6.3 below). Physician services in the inpatient setting are not included in this figure; they are captured in a separate category for physician fees across all settings. There were slightly fewer physician office visits, though at a much lower cost. Because this data was extracted from the Medicare 5% Sample, the approximately 150,000 physician office visits are included in the $148.7 million in physician fees. The physician fees component of the Medicare 5% Sample (SAF) includes all physician fees across all settings of care. It is important to note that this category includes the cost of chemotherapy administered in the physician office.

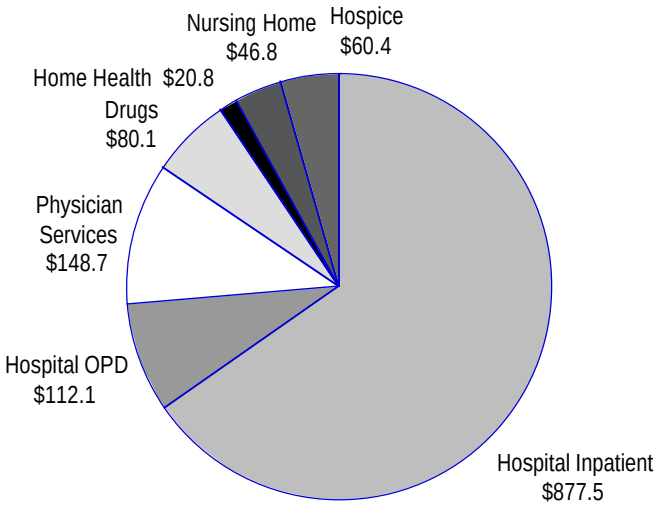
In 1998, there were 45,000 visits to hospital outpatient departments and 18,000 to emergency departments for liver cancer, contributing an additional $112.1 million in facility charges. Physician services across all settings are captured in one category in this data source (see previous paragraph).

An important methodological aspect is the accounting for cancers metastatic to the liver in these direct cost figures for each setting. The total direct costs associated with liver cancer included 20% of the total charges incurred as a result of visits due to metastatic liver cancer, which is almost exclusively a secondary diagnosis. Thus, 80% of the charges

[27] National Cancer Institute. Liver and Intrahepatic Bile Duct: US Racial/Ethnic Cancer Patterns. NIH Pub No. 96-4104. Bethesda, MD 1996.

associated with visits in which metastatic liver cancer is a secondary diagnosis are allocated to the cancer of origin.

Figure 6.3. Direct Cost of Liver Cancer (in millions)



The cost of drugs was a large factor in the total cost of treating liver cancer, at $80.1 million. Patients suffering from liver disease tend to require more medication over a longer period of time. The total direct cost of treating liver cancer patients was more than $1.2 billion in 1998, or $1.4 billion in 2000 dollars.

Indirect Costs

Liver cancer patients tend to be very ill during the course of the disease. Consequently, they require a great deal of care and resources and are typically unable to carry out their own normal daily routines. According to NHDS, the average length of hospital stay for a liver cancer patient in 1998 is 9.0 days, and the median length of stay is 5.0 days, accounting for nearly 1.5 million inpatient hospital days. (However, only 94,000 days were consumed by patients with primary liver cancer; the balance was consumed by metastatic liver cancer patients.) Therefore, the value of work-loss days for persons of working age suffering from liver cancer, while considerable, is an overestimate due to inclusion of care consumed by metastatic liver cancer patients. The total indirect cost of liver cancer, using the value of wages to account for time away from work due to care in all settings, was $78.1 million in 1998. In year 2000 dollars this estimate is $82.5 million.

Pancreatic Cancer

Approximately 95% of pancreatic cancers are adenocarcinomas that originate in cells lining the pancreatic duct. The causes of pancreatic cancer are poorly understood. Pancreatic cancer is difficult to diagnose during its initial stage because it does not cause noticeable symptoms. When symptoms do appear, they are usually nonspecific and are

often ignored. Symptoms include weight loss and abdominal pain, often accompanied by jaundice (due to obstruction of the common bile duct), general skin irritation or itchiness, and depending on the site and size of the tumor, enlarged spleen and esophageal bleeding. Further, because the pancreas is deep inside the body, tumors are not detected during routine physician exams. For these reasons, the disease is often very advanced by the time a diagnosis is established. Diagnosis of pancreatic cancer is aided by techniques that allow pancreatic imaging, such as an upper GI series, CT, MRI, endoscopic retrograde pancreatography (a form of x-ray), and ultrasonography. The presence of the cancer is confirmed by a biopsy. Unless diagnosed at an early stage, pancreatic cancer is very difficult to control.

Pancreatic cancer has one of the poorest survival rates among malignant diseases. The five-year survival of adenocarcinoma of the pancreas is less than 2%. From time of diagnosis, median survival rate is six months. Treatment is focused primarily on symptom management, and may include surgery, chemotherapy, radiation, or a combination of these methods. Surgery, involving removal of the pancreas and in some cases the duodenum, is performed only on patients in whom the cancer has not spread. In these patients, five-year survival is about 10%. Pain management may involve opioid analgesics and injections of nerve blocking agents for severe pain.

Cystadenocarcinoma is a rare form of pancreatic cancer that grows more slowly than adenocarcinoma of the pancreas. If discovered before it has spread and the entire pancreas is removed, five-year survival is about 65%.

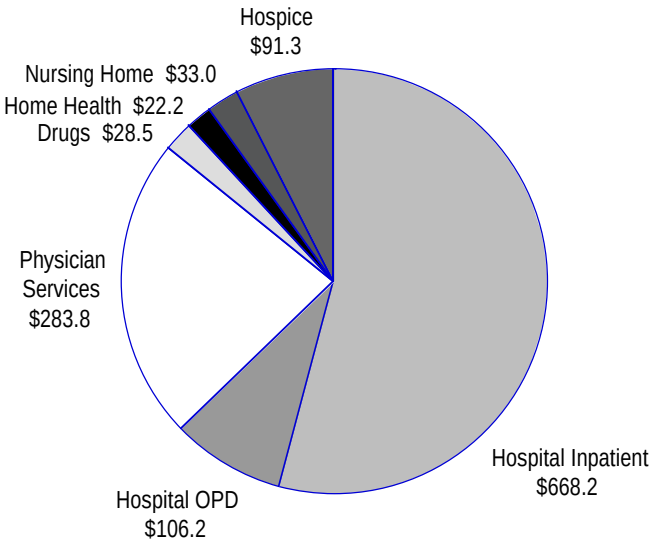
The ICD-9 diagnosis codes used to identify pancreatic cancer in this study are: 157 (Malignant neoplasm of pancreas); 197.8 (Secondary malignant neoplasm of respiratory and digestive systems; Other digestive organs and spleen); 230.9 (Carcinoma in situ of digestive organs; Other and unspecified digestive organs).

Epidemiology

According to SEER, the point prevalence of pancreatic cancer on January 1, 1997, was 18,000 cases. The prevalence rate was 6.75 cases per 100,000. Pancreatic cancer is twice as likely to occur in males than in females, especially those between the ages of 60 and 70 years. It is two to three times more likely to occur in heavy smokers than non-smokers. People with chronic pancreatitis are at higher risk for pancreatic cancer. High-fat diets and exposure to certain chemicals may also increase risk. Pancreatic cancer is rare among people younger than age 50, and the average age of diagnosis is about age 55. Although NHIS data regarding prevalence of pancreatic cancer in the African-American population was insufficient for analysis, African-Americans are at greater risk for developing the disease than white Caucasians.

Direct Costs

Figure 6.4. Direct Cost of Pancreatic Cancer (in millions)



Though most care for pancreatic cancer is sought in the physician office setting, the highest costs arise in the hospital inpatient setting. The 71,000 inpatient stays for pancreatic cancer, with an average length of stay of 9.4 days and median length of stay of 7.0 days, resulted in $688.2 million in facility charges in 1998 (see Figure 6.4 below). In 54% of cases pancreatic cancer was the primary diagnosis. There were 222,000 physician office visits, the cost of which falls under the total cost of physician services across all settings, estimated at $283.8 million in 1998. As with the colorectal and liver cancer data, this figure includes the cost of chemotherapy used in the physician office.

In 1998, there were 31,000 visits to the hospital outpatient department and 15,000 visits to the emergency room for pancreatic cancer, comprising a total cost of $106.2 million. (This figure represents the facility costs in these two settings of care).

The costs of chemotherapeutic agents for pancreatic cancer administered in the outpatient setting are included in the Medicare Part B expenditure data, and appear above in the $283.8 million figure for the year 1998. The cost of other drugs to treat pancreatic cancer was extracted from two sources in order to arrive at a more reliable estimate of the cost of inpatient and outpatient treatment. Based on data from the Scott-Levin PDDA and the Scott-Levin SPA, the cost of these other medications for pancreatic cancer was $28.5 million. Combining these categories of direct costs yields a total direct cost figure of $1.2 billion for 1998. Adjusted for inflation, the total direct cost of treating this disease is over $1.3 billion in year 2000 dollars.

Indirect Costs

During their relatively short survival time, patients with pancreatic cancer tend to be very sick and, if of working age, miss many days from work. Pancreatic cancer patients were hospitalized for a total of 590,000 days with an average length of stay of 8.3 days. The total indirect cost of pancreatic cancer, using the value of wages for time away from work due to care in all settings, was $29.7 million in 1998 ($31.4 million in year 2000 dollars).

Table 6.1. Health Care Utilization for Gastrointestinal Cancers

Disease	Inpatient Hospital Stays	Inpatient Hospital Stays (Primary Diagnosis Only)	Outpatient Hospital Visits	Emergency Room Visits	Physician Office Visits
Colorectal Cancer	267,104	172,938	350,975	50,049	1,787,879
Liver Cancer	195,689	36,305	45,242	18,008	149,319
Pancreatic Cancer	71,054	34,031	31,036	14,937	221,883

CHAPTER 7: INFECTIONS OF THE GASTROINTESTINAL SYSTEM

This chapter presents the estimates of the costs for infectious gastrointestinal diseases, including foodborne illnesses and non-foodborne gastroenteritis and other intestinal infections.

Foodborne Illnesses

Foodborne illnesses comprise a subset of acute gastroenteritis that are caused by contaminated food and beverages. Raw foods of animal origin such as dairy products, meat, and fish are the most likely sources of this contamination. Certain preventive measures, such as sterilization of water supplies and pasteurization of milk, have eliminated some common foodborne diseases of the past. However, a variety of other pathogens have emerged to take their place.

More than 200 known diseases are transmitted by food, many of which are caused by contamination with toxins produced by bacteria. The organisms that are most commonly implicated in foodborne illnesses include the bacteria *Campylobacter*, *Salmonella*, and *E. coli* O157:H7 (hemorrhagic colitis), and Norwalk-like virus. Some of the particular types of gastroenteritis that are or can be foodborne include hemorrhagic colitis (e.g., from *E. coli* O157:H7), Staphylococcal food poisoning, foodborne botulism, Clostridium perfringens food poisoning, and traveler's diarrhea (e.g., from *E. coli*). Intestinal parasites such as *Cryptosporidium* and *Giardia lambia* are commonly acquired by drinking contaminated water. Chemical food poisoning results from eating a plant or animal that contains a poison, such as poisoning from certain mushrooms, potatoes, leaves, fruits, bony fish, and shellfish. It may also result from unintentional ingestion of water or food contaminated with heavy metals such as arsenic, lead, and mercury.

Most foodborne illnesses present with similar symptoms, such as loss of appetite, nausea, vomiting, abdominal cramps, diarrhea, fever, aching muscles, headache, and exhaustion. Severe vomiting and diarrhea can cause dehydration and electrolyte imbalance, which may lead to potentially dangerous loss in blood pressure then shock. Dehydration can be especially dangerous for infants and children. Certain chemical poisoning may cause muscle weakness and paralysis. Foodborne illnesses are greatly under-diagnosed. Many persons suffering from foodborne illness experience only transient symptoms and do not seek medical attention; thus they are not tested and not diagnosed. Further, the specific laboratory tests required to identify the causative organism may not be readily available, or require more time to produce results than the acute course of the disease. As a result, many patients are treated empirically based on symptoms and information given by patients and others about possible causes. For symptoms lasting longer than 48 hours, tests may be conducted on stool samples, vomit, blood, or the suspected food itself. For persistent symptoms, patients may be examined by colonoscopy for other causes such as amebic dysentery or ulcerative colitis.

Treatment depends on the type of illness, symptoms, and whether the patient is at particular risk, such as infants, those who are immunocompromised, and elderly adults. For most cases, treatment involves drinking fluids, with intravenous fluids and electrolytes for more severe dehydration. Upon improvement of symptoms, patients are given bland

and lactose-free diets. Even when the bacterial agent is identified, antibiotics usually are not appropriate because they may further upset the bacterial balance in the GI tract and cause diarrhea. Antibiotics are used for certain bacteria, however, such as *Campylobacter* and *Shigella*. In the case of very powerful toxins or chemical poisoning such as botulism or shellfish poisoning, actions may be taken to rid the body of the toxin, such as induced vomiting, gastric lavage, or laxatives.

The ICD-9 diagnosis codes used to identify infections of the gastrointestinal system are: 001 (Cholera); 002 (Typhoid and paratyphoid fevers); 003 (Other salmonella infections); 004 (Shigellosis); 005 (Other food poisoning, bacterial); 006 (Amebiasis); 007 (Other protozoal intestinal diseases); 008 (Intestinal infections due to other organisms); 009 (Ill-defined intestinal infections); and 558.9 (Other and unspecified noninfectious gastroenteritis and colitis). Because the organisms classified here may cause both foodborne and non-foodborne illness, this study used validated CDC methods to assign a portion of these organisms as foodborne. Additionally, CDC notes that 5% of hepatitis A cases are foodborne. Therefore, this study used ICD-9 diagnosis codes 070.0 (Viral hepatitis A with hepatic coma) and 070.1 (Viral hepatitis A without mention of hepatic coma) and apportioned relevant resource utilization accordingly.

Epidemiology

According to a synthesis of available data and expert opinion from the CDC, foodborne diseases cause approximately 76 million illnesses annually.[28] Approximately 36% of gastroenteritis is foodborne related and included in this section on foodborne illnesses. There are some indications that younger persons are more likely to contract these illnesses.[29,30] According to a 1999 FoodNet report, 45% of people infected with nine pathogens were under 20 years old. Also, while prevalence rates are similar in NHIS between white Caucasian and African-American populations, these two groups have noticeably higher rates than Hispanic and Asian populations. According to the same source, there is no significant difference between prevalence in males and females. The CDC estimates that foodborne illnesses cause approximately 5,000 deaths each year.

Direct Costs

Given the significant number of estimated cases, the direct costs of foodborne illnesses resulting from the utilization of health care services and medication are considerable. There are approximately 250,000 hospital inpatient stays which account for $492.1 million in physician services and facility costs in 1998 dollars (see Table 7.1 at the end of this chapter and Figure 7.1 below). There were even greater number of visits to physician offices and hospital emergency departments for foodborne illness. In 1998, there were more than 2 million visits to physician offices, resulting in a cost of $154.7 million dollars. The 790,000 emergency department visits cost a total of $154.4 million in 1998. The hospital outpatient department was the least utilized of the four settings of care and had the lowest total cost, with approximately 140,000 visits at a cost of $47 million.

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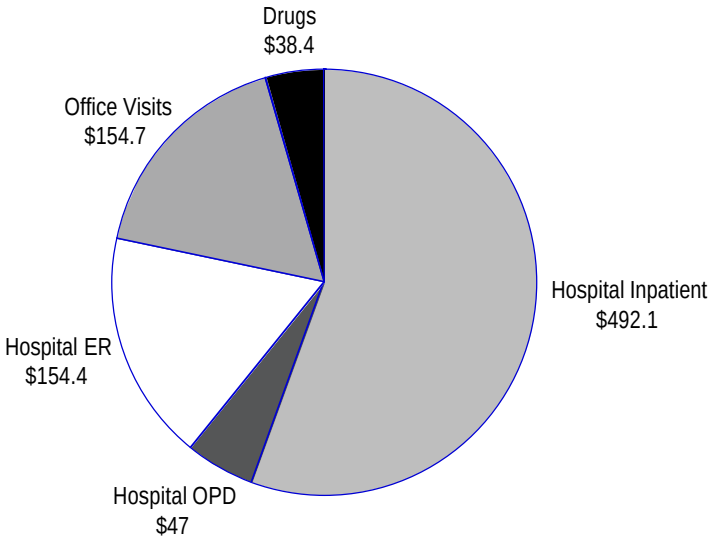
[28] Mead SP. Food-Related Illness and Death in the United States. *Emerging Infectious Diseases* 1999;5(5): 607-625.
[29] Garthright WE, Archer DL, Kvenberg JE, Estimates of Incidence and Costs of Intestinal Infectious Diseases in the United States. Public Health Reports 1988:103(2):107-115.
[30] 1999 Food Net Report

The hospital inpatient utilization figures for the known pathogens (ICD-9 codes 001-008) were computed using methods published by the CDC. The inpatient utilization figures for unknown pathogens (ICD-9 codes 009 and 558.9) were extracted from the NHDS database. The outpatient and ambulatory utilization figures were extracted from the NHAMCS and NAMCS databases, respectively. The unweighted cell counts for the known pathogens were inadequate (i.e., less than 30), suggesting a high rate of under-diagnosis and under-reporting. Consequently, a high proportion of the utilization figures represent the care received for the unknown pathogens. The total costs per site of care were obtained through analyses of the GHC/Puget Sound database. The facility cost of inpatient setting was obtained through analysis of the NIS database.

According to 2000 Scott-Levin data, approximately $38.4 million was spent on medications used to treat foodborne illnesses, most of which were antibiotic drugs.

The total direct cost of treating foodborne illnesses in 1998 amounted to $887 million. After inflating via the medical CPI, the estimate for the year 2000 is close to $946 million.

Figure 7.1. Direct Cost of Foodborne Illnesses (in millions)



Indirect Costs

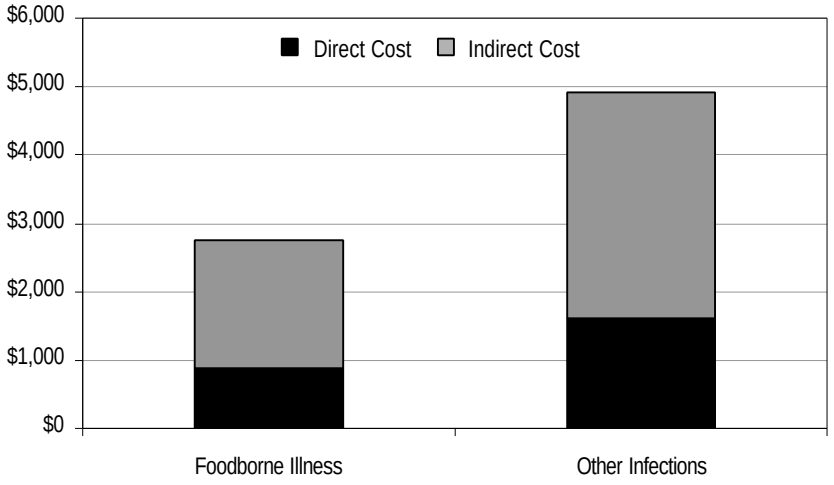
The annual indirect costs resulting from foodborne illness are estimated to reach $1.9 billion (see Figure 7.2). This figure was calculated using data from a large community based study that measured restricted activity days in patients with GI infections. A prospective study of 4000 persons found that 48.2% of patients with GI infection over the age of 20 experienced at least one day of restricted activity.[31] This estimate was more conservative and reliable than the estimated restricted activity days from the 1995 NHIS

[31] Monto SA and Koopman JS The Tecumseh Study XI. Occurrence of acute enteric illness in the community. American Journal of Epidemiology 1980; 112(3):323-333.

(for ICD-9 codes 001-009) and was therefore used to calculate the total work loss associated with foodborne illness. The proportion of total cases of working age were estimated from the 1999 FoodNet Annual Report. Thus, one work loss day was counted for each case estimated to be of working age. Accounting for inflation increases the indirect costs to $2.0 billion in year 2000 dollars.

The indirect cost estimate for foodborne illness is only $233 million, when work days lost to consumption of health care is used as the sole basis of determining cost. This is a vast underestimate, as seen when compared to the indirect cost estimated developed through more comprehensive methods.

Figure 7.2. Direct and Indirect Costs of Infections of Gastrointestinal System



Non-foodborne Gastroenteritis and Other Intestinal Infections

This section addresses non-foodborne gastroenteritis and other intestinal infections. Causes of these infections include bacteria, viruses, and parasites. The bacteria, which include *Campylobacter*, *Shigella*, and *Salmonella*, are some of the same that infect the body via the foodborne pathway. For example, Salmonella bacteria can be spread from reptiles to people when they touch their fingers to their mouth after handling an infected reptile. Viruses that can cause gastroenteritis include Norwalk virus, coxsackievirus, and rotavirus, as well as viruses such as enterovirus and adenovirus that can affect the lungs as well as the GI tract. Symptoms, diagnosis, and treatment of these conditions are the same or similar to those discussed above for foodborne illnesses.

The ICD-9 diagnosis codes used to identify infections of the gastrointestinal system are: 001 (Cholera); 002 (Typhoid and paratyphoid fevers); 003 (Other salmonella infections); 004 (Shigellosis); 005 (Other food poisoning, bacterial); 006 (Amebiasis); 007 (Other protozoal intestinal diseases); 008 (Intestinal infections due to other organisms); 009 (Ill-defined intestinal infections); and 558.9 (Other and unspecified noninfectious gastroenteritis and colitis). Because the organisms classified here may cause both

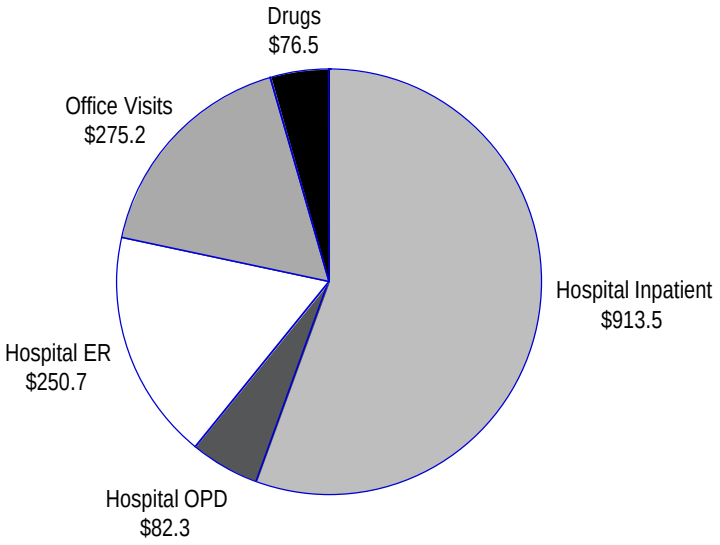
foodborne and non-foodborne illness, this study used estimates published by CDC to assign the relevant proportions of health care resource utilization and costs to each pathogen studied.

Epidemiology

There is no apparent difference in susceptibility to GI infections between males and females, or by race. However, children may be more prone to being affected by these viruses, e.g., rotavirus in children under the age of five. According to analysis of the databases used in this study, the prevalence of these types of GI infection is considerably higher than their foodborne counterparts. There were a total of 135 million acute episodes of non-foodborne gastroenteritis and other intestinal infection in 1998.

Direct Costs

Figure 7.3. Direct Cost of Non-Foodborne Gastroenteritis and Other Intestinal Infections (in millions)



Due in part to the greater prevalence of this disease compared to foodborne illness, the total direct costs of non-foodborne illness and other intestinal infections were quite substantial. In 1998, there were 465,000 inpatient visits for this disease, which cost a total of $913.5 million (see Table 7.1 at the end of this chapter and Figure 7.3 above). There were 3.6 million visits to physician offices, generating another $275.2 million in direct costs. There were 1.2 million visits to hospital emergency departments at a cost of $250.7 million, and 240,000 visits to hospital outpatient departments at a cost of $82.3 million.

The total cost of drugs used to treat this group of diseases reached $76.5 million in 2000 according to Scott-Levin, a figure that is nearly twice the amount spent on drugs for foodborne illnesses. Total direct costs for this group of diseases was $1.6 billion in 1998.

Adjusting for inflation in order to estimate the direct cost in year 2000 yields a figure of $1.7 billion.

Table 7.1. Health Care Utilization for Infections of the Gastrointestinal System

Disease	Inpatient Hospital Stays	Outpatient Hospital Visits	Emergency Room Visits	Physician Office Visits
Foodborne Illness	256,626	142,384	787,977	2,022,860
Non-foodborne gastroenteritis and other intestinal infections	465,254	240,191	1,159,149	3,638,729

Indirect Costs

The annual indirect cost estimate for non-foodborne gastroenteritis and other intestinal infections is approximately $505 million if only work days lost due to consumption of health care is used in determining cost. However, the methods used to estimate the more inclusive indirect cost figure for foodborne illness can also be applied to this disease area.

Indirect costs due to other GI infections and gastroenteritis were estimated to be $3.3 billion (see Figure 7.2 above), when using more comprehensive methods. This estimate was derived using methodology described under foodborne illness. The Tucumseh study, which served as the basis for the estimated restricted activity and work-loss, was not pathogen specific; therefore, the total number of cases with other gastrointestinal infections and gastroenteritis that were of working age determined the total work loss and indirect costs. Similar to foodborne illness, the NHIS work loss estimates for ICD-9 codes 001-009 were not used for this study due to a low cell count and an inexplicably large number of work loss days per patient. Inflating the indirect cost to year 2000 dollars brings this estimate to $3.5 billion.

CHAPTER 8: SUMMARY OF COSTS OF GASTROINTESTINAL DISEASES

GI diseases impose significant health and economic burdens in the U.S. Based largely on 1998 data, the total direct and indirect costs of the 17 selected GI diseases examined in this report range from $0.37 billion (Barrett's esophagus) to $9.8 billion (GERD) in 1998 dollars, as shown in Table 8.1.

Table 8.1. Prevalence and Direct and Indirect Costs of Selected Gastrointestinal Diseases

	1998				2000*
Disease	**Prevalence (in thousands)**	**Direct Cost ($ in millions)**	**Indirect Cost*** ($ in millions)**	**Total ($ in millions)**	**Total ($ in millions)**
GERD	18,600	9,325	479	9,804	10,070
Gallbladder Disease	20,500	5,755	294	6,049	6,467
Colorectal Cancer	422	4,846	106	4,952	5,294
Peptic Ulcer Disease	6,730	3,059	201	3,260	3,441
Diverticular Disease	2,254	2,357	141	2,498	2,667
Diseases of Pancreas**	1,151	2,123	212	2,335	2,492
Non-foodborne Gastroenteritis and Other Intestinal Infections	135,000	1,598	505	2,103	2,238
Chronic Liver Disease and Cirrhosis	5,490	1,421	222	1,642	1,752
Irritable Bowel Syndrome	15,396	1,353	205	1,558	1,658
Liver Cancer	10	1,266	78	1,344	1,518
Pancreatic Cancer	18	1,225	30	1,255	1,370
Foodborne Illness	76,000	887	233	1,119	1,192
Crohn's Disease	359	707	75	781	826
Chronic Hepatitis C	2,530	693	51	744	758
Chronic Diarrhea	3,080	493	129	622	661
Ulcerative Colitis	619	388	36	423	443
Barrett's Esophagus	808	351	22	372	389
TOTAL****	---	36,310	2,817	39,197	41,816

*Inflated to year 2000 dollars using Medical CPI
**Excludes diabetes mellitus
***Indirect cost estimates include only lost days of work due to consumption of health care.
****Due to overlapping costs, total costs do not include Barrett's esophagus, chronic hepatitis C, and chronic diarrhea.

In terms of total direct and indirect costs, the five most costly diseases are: GERD ($9.8 billion), gallbladder disease ($6.0 billion), colorectal cancer ($5.0 billion), peptic ulcer disease ($3.3 billion), and diverticular disease ($2.5 billion). Across diseases, the pattern of relative contributions of direct and indirect costs to total costs is revealing of the types of economic burdens of these diseases and the role of advances in health care in alleviating or redistributing population-wide disease burdens.

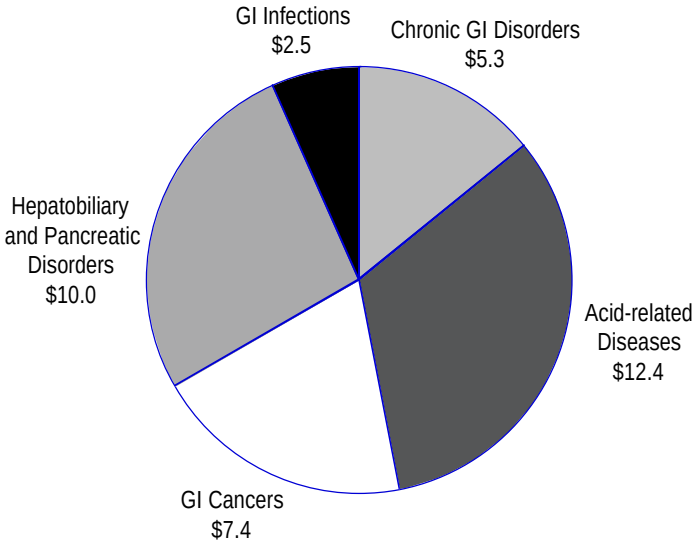
The top five diseases in terms of direct costs are: GERD ($9.3 billion), gallbladder disease ($5.8 billion), colorectal cancer ($4.8 billion), peptic ulcer disease ($3.1 billion), and diverticular disease ($2.4 billion). The top two diseases in terms of indirect costs are non-foodborne gastroenteritis and other intestinal infections ($505 million) and GERD ($479

million), followed by gallbladder disease ($294 million), foodborne illness ($233 million), and chronic liver disease and cirrhosis ($222 million).

The direct costs of GERD rank highest due in great measure to pharmaceutical costs, which comprise 63% of its total direct costs ($9.3 billion), boosting it well above the second-ranking disease in direct costs, gallbladder disease. In contrast to GERD, and other chronic diseases ranking high in direct costs, non-foodborne gastroenteritis and other intestinal infections and foodborne illness were by far the most prevalent conditions studied, but generally do not demand ongoing health care due to their acute and episodic nature. Therefore, the total direct costs associated with these conditions are, on average, significantly lower than GERD, colorectal cancer, PUD, and diverticular disease on a per-patient basis.

Gallbladder disease is the third most prevalent disease among this set, just ahead of GERD. It ranks second only to GERD in direct costs and third in indirect costs. Of its total direct costs of $5.8 billion, 75% is attributable to hospitalization and 16% to hospital outpatient use, with a mere fraction of a percent to pharmaceutical costs. While minimally-invasive surgery for gallbladder removal (laparoscopic cholecystectomy) has contributed to the number of cases that entail hospital-based care, the successful outcomes and rapid post-operative recovery associated with this procedure dramatically reduce the need for subsequent care for many patients. Thus, despite the large number of people who have gallbladder surgery, the indirect cost burden has been minimized by the development and refinement of minimally-invasive techniques and related patient management.

Figure 8.1. Direct Cost of Gastrointestinal Diseases by Class, 1998 (in billions)



Among groups of diseases, the acid-related diseases (GERD [including Barrett's esophagus] and peptic ulcer disease), and the hepatobiliary and pancreatic diseases (chronic liver disease and cirrhosis, hepatitis C, gallbladder disease, and diseases of the pancreas other than cancer) were associated with the highest direct medical costs, totaling $12.4 billion and $10.0 billion, respectively. (See Figure 8.1.)

As described in this report, it is important to note that these cost figures represent conservative estimates for the following reasons:

- Estimates could not be developed for some GI diseases due to lack of information on per-patient costs or prevalence.
- Estimates exclude important categories of direct or indirect costs due to lack of data in the literature and in datasets.
- Estimates were not made for resource utilization and costs incurred at federal facilities (e.g., Veterans Health Administration).
- Some data sources are older than others, and while adjustments can be made for inflation, they cannot be made for trends in prevalence, costs, or other relevant parameters over time.

The indirect cost estimates for the diseases, in which indirect costs are a function of work loss due to consumption of health care, underestimate total indirect costs of these diseases. If more reliable data sources were available to adequately capture other segments of indirect cost (e.g., reduced productivity while working, lost unpaid labor, lost leisure time), it is probable that overall costs would be greater, with a greater share attributable to indirect costs. There are published studies that have measured productivity loss in PUD, GERD, IBS, and foodborne illness suggest that indirect costs often exceed direct costs for a given disease when adequately captured. For example, when data from a study of functional digestive diseases these are extrapolated, indirect costs for IBS are thirteen fold higher than the direct costs. However, there are insufficient data across all GI diseases for productivity losses due to mortality, to illness other than time lost in receiving health care, and to caregiving by family members and others. Losses due to pain, suffering, and diminished quality of life, known as "intangible costs," are considerable yet unmeasured for many of these diseases.

There are persons who suffer from these diseases but do not have health insurance or other resources at their disposal to access health care services, and therefore go undiagnosed and untreated. As some of these diseases are inversely correlated with socioeconomic status, there is likely to be considerable under-reporting of these diseases.

Examination of relative health and economic burdens of diseases can raise questions about R&D efforts devoted to reducing these burdens. The NIH is the greatest source of federal funding dedicated to GI research, with other considerable support from the Centers for Disease Control and Prevention, Food and Drug Administration, Department of Agriculture, and other agencies. In FY2000, the NIH allocated more than $675 million to research concerning GI diseases. Approximate allocations by disease are shown in Table 8.2.

Other investigators have explored the relationship between burden of disease and NIH funding. Gross et al.[32] found that research funding for HIV/AIDS, breast cancer, and dementia was much greater than other diseases with similar disability-adjusted life-years.[33] That study suggested that the health impact of disease does not coincide with the level of

[32] Gross CP, Anderson GF, Powe NR. The relation between funding by the National Institutes of Health and the Burden of Disease. N Engl J Med 1999;340:1881-7.
[33] One disability-adjusted life-year defined as the loss of one year of healthy life to disease.

public research funding. However, that study used hospitalization as a surrogate for the economic impact of disease.

Table 8.2. NIH Research Expenditures by Disease in FY2000

Disease	Research $ (in millions)
Chronic Liver Disease and Cirrhosis	218.6
Liver Cancer	46.2
Ulcerative Colitis and Crohn's Disease	27.0
Pancreatic Cancer	20
Gallbladder Disease	14.5
Chronic Hepatitis C	66.5
Irritable Bowel Syndrome	8.2
Peptic Ulcer Disease	12.1
Foodborne Illness	57.5
Colorectal Cancer	205.2

Sources: NIH Office of the Director; NIDDK, NCI, and NIAID

The present report extends certain aspects of that inquiry to GI diseases by quantifying, in economic terms, hospitalization as well as outpatient care, pharmaceuticals, and certain losses to productivity. As such, this provides a broader picture of the health and economic impact of GI disease, and helps to highlight the relative economic burdens to the nation of different types of costs associated with these conditions. In weighing R&D funding priorities and considering policies that otherwise affect R&D spending, policy makers must examine both federal and industry commitments to the types of R&D and the magnitude of allocations to these. In doing so, it is essential to account for the health and economic impacts of disease, including their burdens to the nation in terms of both direct and indirect costs.

The considerable costs of GI diseases documented in this report cannot be overlooked in national policy making on R&D investment, health care delivery, and other national health care priorities. The health and economic burdens of GI disease represent a challenge to policy makers, clinicians, researchers, and others concerned with how to reduce these burdens. The causes of many of these diseases, including Crohn's disease, pancreatic cancer, and others, remain undetermined. Improvements in the prevention and treatment of these diseases are vital. The scientific and public health commitments needed to diminish the extraordinary burdens of GI disease require greater attention to informed priority setting and adequate funding.

APPENDIX 1 - BIBLIOGRAPHY

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APPENDIX 2 – SUMMARY TABLES

Table A.1. Health Care Utilization and Costs in Non-federal, Short-stay Hospitals for Digestive Diseases in 1998

Disease	Mean Length of Stay (Primary Dx)	Total Days of Care (000)	Average Facility Cost per Day	Average Physician Cost per Day	Total Facility Costs (millions)	Total Physician Costs (millions)
Foodborne Illness	5.1	1,013	$919	$137	$400.6	$91.5
Other GI Infections and Gastroenteritis	5.4	1,988	914	138	725.7	187.8
Chronic Hepatitis C	5.8	389	1,447	74	107.9	20.7
Colorectal Cancer	8.7	2,283	*	*	3,082.4	*
Liver Cancer	9.0	1,479	*	*	877.5	*
Pancreatic Cancer	9.4	591	*	*	688.2	*
GERD	3.4	4,794	1,514	474	1,991.7	548.7
Barrett's Esophagus	4.6	344	1,220	318	159.8	38.4
Peptic Ulcer Disease	5.3	2,962	1,287	268	1,649.7	155.3
Crohn's Disease	5.8	487	1,037	206	255.0	47.6
Ulcerative Colitis	6.3	279	999	263	156.6	35.5
Diverticular Disease	5.4	2,774	1,138	369	1,578.8	301.1
Irritable Bowel Syndrome	3.1	1,933	1,038	110	848.4	148.4
Chronic Liver Disease and Cirrhosis	5.9	2,305	1,477	173	1,140.8	134.0
Gallbladder Disease	3.8	3,311	2,064	691	3,509.7	827.5
Diseases of Pancreas	6.5	2,371	1,172	185	1,686.8	255.7
Chronic Diarrhea	2.2	831	879	148	193.2	23.5

Sources: 1998 National Hospital Discharge Survey; 1997 Nationwide Inpatient Sample; 1997-99 GHC/Puget Sound; 1998 Medicare Standard Analytic Files.
** Cost of physician services for cancers are captured in the Table A 3*

Table A.2. Health Care Utilization and Costs in Non-federal, Hospital Outpatient Departments for Digestive Diseases in 1998

Disease	OPD Visits (000)	ED Visits (000)	OPD Visit Cost	ED Visit Cost	Total OPD Visit Cost (millions)	Total ED Visit Cost (millions)
Foodborne Illness	142	788	$483	$322	$47.0	$154.4
Other GI Infections and Gastroenteritis	240	1,159	492	319	82.3	250.7
Chronic Hepatitis C	46	N/A	345	324	10.5	N/A
Colorectal Cancer	351.	50	*	*	309.9	*
Liver Cancer	45	18	*	*	112.1	*
Pancreatic Cancer	31	15	*	*	106.2	*
GERD	830	460	525	299	212.9	77.5
Barrett's Esophagus	10	N/A	557	295	3.7	N/A
Peptic Ulcer Disease	256	188	4,233	908	370.2	66.8
Crohn's Disease	51	70	337	253	11.3	8.5
Ulcerative Colitis	65	26	377	244	15.9	2.9
Diverticular Disease	148	165	744	2,452	52.7	199.2
Irritable Bowel Syndrome	145	87	383	309	34.7	12.9
Chronic Liver Disease and Cirrhosis	186	55	452	290	57.1	7.0
Gallbladder Disease	670	564	2,005	778	940.4	240.7
Diseases of Pancreas	78	195	631	337	28.9	39.6
Chronic Diarrhea	210	455	307	235	41.3	49.9

**Cost of ED services for GI cancers is included in the Cost of OPD services. Cost of physician services are captured in Table A 3.*

Sources: 1998 National Hospital Ambulatory Medical Care Survey; 1997-99 GHC/ Puget Sound; 1996 Medical Expenditure Panel Survey; 1998 Medicare Standard Analytic Files.

Table A.3. Health Care Utilization and Costs of Physician Office Visits for Digestive Diseases in 1998

Disease	Office Visits (000)	Office Visits Primary Diagnosis (000)	Cost per Visit	Total Cost (millions)
Foodborne Illness	2,023	1,756	$105	$154.7
Other GI Infections and Gastroenteritis	3,639	3,122	105	275.2
Chronic Hepatitis C	317	245	111	23.9
Colorectal Cancer	1,788	1,492	*	1,092.9*
Liver Cancer	149	72	*	148.7*
Pancreatic Cancer	222	222	*	283.8*
GERD	9,114	4,580	124	603.1
Barrett's Esophagus	231	118	248	30.1
Peptic Ulcer Disease	2,652	1,527	136	196.3
Crohn's Disease	1,180	1,093	113	101.6
Ulcerative Colitis	497	352	119	38.2
Diverticular Disease	2,217	982	171	176.6
Irritable Bowel Syndrome	3,658	2,154	107	228.0
Chronic Liver Disease and Cirrhosis	758	422	158	64.8
Gallbladder Disease	1,683	1,452	194	234.3
Diseases of Pancreas	532	364	197	63.8
Chronic Diarrhea	2,210	1,328	113	148.3

** GI Cancers: these figures represent the total cost of physician services across all settings of care.*

Sources: 1998 National Ambulatory Medical Care Survey; 1997-99 GHC/Puget Sound; 1996 Medical Expenditure Panel Survey; 1998 Medicare Standard Analytic Files.

Table A.4. Death Count and Mortality Rate by Gender for Selected Digestive Diseases*

	Female		Male	
Disease	**Death Count**	**Mortality Rate****	**Death Count**	**Mortality Rate**
Colorectal Cancer	24,842	17.96	23,357	17.68
Liver Cancer	3,336	2.41	6,575	4.98
GERD	681	0.49	617	0.47
Peptic Ulcer Disease	2,460	1.78	2,235	1.69
Ulcerative Colitis	245	0.18	220	0.17
Irritable Bowel Syndrome	43	0.03	25	0.02
Gallbladder Disease	678	0.49	465	0.35

**All data from Centers for Disease Control. Data only presented for selected diseases, due to inadequate data for numerous diseases. Data are based on records of underlying cause of death, which is classified in accordance with the International Classification of Disease, Ninth Revision (ICD-9) codes.*
***Mortality rates are calculated as number of deaths per 100,000 population.*

Table A.5. Discharge Status of Patients Admitted with a Gastrointestinal Disease as a Primary Diagnosis in 1998

	Discharge Status				
Disease	**Home**	**Died**	**Short-term Facility**	**Long-term Care Institution**	**Other**
Chronic Hepatitis C	4,831	79	0	108	1,142
Colorectal Cancer	126,131	7,424	6,127	20,714	12,542
Liver Cancer	21,498	8,172	1,828	2,346	2,461
Pancreatic Cancer	23,188	3,393	1,683	3,265	2,502
GERD	157,935	434	1,999	7,016	8,341
Barrett's Esophagus	13,569	348	747	1,784	2,415
Peptic Ulcer Disease	146,789	4,257	4,473	21,666	12,280
Crohn's Disease	31,723	19	2,540	1,002	1,912
Ulcerative Colitis	20,272	195	287	704	1,989
Diverticular Disease	192,756	3,156	4,572	15,334	14,240
Irritable Bowel Syndrome	179,608	28	1,009	7,519	6,105
Chronic Liver Disease and Cirrhosis	64,447	8,786	5,537	4,521	6,490
Gallbladder Disease	389,775	2,593	11,337	11,852	18,570
Diseases of Pancreas	178,676	4,223	6,761	7,052	15,090
Chronic Diarrhea	746	0	0	14	103

Note: Discharge Status was not available for Foodborne Illnesses and Non-foodborne Gastroenteritis and Other Intestinal Infections
Source: 1998 National Hospital Discharge Survey.

Table A.6. Proportion of Hospital Inpatient Stays in which a GI Disease is a Secondary Diagnosis

Disease	Number of Inpatient Stays	Percent Secondary Diagnosis
Chronic Diarrhea	165,298	100
Chronic Hepatitis C	60,638	91
GERD	968,341	87
Liver Cancer	195,689	78
Chronic Liver Disease and Cirrhosis	356,667	77
Barrett's Esophagus	60,906	75
Irritable Bowel Syndrome	475,409	69
Peptic Ulcer Disease	469,857	66
Crohn's Disease	84,622	55
Diverticular Disease	455,409	55
Gallbladder Disease	673,762	51
Ulcerative Colitis	46,630	47
Pancreatic Cancer	71,054	46
Diseases of Pancreas	327,474	42
Colorectal Cancer	267,104	34

Source: 1998 National Hospital Discharge Survey

Table A.7. Payor Mix for Selected Diseases

Disease	Medicare	Medicaid	BCBS	HMO/PPO	Other Private	Other
Foodborne Illness	18.8%	8.0%	0	8.4%	61.0%	3.8%
Other GI Infections and Gastroenteritis	25.6%	19.7%	2.2%	8.8%	35.9%	7.8%
GERD	48.5%	9.4%	4.0%	7.6%	23.8%	6.7%
Barrett's Esophagus	58.2%	7.4%	4.1%	7.2%	17.3%	5.7%
Peptic Ulcer Disease	58.7%	8.2%	3.1%	5.6%	18.2%	6.1%
Crohn's Disease	27.4%	10.3%	5.9%	14.0%	31.9%	10.5%
Ulcerative Colitis	33.4%	4.9%	4.9%	10.0%	36.7%	10.2%
Diverticular Disease	64.1%	3.3%	3.4%	6.6%	18.8%	3.9%
Irritable Bowel Syndrome	0	0	0	0	0	100%
Chronic Liver Disease and Cirrhosis	45.4%	15.9%	3.4%	6.2%	18.0%	11.1%
Gallbladder Disease	41.4%	10.2%	3.8%	10.3%	25.0%	9.4%
Diseases of Pancreas	36.5%	14.8%	5.1%	6.8%	24.6%	12.5%
Chronic Diarrhea	0	0	70.6%	0	0	29.4%