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Burden and Cost of Gastrointestinal, Liver, and Pancreatic Diseases in the United States: Update 2018

Anne F. Peery, MD MSCR[1], **Seth D. Crockett, MD MPH**[1], **Caitlin C. Murphy, PhD**[2], **Jennifer L. Lund, MSPH PhD**[3], **Evan S. Dellon, MD MPH**[1], **J. Lucas Williams, MPH**[4], **Elizabeth T. Jensen, MPH PhD**[5], **Nicholas J. Shaheen, MD MPH**[1], **Alfred S. Barritt, MD MSCR**[1], **Sarah R. Lieber, MD**[1], **Bharati Kochar, MD, MSCR**[1], **Edward L. Barnes, MD, MPH**[1], **Y. Claire Fan, MD**[1], **Virginia Pate, PhD**[3], **Joseph Galanko, PhD**[1], **Todd H. Baron, MD**[1], **Robert S. Sandler, MD MPH**[1]

[1]University of North Carolina School of Medicine, Chapel Hill, NC

[2]University of Texas Southwestern Medical Center, Dallas, Texas

[3]Gillings School of Global Public Health, Chapel Hill, NC

[4]GI Quality Improvement Consortium

[5]Wake Forest School of Medicine, Winston-Salem, NC

Abstract

Background & Aims: Estimates of disease burden can inform national health priorities for research, clinical care, and policy. We aimed to estimate health care use and spending among gastrointestinal (GI) (including luminal, liver, and pancreatic) diseases in the United States.

Methods: We estimated health care use and spending based on the most currently available administrative claims from commercial and Medicare Supplemental plans, data from the GI Quality Improvement Consortium Registry, and national databases.

Results: In 2015, annual health care expenditures for gastrointestinal diseases totaled $135.9 billion. Hepatitis ($23.3 billion), esophageal disorders ($18.1 billion), biliary tract disease ($10.3 billion), abdominal pain ($10.2 billion), and inflammatory bowel disease ($7.2 billion) were the most expensive. Yearly, there were more than 54.4 million ambulatory visits with a primary diagnosis for a GI disease, 3.0 million hospital admissions, and 540,500 all-cause 30-day readmissions. There were 266,600 new cases of GI cancers diagnosed and 144,300 cancer deaths. Each year, there were 97,700 deaths from non-malignant GI diseases. An estimated 11.0 million

Corresponding Author: Anne F. Peery, MD, MSCR, Division of Gastroenterology and Hepatology, University of North Carolina School of Medicine, Bioinformatics Building, CB # 7080 130 Mason Farm Road, Chapel Hill, NC 27599-7555, Phone: (919) 593-5278, Fax: (919) 966-8929, Anne_Peery@med.unc.edu.

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colonoscopies, 6.1 million upper endoscopies, 313,000 flexible sigmoidoscopies, 178,400 upper endoscopic ultrasound examinations, and 169,500 endoscopic retrograde cholangiopancreatography procedures were performed annually. Among average-risk persons ages 50–75 years who underwent colonoscopy, 34.6% had 1 or more adenomatous polyps, 4.7% had 1 or more advanced adenomatous polyps, and 5.7% had 1 or more serrated polyps removed.

Conclusions: GI diseases contribute substantially to health care use in the United States. Total expenditures for GI diseases are $135.9 billion dollars annually—greater than for other common diseases. Expenditures are likely to continue increasing.

Keywords

health care costs; endoscopy; digestive system diseases; neoplasms

Introduction

Gastrointestinal (GI) diseases account for considerable health care utilization and spending. We provide an updated and expanded report[1] detailing select estimates of disease incidence and prevalence, health care utilization and spending across GI diseases (including luminal, liver, and pancreatic) in the United States.

To achieve this objective, we used multiple data sources to generate summary statistics on office-based and emergency department (ED) visits, hospitalizations including readmissions, cancer, and mortality. We have included estimates of the prevalence of chronic hepatitis C virus (HCV) to highlight recent and clinically important trends. Because GI endoscopic procedures are responsible for considerable costs and effort, we report an estimate of the annual number of endoscopies by procedure as well as selected pathology (adenomatous polyps, advanced adenomatous polyps, serrated polyps, and adenocarcinoma). We have estimated health care expenditures for GI diseases and summarized funding for GI diseases research from the National Institutes of Health.

Methods

Symptoms and Diagnoses across Ambulatory Settings

We used the 2014 National Ambulatory Medical Care Survey (NAMCS) to tabulate the leading GI symptoms and diagnoses in the United States for office-based outpatient visits. We used the National Hospital Ambulatory Medical Care Survey (NHAMCS) for ED visits for 2014. NHAMCS collects data on the utilization of ambulatory care services in hospital EDs, regardless of outcome (discharge from the ED, hospital admission, transfer or death). NAMCS and NHAMCS are annual national surveys sponsored by the US Centers for Disease Control and Prevention (CDC) (http://www.cdc.gov/nchs/ahcd.htm). The NAMCS surveys non-federal employed office-based physicians or non-physician clinicians who are primarily engaged in direct patient care. The NHAMCS collects data on visits to ED and hospital-based outpatient visits exclusive of Federal, military, and Veterans Administration hospitals. We downloaded public use data files from the CDC website to perform our analyses.

Patient-reported symptoms are available in both NAMCS and NHAMCS. We used the patient's self-reported most important complaint for our analyses. We combined related symptoms (supplemental tables), and we totaled data from office and ED visits to present the top 10 most common GI symptoms. We categorized physician and non-physician clinician diagnoses into relevant disease categories based on clinical expertise using International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) (supplemental tables). We used the primary diagnosis code only. After combining the related diagnoses, we created a rank order list. NAMCS and NHAMCS are based on probability samples. Therefore, sampling weights were applied to all analyses in order to generate national estimates. When there are fewer than 30 observations for a specific condition, estimates are unreliable and should be interpreted with caution. Unreliable estimates are clearly labeled in the tables with footnotes. Both analyses include children and adults. These analyses were conducted using SAS version 9.4 (Cary, NC).

Emergency Department Visits

The most common ED GI diagnoses were compiled from the Nationwide Emergency Department Sample (NEDS), one of the databases in the Healthcare Cost and Utilization Project (HCUP) (https://hcupnet.ahrq.gov). The NEDS was constructed using the HCUP State Emergency Department Databases (SEDD) and the State Inpatient Databases (SID). The SEDD captures discharge information on ED visits that do not result in an admission, and SID has information on patients initially seen in the ED and then admitted to the same hospital. NEDS is the largest all-payer ED database that is publicly available in the United States. The 2014 NEDS contains information from 31 million ED visits at 945 hospitals participating in HCUP across 33 states and the District of Columbia, approximating a 20-percent stratified sample of U.S. The weighted national estimates pertain to 138 million ED visits in 2014. The NEDS sampling frame includes discharge information on patients admitted to the hospital from EDs, patients treated and released from EDs, and patients transferred to another hospital from an ED.

We queried the database for the rank order of the principal visit diagnosis (i.e., ICD-9-CM) from the ED for all patients in all hospitals. From the top 100 diagnoses, we identified the GI diagnoses, which were subsequently rank-ordered after combining related diagnosis codes. Weighted national estimates for visits in 2014 were generated. Diagnosis categories and associated codes (supplemental tables) were determined using previously published GI coding categories[1–5], and modified for accuracy and relevance with the input of multiple gastroenterology subspecialists. We calculated the percent change in the number of visits between the year 2006 (first year of NEDS) and 2014. We then performed a separate query for each individual ICD-9-CM code (or group of codes) to generate estimates of the total number of visits, rate of visits per 100,000 people, patients admitted to the same hospital from the ED with that diagnosis, and percent deaths either in the hospital or the ED.

Hospitalizations

The most common inpatient GI discharge diagnoses were compiled from the National Inpatient Sample (NIS), a publically available dataset part of HCUP (http://hcup.ahrq.gov/hcupnet.jsp). The 2014 NIS contains a 20 percent sample of discharges from 4,411

community hospitals participating in HCUP across 44 states. The sampling frame for the 2014 NIS comprises over 96 percent of the U.S. population and includes more than 94 percent of discharges from U.S. community hospitals. The NIS is the only national hospital database containing charge information on all patients, regardless of payer, including persons covered by Medicare, Medicaid, private insurance, and the uninsured.

We queried the database for the rank order of the principal discharge diagnosis (i.e., ICD-9-CM) for all patients in all hospitals. From the top 100 diagnoses, we identified the GI diagnoses, which were subsequently rank-ordered after combining related diagnosis codes. Weighted national estimates for visits in 2014 were generated. We then performed a separate query for each individual ICD-9-CM code (or group of codes) to obtain estimates of the mean and median length of stay (LOS), median charges and costs, aggregate charges (i.e. "the national bill") and aggregate costs, and number of inpatient deaths associated with each diagnosis or diagnosis group. We calculated the percent change in the number of admissions between the year 2005 and 2014 and performed temporal analyses for the principal diagnoses with the greatest change in number of admissions. The 2014 version of NIS (the last full calendar year of ICD-9-CM coding) was used for this analysis to facilitate measurement of trends.

Diagnosis categories and associated codes (supplemental tables) were determined using previously published GI coding categories[1–5], as described above. The total LOS was estimated by the product of the mean LOS and the number of discharges for each diagnosis. Total charges were converted to costs by HCUP using cost-to-charge ratios based on hospital accounting reports from the Centers for Medicare and Medicaid Services (CMS). Cost data are presented preferentially, as costs tend to reflect the actual costs of production, while charges represent what the hospital billed for the case.

Readmissions

Common and select GI readmissions were compiled from the 2015 Nationwide Readmissions Database (NRD), a resource of HCUP State Inpatient Databases. The NRD is a publicly available all-payer inpatient database from the United States that includes data from 14,208,678 admissions across 27 states. Using individual linkage identifiers within a state, the NRD is designed to be nationally-representative of readmission rates for all payers and the uninsured.

We identified all patients with an ICD-9-CM or ICD, 10th Revision (ICD-10-CM) code for the most common inpatient GI discharge diagnoses in the NRD. From January 1, 2015 through September 31, 2015, ICD-9-CM codes were utilized by HCUP in the NRD. Beginning on October 1, 2015, ICD-10-CM coding was used to categorize diagnoses. Any patient with an ICD-9-CM or ICD-10-CM diagnosis code as a primary diagnosis on the index admission was eligible for inclusion in this study. Diagnosis categories and associated codes (supplemental tables) were determined using previously published GI coding categories.[1–5]

We included patients age 18 years and older with a full 30 days between the date of discharge from their index admission and December 31, 2015. We excluded patients with an

index hospitalization that ended in death or transfer to another acute care faculty. The primary outcome of interest was the first all-cause readmission within 30 days of the index hospitalization. Weighted national estimates for visits in 2015 were generated. We calculated the total charges associated with both the index admission and the first readmission. There is no cost-to-charge ratio available from HCUP for the 2015 NRD data, therefore only total charges are reported. These analyses were conducted using survey procedures in SAS version 9.4 (Cary, NC) to account for the complex survey design.

Hepatitis C Virus Infection

We estimated the prevalence of chronic HCV in the United States between 2009–2016 using cross-sectional data from The National Health and Nutrition Examination Survey (NHANES) (https://www.cdc.gov/nchs/nhanes/index.htm). The NHANES is a nationally representative household survey designed to assess the health and nutritional status of adults and children in the United States. NHANES is a major program of the National Center for Health Statistics (NCHS). Data from NHANES has been used previously to estimate the prevalence of HCV in the United States.[6–8] The survey examines a nationally representative sample of approximately 5,000 noninstitutionalized persons each year and includes demographic, socioeconomic, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests. Serum samples were tested for HCV antibody. Serum samples positive or indeterminate for anti-HCV were tested for HCV RNA. Prevalence was calculated as confirmed HCV cases (RNA positive) divided by the total population at risk (sum of HCV antibody testing including positive, negative, and indeterminate cases) as in prior prevalence studies with NHANES. These analyses were conducted using SAS version 9.4 (Cary, NC).

Cancer Incidence and Mortality

We estimated age-adjusted (2000 U.S. standard population) incidence of and mortality from GI cancers among adults (age ≥20 years) using data from the United States Cancer Statistics (USCS) in 2014 (www.cdc.gov/uscs). USCS collects data on incidence from state cancer registries, in collaboration with the National Program of Cancer Registries and the Surveillance, Epidemiology, and End Results program. Information on cancer deaths comes from death certificates collected by the National Vital Statistics System at the National Center of Health Statistics. To further illustrate time trends, we plotted incidence and mortality rates (per 100,000 persons) of colorectal cancer by 10-year age group over the period 2000 – 2014.

Non-Cancer Mortality

We generated a list of the most common non-malignant GI causes of death using data from the Centers for Disease Control Wide-ranging Online Data for Epidemiologic Research (CDC WONDER) (http://wonder.cdc.gov). CDC WONDER is a publically available database provided by the Centers for Disease Controls. The CDC reports national mortality of children and adults collected and reported by state registries. The causes of death are derived from death certificates and are classified using the ICD-10 system. The underlying cause of death is defined as the disease that initiated the sequence of morbid events leading

directly to death. Contributing cause of death statistics include all deaths with the disease of interest as either the underlying cause or any of 20 additional diseases leading to death.

To perform our analyses, we downloaded the 2016 public use data files for underlying cause of death and multiple cause of death from the CDC website. Using ICD-10 codes (supplemental tables), the 15 most common non-malignant GI causes of death were ranked. Diagnoses were combined to create clinically meaningful categories. The crude rate per 100,000 deaths was calculated by dividing the number of deaths listed as an underlying cause by the total U.S. population in the United States in 2016 (323,127,513 from the U.S. Census Bureau) then multiplying by 100,000. Results include children and adults.

Endoscopy Use and Trends

Using MarketScan Commercial Claims and Encounters data (Truven Health Analytics, Ann Arbor, MI) and a 5% random sample of all Medicare beneficiaries with at least one month of Part A (hospital) and B (outpatient) coverage (excluding HMO plans), we examined patterns of endoscopy use in adults between 2002 and 2013. We looked at temporal trends in upper endoscopy, colonoscopy, flexible sigmoidoscopy, endoscopic retrograde cholangiopancreatography (ERCP) and upper and lower endoscopic ultrasound (EUS). MarketScan is a large, employer-based claims database that includes 77 contributing employers and 12 contributing health plans, with 126 unique carriers and 8 Medicaid states representing approximately 165 million covered lives. Medicare provides public insurance to over 98% of older US adults and approximately 75% have coverage with Parts A and B. We summed the total number of months individuals aged 18–64 years (MarketScan) and > 65 years (Medicare) were enrolled in their insurance plan in each calendar year as standardized denominators of “enrollee-time.” We then depicted time trends by calculating a rate of the procedure per 1,000 enrollee-years in each calendar year, assuming constant rates within each calendar year. We examined rates by age group (18–29, 30–39, 40–49, 50–64, 65–74 and ≥75 years). We estimated the number of procedures performed in the United States in 2013 by standardizing the number of procedures in each database to 2013 United States Census Bureau data (within age categories). These analyses were conducted using SAS version 9.4 (Cary, NC).

Endoscopy Safety, Quality and Findings

Using 2014–2016 data from the GI Quality Improvement Consortium (GIQuIC) Registry, we report select findings and quality measures for upper endoscopy and colonoscopy. The GIQuIC Registry is a gastrointestinal endoscopy quality improvement registry that is a joint collaboration of the American College of Gastroenterology and the American Society for Gastrointestinal Endoscopy. GIQuIC was established in 2010 and is a voluntary nationwide registry. Participating sites submit patient and procedural data using standardized data elements. During the study period, 538 sites contributed colonoscopy data and 232 sites contributed upper endoscopy data (supplemental tables).

The GIQuIC Registry captures patient demographics, procedure details (indication for procedure, immediate adverse events), and post-procedure details (documentation of discharge instructions, pathology results, recommended follow-up interval) for both

colonoscopy and upper endoscopy procedures. For colonoscopy reports, procedure type (screening, surveillance, or diagnostic), colorectal neoplasm risk assessment (average or high-risk), photo documentation of the cecum, bowel preparation adequacy, and cecal insertion/withdrawal times are also collected.

Data for all colonoscopy procedures performed at the site are required to be submitted to the registry. Contribution of upper endoscopy records is optional, but for those practices who do opt in for such reporting, they must submit data from all upper endoscopy procedures. For research purposes, data from GIQuIC is de-identified and stored in a research database that is maintained on a separate server from the overall registry.

We estimated the rates of immediate adverse events for upper endoscopy and colonoscopy. We report the percentage of colonoscopies with an adequate bowel preparation, documented cecal landmarks and average withdrawal time. We have estimated the prevalence of adenomatous polyps, advanced adenomatous polyps, serrated polyps, and adenocarcinoma among average risk persons having a screening colonoscopy by age, sex and race. We also report overall colonoscopy polyp pathology in the total population and screening population. These analyses were conducted using SAS version 9.4 (Cary, NC).

Expenditures

We estimated total expenditures and distribution of expenditures for GI diseases and symptoms using data from the 2015 Medical Expenditure Panel Survey (MEPS) (https://meps.ahrq.gov/). The MEPS is a set of large-scale surveys of families and individuals, their medical providers (doctors, hospitals, pharmacies, etc.), and employers across the United States. MEPS collects data on the use of specific health services, how frequently they are used, the cost of these services, and how they are paid for. These surveys are designed to collect data from a nationally representative sample of households in the United States and reports detailing health care expenses in the United States are routinely published.[9, 10] In the 2015 MEPS Household Component, 33,983 persons from 13,800 families were surveyed. This survey represents the civilian noninstitutionalized population. All GI diseases and symptoms available in MEPS were pulled for this analysis (supplemental tables). The condition categories are defined using the Clinical Classification Software (CCS), which is a tool, developed by Agency for Healthcare Research and Quality for clustering diagnoses into a manageable number of clinically meaningful policy-relevant categories. All estimates were weighted by the MEPS person-level weight (PERWT08F) to produce national estimates of expenditures. These analyses were conducted using SAS version 9.4 (Cary, NC).

We estimated total expenditures by prescribed acid suppressing drug using data from the 2001–2015 MEPS household component summary tables (https://meps.ahrq.gov/mepstrends/home/index.html).[11] The estimates are for prescribed drugs obtained by household members and do not include drugs administered in hospitals or provider offices. These estimates represent persons in the United States civilian non-institutionalized population.

National Institutes of Health Categorical Spending

We collected estimates of grants, contracts, and other funding mechanisms used across the National Institutes of Health (NIH) for select research, condition, and disease categories for 2013–2018 (https://report.nih.gov/categorical_spending.aspx). Actual expenditures are reported when available, otherwise the values were estimated. Categories specific to GI diseases were selected from 282 total research/disease areas. The research categories are not mutually exclusive. Individual research projects could be included in multiple categories.

Results

Symptoms and Diagnoses across Ambulatory Settings

Using weighted national data, in 2014 there were more than 40.7 million ambulatory visits in the United States for GI symptoms (Table 1) and 54.4 million ambulatory visits with a primary diagnosis code for a GI disease (Table 2). The symptom of abdominal pain was responsible for more than 21.8 million total visits, followed by vomiting (4.7 million visits) and diarrhea (3.4 million visits) (Table 1). Abdominal pain was also the most frequent diagnosis (Table 2) with 16.5 million annual visits. There were more than 5.6 million visits for gastroesophageal reflux disease and reflux esophagitis. Constipation and hemorrhoids each accounted for 2.5 million visits.

Emergency Department Visits

In 2014, there were more than 15.7 million emergency department visits in the United States with a principal diagnosis code for a GI disease (Table 3). Abdominal pain (6.0 million), nausea/vomiting (2.1 million) and noninfectious gastroenteritis/colitis (1.2 million) were the most common diagnoses in the emergency department. Of the 18 listed diagnoses, the numbers of visits for 16 of the diagnoses have increased in the last 10 years. HCV, constipation, and inflammatory bowel disease had the largest increase in number of visits compared to 2006. Among the most common principal GI diagnoses, liver diseases had the highest mortality at 3.1% overall.

Hospitalizations

In 2014, there were more than 3.0 million hospital admissions in the United States with a principal diagnosis code for a GI disease at a cost of $30.6 billion dollars (Table 4). GI hemorrhage, gallbladder disease, and pancreatitis were the most common GI discharge diagnoses overall. The combined cost of these 3 diagnostic categories was nearly $12 billion dollars. GI hemorrhage alone was responsible for over 500 thousand hospitalizations, 2.2 million days of hospitalization, $5 billion dollars in direct costs, and nearly 11 thousand deaths. Chronic liver disease had the highest inpatient mortality (5.6%) with over 14 thousand annual hospital deaths. Colorectal cancer was ranked ninth overall in hospitalizations, and was associated with the highest median costs ($16,904 per hospitalization) and the second highest inpatient mortality (3%) among included conditions.

Hospitalizations for chronic liver disease increased 25% over the past 10 years, with the largest increase in hepatitis C hospitalizations (Figure 1a). Hospitalizations for clostridium difficile infections increased until 2011 and have since plateaued (Figure 1b). There has been

a gradual rise in hospitalizations for intestinal obstruction since the 1990s (Figure 1c). The number of hospital admissions for appendicitis and appendectomies has decreased substantially since 2009–2010, while emergency department visits have remained static, and discharges from the emergency department have increased (Figure 2).

Readmissions

There are more than 540 thousand readmissions in the United States annually within 30 days of an index admission for a GI disease (Table 5). GI hemorrhage, gallbladder disease and intestinal obstruction had the highest number of all-cause readmissions within 30 days (Table 5). Liver disease, GI hemorrhage and gallbladder disease had the highest rates of all-cause readmissions. The median charge for a readmission was higher than the median charge for an index admission for each disease category.

Hepatitis C Virus Infection

Based on 248 participants who tested positive for HCV RNA, the estimated prevalence of chronic HCV in the United States between 2009–2016 was 0.80% (95% CI 0.66–0.96) (Table 6). Chronic HCV was most common individuals aged 51–69 years (68% of cases), however more than a quarter of cases (26%) occurred among individuals between the ages of 18 and 50. As compared to those who tested negative on screening (i.e. HCV antibody negative), HCV cases occurred more predominantly in males (68% vs. 49%) and non-Hispanic blacks (41% vs. 21%).

Cancer Incidence and Mortality

There were 266,564 incident cases of GI cancers diagnosed in 2014 (Table 7). The incidence of colorectal cancer was highest (53.7 per 100,000), followed by pancreatic (17.6 per 100,000) and liver (11.3 per 100,000) cancers. The incidence and mortality of colorectal (Figures 3A and 3B) cancer decreased markedly among older adults (age ≥60 years) from 2000 – 2014. We observed slight increases in the incidence of colon and rectal cancers in younger populations, although mortality remained stable during the same time period (supplemental tables).

Non-Cancer Mortality

There were 97,698 deaths from non-malignant GI diseases in 2016 (Table 8). The most common causes of non-malignant mortality were alcoholic liver disease, all-cause cirrhosis, gastrointestinal hemorrhage, vascular disorders of the intestine and clostridium difficile colitis. More than half (54%) of deaths from all non-malignant GI diseases were attributable to liver disease.

Endoscopy Use and Trends

There were an estimated 10,964,034 colonoscopies, 6,069,647 upper endoscopies, 313,045 flexible sigmoidoscopies, 178,417 upper EUSs, 169,510 ERCPs and 17,727 lower EUSs performed in adults in the United States in 2013 (Table 9). Colonoscopy use in adults aged 18–64 increased between 2002 and 2008 and then began to decrease (Figure 4A). Colonoscopy use has been decreasing in adults over the age of 65 years since 2005 (Figure

4A). Between 2002 and 2013, the rates of upper endoscopies increased slightly in adults aged 18–64 but decreased in adults over the age of 65 years (Figure 4B). The rates of flexible sigmoidoscopies have decreased each year across all age groups since 2002 (Figure 4C). The rates of ERCPs decreased each year across all age groups (Figure 4D), while use of upper EUSs increased each year (Figure 4E). The rates of lower EUSs have increased each year (Figure 4F).

Endoscopy Adverse Events, Quality Measures and Findings

Between 2014–2016, quality improvement data were collected on 3,916,419 colonoscopies and 564,691 upper endoscopies performed across the United States (supplemental tables). Rates of immediate adverse events for upper endoscopy and colonoscopy are reported in Table 10. Among all screening and surveillance colonoscopies, 95% had an adequate bowel preparation, 94% had documented cecal landmarks and the average withdrawal time was 10.7 minutes (standard deviation 5.8 minutes). The average withdrawal time when no tissue was collected was 8.1 minutes (standard deviation 3.4 minutes).

Among average-risk persons ages 50–75 years having a colonoscopy for a screening indication, 34.6% had 1 or more adenomatous polyps removed (Table 11). The prevalence of any adenomatous polyp increased with age and was higher in men compared with women (Figure 5a). Among average-risk persons ages 50–75 years having a colonoscopy for a screening indication, 4.7% had 1 or more advanced adenomatous (≥ 10 mm, high grade dysplasia, villous component) polyps removed (Table 11). The prevalence of advanced adenomatous polyps increased with age and was higher in men compared with women (Figure 5b). Among average-risk persons ages 50–75 years having a colonoscopy for a screening indication, 5.7% had 1 or more serrated polyps removed (Table 11). The prevalence of serrated polyps did not increase with age, was similar in men and women, and was higher among whites compared with other races (Figure 5c). Among average-risk persons ages 50–75 years having a colonoscopy for a screening indication, 0.4% had an adenocarcinoma found. The prevalence of adenocarcinoma increased with age, was higher in men compared with women and was higher in blacks compared with other races (Figure 5d). Colonoscopy findings in the total population and screening population are reported in Table 11.

Expenditures

In 2015, health care expenditures for GI conditions totaled $135.9 billion (Table 12). Among the 22 condition categories available, the five most expensive categories were hepatitis ($23.3 billion), esophageal disorders ($18.1 billion), biliary tract disease ($10.3 billion), abdominal pain ($10.2 billion) and inflammatory bowel disease ($7.2 billion). Prescription medications accounted for 96% of total expenditures for hepatitis and 54% of total expenditures for esophageal disorders. Hospital inpatients stays accounted for the majority of cost among all other conditions. Expenditures by prescribed acid suppressing drug in the United States from 2001 to 2015 are detailed in Table 13. In the last five years, expenditures for acid suppressing drugs totaled $60 billion.

National Institutes of Health Categorical Spending

In 2017, the National Institutes of Health supported $1,832 million dollars in digestive diseases and $661 million dollars in liver disease research. Spending for all available GI categories are detailed in Table 14.

Discussion

The impact of GI diseases on patients and the health care system in the United States is substantial. Annual health care expenditures for these diseases total $135.9 billion dollars. This is more than expenditures for heart disease ($113.4 billion), trauma-related disorders ($102.7 billion) and mental disorders ($98.8 billion).[12] There are more than 40.7 million ambulatory visits for GI symptoms and 54.4million visits with a primary diagnosis for a GI disease each year. There are more than 3.0 million hospital admissions at a cost of 31 billion dollars. Among those patients admitted to the hospital, roughly one in seven will be readmitted to the hospital within 30 days. There are 267,000 new cases of GI cancers diagnosed each year and 242,004 deaths from benign and malignant GI diseases. An estimated 17.7 million endoscopic procedures are performed annually in the United States.

In the last twenty years, there has been a dramatic increase in emergency department visits and hospital admission for HCV in the United States. This is a likely consequence of the increasing prevalence of HCV-related cirrhosis and hepatocellular carcinoma in the United States.[13, 14] Mortality attributable to non-malignant liver diseases, including HCV, is also increasing.[15] Among the 22 GI categories available in MEPS, hepatitis was the most expensive category at $23.3 billion per year, with prescription medications accounting for 96% of these expenditures. This estimate is congruent with the IMS Institute report that 249,000 patients received treatment for HCV in 2015, resulting in $18.8 billion dollars in non-discounted spending (for direct-acting antiviral therapy).[16] Because only 12.8% of the baby boomer population has been screened for HCV[17] and because the opioid epidemic is likely contributing to an increased incidence of HCV[18–21], health care spending for HCV treatment will likely continue to be substantial. Despite the substantial costs of HCV treatment, there is good evidence that treatment is cost-effective at currently available discounts.[22]

Using data from NHANES, the prevalence of chronic HCV appears to be stable and possibly decreasing in the United States. The prevalence of chronic HCV was 1.8% between 1988–1994, 1.6% between 1999–2002 and 1% between 2003–2010 in NHANES.[6–8] We are hesitant to overstate the significance of this decline because there are important limitations of using NHANES to estimate the prevalence of chronic HCV. This survey does not include inmates, the homeless, hospital inpatients, nursing home residents, active duty military, and people living on Indian reservations.[23] Moreover, the NHANES survey may underrepresent individuals who inject drugs, a high-risk population. Therefore, the survey likely substantially underestimates the actual prevalence of chronic HCV in the United States. Despite a decreasing prevalence of HCV in NHANES, there is growing evidence to believe that the burden of chronic HCV may be increasing. The rising opioid epidemic and rates of people who inject drugs is suspected to be contributing to increased incidence of HCV for the first time in over two decades.[18–20, 24] Direct-acting antiviral (DAA) therapy offers a

cure for HCV, but with the current practice of only screening baby boomers, many individuals will remain unaware of their HCV status. The limitations of NHANES data demonstrate the critical need for a better strategy to investigate the prevalence of chronic HCV in the U.S.

The incidence of and mortality from colorectal cancer continues to decline among older adults in the United States, which is partly attributable to colorectal cancer screening.[25] Figure 3 highlights the marked decrease in colorectal cancer but also demonstrates the increasing risk of young-onset colorectal cancer. While the incidence of colorectal cancer has increased in young adults, it is important to note that the absolute risk is very low and mortality has remained stable. The reason for the increase in colorectal cancer in not known, but appears to be a birth cohort effect.[26]

Understanding utilization of endoscopy is important not only for gastroenterology workforce allocation but for understanding and potentially controlling health care costs. We continue to observe, a decline in ERCP procedures and an increase in EUS.[27–29] This suggests that diagnostic ERCPs are being replaced by less invasive and less risky imaging procedures such as MRCP and EUS. With regard to colonoscopy use, surveys estimated that 14.2 million colonoscopies were performed in the United States in 2002[30] and 15 million total colonoscopies in 2012.[31] In our report from 2012, we used 2009 MarketScan data (which included commercial, Medicare, and Medicaid enrollees) and found slightly higher estimated numbers of procedures compared to the current estimates we report here.[32] There is evidence that insured Americans aged 50 to 64 years significantly reduced their use of screening colonoscopy during the 2007–2009 recession[33] and these lower rates may have persisted following the economic upturn. With stricter reimbursement and quality measures, colonoscopy use in the United States may be decreasing. Finally, the numbers of colonoscopies in populations 65 and older are also decreasing. These changes may indicate that we are performing colonoscopies in more appropriate populations or perhaps decreasing unnecessary or too frequent colonoscopies.

With the large volume of endoscopic procedures performed nationally, ensuring high quality exams is paramount, particularly for colonoscopy.[34, 35] Using the GIQuIC Registry, we were able to show high rates of procedural completion as documented by cecal landmarks, adequate bowel preparation, and appropriate withdrawal times, all accepted quality metrics for which there is substantial variation between endoscopists.[36] We have also shown that the risk of immediate adverse events is very low. Notably, our complication rates are lower than prior estimates[37–39] perhaps because these events were documented at the time of the procedure and not within the standard 30-days.

Using data from the GIQuIC Registry, we estimated a “national” adenoma detection rate of 34.6% among 1.5 million screening only, ages 50–75, average risk colonoscopies. The adenoma detection rate is a quality measure inversely associated with the risk of interval colorectal cancer and mortality.[40, 41] Endoscopists with an annual adenoma detection rate > 24.6% achieve a significantly reduced risk.[41] Among the 1.5 million screening only, age 50–75, average risk colonoscopies, we also found that 4.7% had 1 or more advanced adenomatous polyps and 5.7% had 1 or more serrated polyps.

We were also able to stratify the proportion of polyps by histology using age, race, and sex. In contrast with prior studies[42–45], we found that the prevalence of any adenomatous polyps was higher in white women compared with black women before the age of 60. Before the age of 65, the prevalence of any adenomatous polyps was higher in white men compared with black men. Advanced adenomatous (≥ 10 mm, high grade dysplasia, villous component) polyps were more common in white women compared with black women before the age of 65 and white men compared with black men before the age of 60. Despite the lower prevalence of adenomatous polyps on screening colonoscopy, black women and men were more likely to be diagnosed with adenocarcinoma on screening colonoscopy at almost every age category compared with white women and men. While we replicated the known finding that the prevalence of adenomas is higher with increasing age and in men[42], we also demonstrated that the prevalence of serrated polyps did not increase with age, was similar in men and women, and was higher among whites compared with other races. The prevalence of serrated polyps is likely underestimated in this database, due to their minimal role in GIQuIC quality measures, but this would not change the differences we found in prevalence based on age, sex and race/ethnicity. These findings may have implications for screening and detection practices.

This report has limitations, which are inherent to each of the datasets used. We relied on NAMCS and NHAMCS data collected by the CDC to generate an estimate of office visits in the United States for GI symptoms and diagnoses. There were sometimes significant differences between the estimates that we report here using 2014 data compared to estimates that we previously reported using 2010 data.[1] Some of these differences can be accounted for by sparse data. Additionally, the CDC excluded information from community healthcare centers in 2014, which would also lead to smaller numbers. Despite the use of the standard sampling weights from HCUP, differences in the total estimated admissions are demonstrated within the multiple databases presented. This could be due to the use of different years of HCUP data, or a different sampling structure, particularly in the NIS and NRD data sources. We estimated the number of procedures performed in the United States in 2013 by standardizing the number of procedures in MarketScan Commercial Claims and Encounters data and a 5% random sample of all Medicare beneficiaries to United States Census Bureau data. Because we do not have data from the uninsured and those covered by Medicaid, we may have overestimated the number of procedures each year. However, compared with other estimates, ours appears to be conservative.[30, 31] We used GIQuIC to report on quality measures and this registry relies on voluntary reporting of findings linked to endoscopic reporting software. GIQuIC is not population-based, and despite the large number of procedures captured in this database, may not be generalizable to all endoscopic procedures or providers.

This report is a comprehensive and current estimate of the burden of GI diseases in the United States. Health care spending for these diseases is considerable at $135.9 billion dollars annually and is likely to continue increasing for the foreseeable future. It is our hope that this paper will enable clinicians to better understand the challenges our patients face and best target both clinical and research resources to help them.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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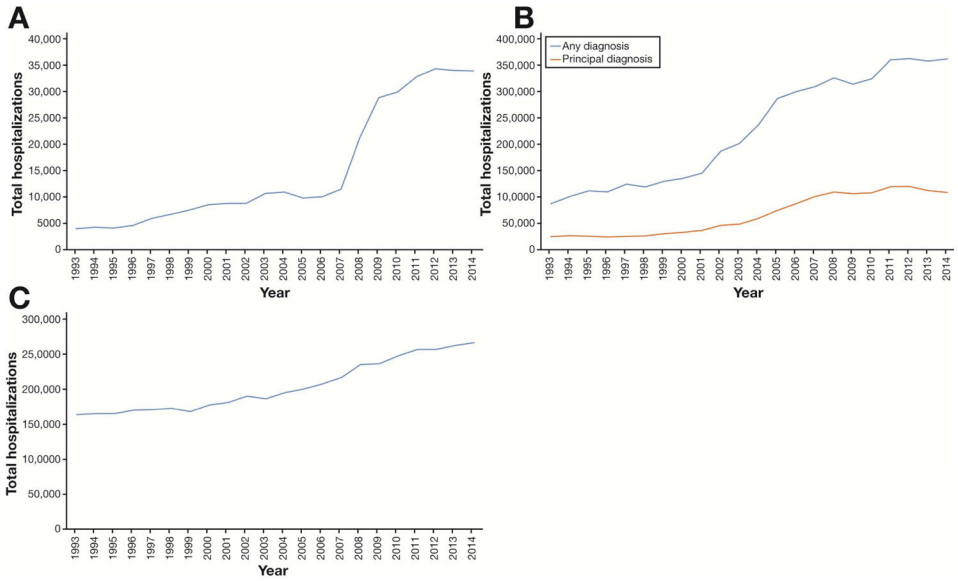

Figure 1A.

Temporal trend in hospitalizations with a principal diagnosis of chronic hepatitis C virus infection, National Inpatient Sample, 1993–2014. (B) Temporal trends in hospitalizations with any diagnosis or principal diagnosis of clostridium difficile infection, National Inpatient Sample, 1993–2014. (C) Temporal trend in hospitalizations with principal diagnosis of intestinal obstruction, National Inpatient Sample, 1993–2014.

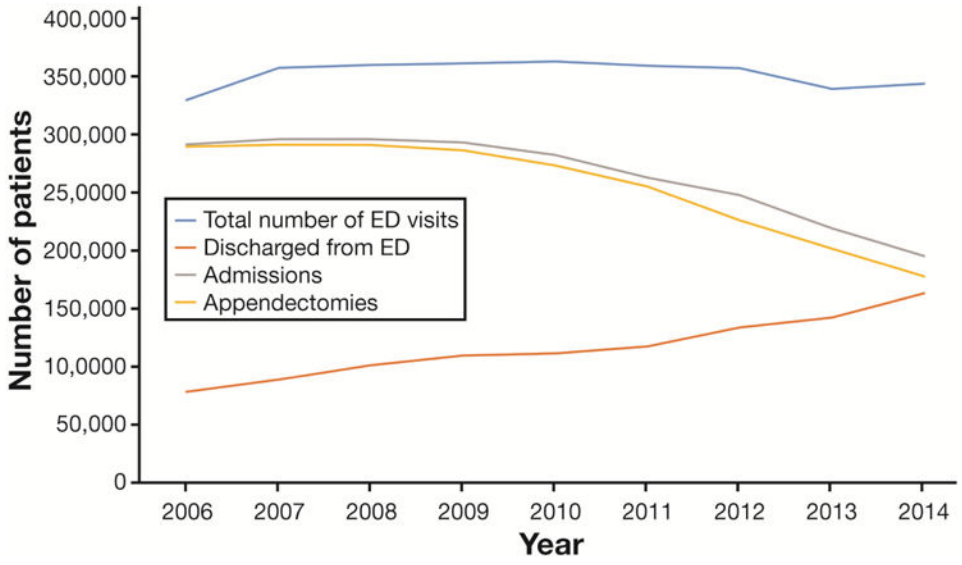

Figure 2.

Temporal trends in emergency department visits, hospitalizations and surgeries for appendicitis, Nationwide Emergency Department Sample and National Inpatient Sample, 2006–2014

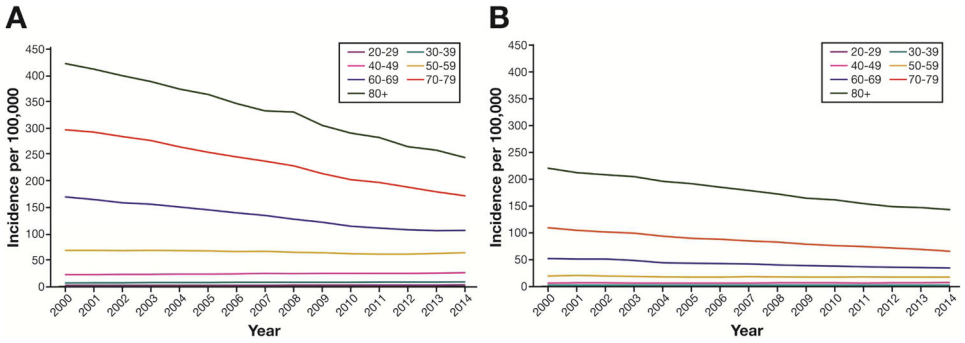

Figure 3A.

Age-adjusted incidence (2000 U.S. standard population) of colorectal cancer by 10-year age group, United States Cancer Statistics, 2000 – 2014. (B) Age-adjusted mortality (2000 U.S. standard population) of colorectal cancer by 10-year age group, United States Cancer Statistics, 2000 – 2014.

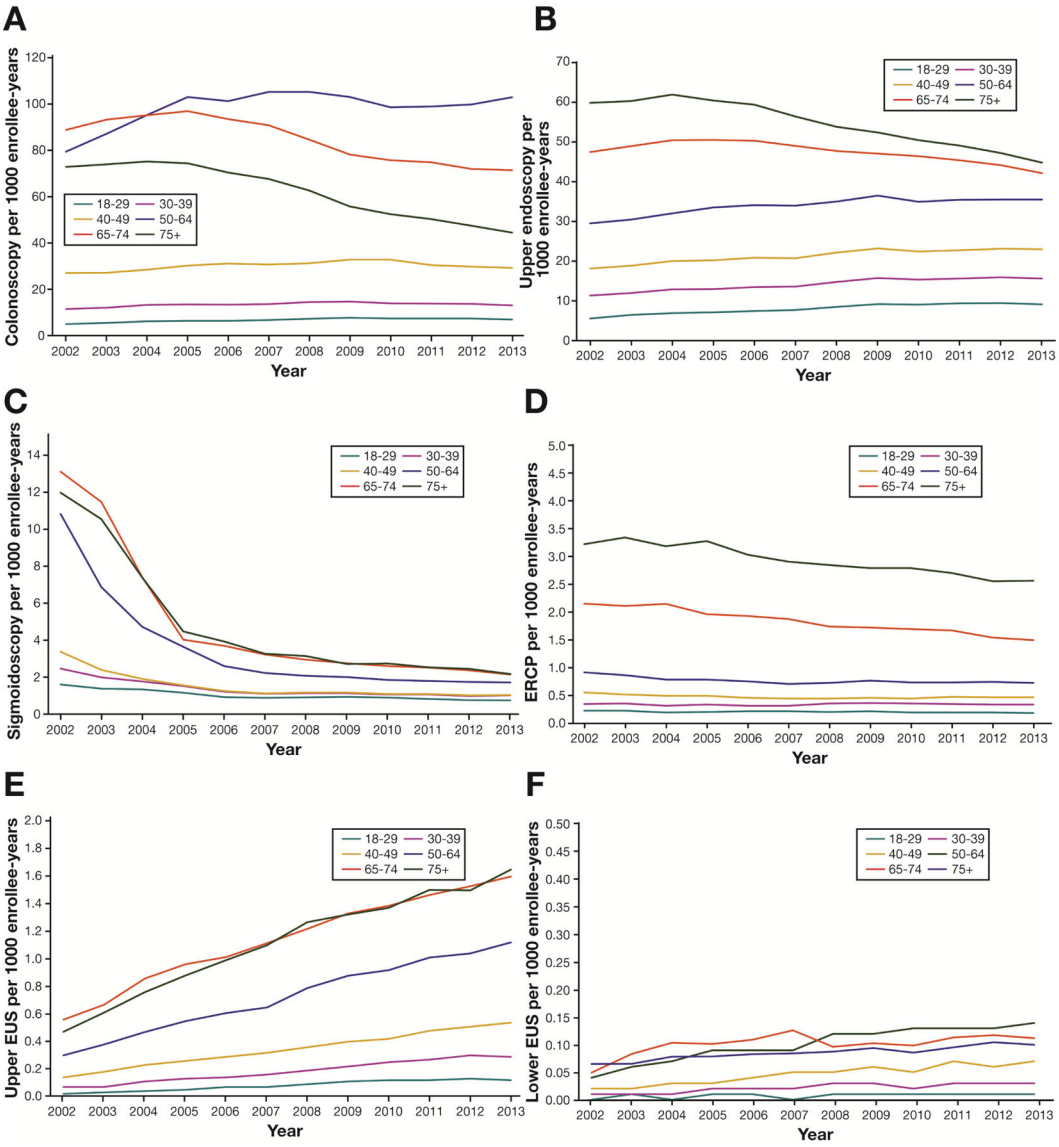

Figure 4A.

Colonoscopies performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013. (B) Upper endoscopies performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013. (C) Flexible sigmoidoscopies performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013. (D) Endoscopic retrograde cholangiopancreatographies performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013. (E) Upper endoscopic ultrasound performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013. (F) Lower endoscopic ultrasound performed per 1,000 enrollee-years, by age group, MarketScan Commercial Claims and Encounters and Medicare, 2002–2013

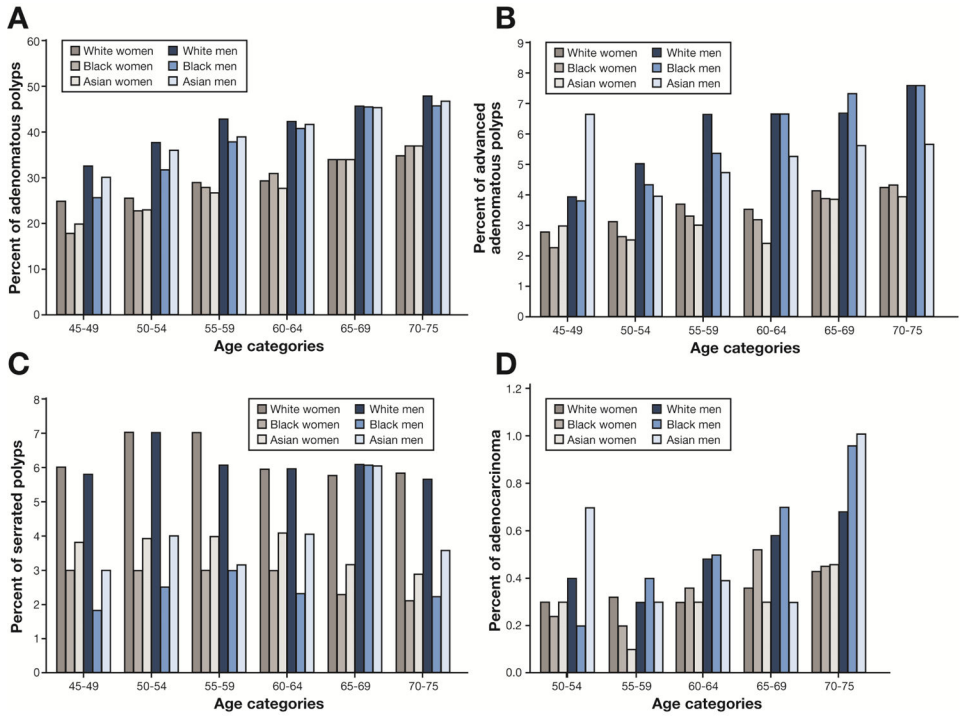

Figure 5A.

Adenomatous polyps on colonoscopy in screening only, ages 45–75, average risk persons by age, sex and race. (B) Advanced adenomatous polyps (≥ 10 mm, high grade dysplasia, villous component) on colonoscopy in screening only, ages 45–75, average risk persons by age, sex and race (C) Serrated polyps on colonoscopy in screening only, ages 45–75, average risk persons by age, sex and race (D) Adenocarcinoma on colonoscopy in screening only, ages 50–75, average risk persons by age, sex and race

Table 1.

Leading Gastrointestinal Symptoms Prompting an Ambulatory Visit in the United States, 2014

		Estimated number of annual visits		
Rank	**Symptoms**	**Office visits**	**Emergency Department**	**Total**
1	Abdominal pain	10,705,448	11,135,099	21,840,547
2	Vomiting	1,725,616	2,936,210	4,661,826
3	Diarrhea	2,423,825	994,454	3,418,279
4	Nausea	1,063,883	2,004,732	3,068,615
5	Bleeding	2,147,949	606,970	2,754,919
6	Constipation	1,086,452	511,317	1,597,769
7	Anorectal symptoms[a]	928,119	220,585	1,148,704
8	Heartburn and indigestion[a]	878,808	63,485	942,293
9	Decreased appetite[a,b]	564,112	94,685	658,797
10	Dysphagia[a]	537,975	88,731	626,706
Total				**40,718,455**

Source: The 2014 National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS), Emergency Department only (https://www.cdc.gov/nchs/ahcd/index.htm)

[a]Denotes category reported from the NHAMCS (Emergency Department only) with <30 observations that should be interpreted with caution

[b]Denotes category reported from the NAMCS with <30 observations that should be interpreted with caution

Table 2.

Leading Physician Diagnoses in the Ambulatory Setting for Gastrointestinal, Liver and Pancreatic Disorders in the United States, 2014

	Estimated number of annual visits		
Diagnosis	**Office Visits**	**Emergency Department**	**Total**
Abdominal pain	8,565,933	7,906,926	16,472,859
Gastroesophageal reflux disease/reflux esophagitis	5,235,107	325,666	5,560,773
Nausea and vomiting	1,935,544	2,943,220	4,878,764
Diarrhea	2,173,179	800,794	2,973,973
Gastritis and dyspepsia	2,398,740	462,065	2,860,805
Abdominal wall and inguinal hernia	2,548,881	236,684	2,785,565
Constipation	1,746,404	771,058	2,517,462
Hemorrhoids	2,237,642	246,623	2,484,265
Diverticular disease of the colon	1,748,508	172,462	1,920,970
Malignant neoplasm of the colon or rectum[a]	1,621,053	28,852	1,649,905
Cholelithiasis	1,126,944	466,832	1,593,776
Lower gastrointestinal hemorrhage	1,269,312	191,724	1,461,036
Chronic liver disease and cirrhosis[a]	1,003,102	41,934	1,045,036
Ulcerative colitis[a]	935,150	21,953	957,103
Dysphagia[a]	861,769	43,172	904,941
Pancreatitis - acute and chronic[b]	562,048	195,113	757,161
Appendicitis[b]	523,524	212,046	735,570
Hepatitis C infection[a]	709,338	3,643	712,981
Crohn's disease[a]	642,547	42,399	684,946
Irritable bowel syndrome[a]	585,061	18,638	603,699
Benign neoplasm of colon and rectum[a, b]	332,191	-	332,191
Barrett's esophagus[a]	274,482	-	274,482
Celiac disease[a, b]	190,381	-	190,381
Hepatitis, unspecified[a, b]	24,088	9,775	33,863
Total			**54,392,507**

Source: The 2014 National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS), Emergency Department only (https://www.cdc.gov/nchs/ahcd/index.htm)

[a]Denotes category reported from the NHAMCS (Emergency Department only) with <30 observations that should be interpreted with caution

[b]Denotes category reported from the NAMCS with <30 observations that should be interpreted with caution

Table 3.

Most Common Gastrointestinal, Liver and Pancreatic Principal Diagnoses From Emergency Department Visits, 2014[a]

Rank	Principal diagnosis[b]	Annual # visits	% change from 2006	Rate of visits per 100,000 persons	Admitted to hospital with principal diagnosis N (%)	ED or hospital deaths N (%)[c]
1	Abdominal pain	5,981,182	+32%	1,876	104,842 (1.8)	230 (0.004)
2	Nausea and vomiting	2,062,444	+44%	647	30,236 (1.5)	195 (0.01)
3	Noninfectious gastroenteritis/colitis	1,234,264	−22%	387	111,441 (9.0)	332 (0.03)
4	Constipation	882,235	+78%	276.7	47,757 (5.4)	408 (0.05)
5	Gastrointestinal hemorrhage	844,451	+17%	264.8	456,935 (54.1)	10,007 (1.2)
	Lower[d]	367,881	+25%	115.4	144,401 (39.3)	1,923 (0.5)
	Upper[d]	231,567	−4%	72.6	181,603 (78.4)	3,739 (1.6)
6	Cholelithiasis and cholecystitis	664,977	+34%	208.6	293,408 (44.1)	1,137 (0.2)
7	Gastritis/duodenitis	623,768	+21%	195.6	58,123 (9.3)	81 (0.01)
8	Diarrhea	599,122	+43%	187.9	19,668 (3.3)	173 (0.03)
9	Gastrointestinal infection[e]	474,341	+9%	148.8	188,570 (39.8)	1,876 (0.4)
10	Pancreatitis	390,940	+18%	122.6	255,966 (65.5)	1,584 (0.4)
	Acute	351,526	+18%	110.2	246,023 (70.0)	1,571 (0.5)
	Chronic	39,413	+12%	12.4	9,944 (25.3)	13 (0.03)
11	Diverticulitis	371,742	+45%	116.6	159,966 (43.0)	674 (0.2)
12	Appendicitis	344,744	+4%	108.1	181,877 (52.8)	181 (0.05)
14	Liver disease/viral hepatitis	325,643	+40%	102.1	204,511 (62.8)	10,110 (3.1)
	Alcoholic liver disease	70,009	+7%	22.0	55,692 (79.6)	2,544 (3.6)
	Ascites or SBP	58,950	+128%[g]	18.5	12,651 (21.5)	470 (0.8)
	Hepatic encephalopathy[f]	57,578	+35%	18.1	49,079 (85.2)	2,258 (3.9)
	Hepatitis C	34,922	+190%	11.0	28,073 (80.4)	1153 (3.3)
	Acute liver failure	11,054	+32%	3.5	7,731 (69.9)	994 (9.0)
	Hepatitis B	4,662	+34%	1.5	3,807 (81.7)	174 (3.7)
15	Gastroesophageal reflux	316,695	+2%	99.3	30,147 (9.5)	52 (0.02)

Rank	Principal diagnosis[b]	Annual # visits	% change from 2006	Rate of visits per 100,000 persons	Admitted to hospital with principal diagnosis N (%)	ED or hospital deaths N (%)[c]
16	GI disorders during pregnancy	287,644	+35%	90.2	12,229 (4.3)	NE
17	Foreign body in GI tract	182,353	+17%	57.2	11,972 (6.6)	69 (0.04)
18	Inflammatory bowel disease	137,946	+52%	43.3	73,637 (53.4)	217 (0.2)
	Crohn's disease	93,277	+48%	29.3	45,888 (49.2)	72 (0.08)
	Ulcerative colitis	44,669	+60%	14.0	27,749 (62.1)	146 (0.3)
Total		**15,724,491**				

Source: Healthcare Cost and Utilization Project Nationwide Emergency Department Sample (NEDS) (https://hcupnet.ahrq.gov)

[a] Weighted national estimates from HCUP Nationwide Emergency Department Sample (NEDS) 2014 and 2006, Agency for Healthcare Research and Quality (AHRQ)

[b] See supplementary table for specific groupings of ICD-9 CM codes for each category

[c] Includes deaths in ED and in hospital deaths for patients admitted from ED with corresponding diagnoses

[d] The code "Gastrointestinal hemorrhage NOS" (578.9) was included in the overall GI bleeding category but was not included in subcategories of upper and lower GI bleeding, because it is nonspecific.

[e] Includes Salmonella, Shigella, E.coli, and other viral, bacterial, and parasitic GI infections. Also includes Clostridium difficile infections

[f] Category may not include encephalopathy associated with viral hepatitis

[g] Part of measured increase since 2006 may be due to coding change in 2007 for ascites

ICD-9-CM: International Classification of Diseases, 9th edition, Clinical Modification; SBP: spontaneous bacterial peritonitis; NE: no estimate due to few data

Table 4.

Most Common Gastrointestinal, Liver and Pancreatic Principal Diagnoses in US Hospitals, 2014[a]

Rank	Principal diagnoses[b]	Annual # admissions	% Δ from 2005	Median LOS (days)	Total hospital days)[c]	Median costs (USD)	Aggregate charges (USD) "National bill"	Aggregate cost (USD)	In hospital deaths n (%)
1	Gastrointestinal hemorrhage	512,925	−0.1%	3.0	2,205,578	6,901	19,202,312,421	4,992,811,950	10,930 (2.1)
	Upper[d]	203,460	−18%	3.0	895,224	7,413	2,143,858,020	4,100 (2.0)	4,100 (2.0)
	Lower[d]	161,540	+2%	3.0	678,468	6,376	1,488,914,180	2,280 (1.4)	2,280 (1.4)
2	Cholelithiasis and cholecystitis	347,985	−13%	3.0	1,322,343	9,609	16,334,942,913	4,083,951,960	1,445 (0.4)
3	Pancreatitis	291,915	+10%	3.0	1,342,809	6,240	10,486,824,627	2,772,024,840	1,855 (0.6)
	Acute	279,145	+15%	3.0	1,284,067	6,240	2,640,588,806	1,840 (0.7)	1,840 (0.7)
	Chronic	12,770	−42%	3.0	62,573	6,202	133,586,970	NE	NE
4	Intestinal obstruction	266,465	+33%	3.0	1,465,558	5,273	11,066,475,706	2,943,372,390	4,225 (1.6)
5	Liver disease/viral hepatitis	251,790	+25%	4.0	1,435,203	6,354	13,629,085,670	3,545,958,570	14,130 (5.6)
	Alcoholic liver disease	64,565	−2%	4.0	380,934	8,552	924,829,060	3,420 (5.3)	3,420 (5.3)
	Hepatic encephalopathy[e]	55,485	+33%	4.0	305,168	6,354	619,490,025	3,010 (5.4)	3,010 (5.4)
	Hepatitis C	33,940	+250%	4.0	186,670	7,388	500,920,460	1,715 (5.1)	1,715 (5.1)
	Ascites or SBP	16,155	+134%[h]	3.0	82,391	6,073	177,801,930	595 (3.7)	595 (3.7)
	Acute liver failure	10,245	+57%	4.0	69,666	9,005	205,811,805	1405 (13.7)	1405 (13.7)
	Hepatitis B	4,720	+51%	3.0	24,072	5,134	53,841,040	210 (4.5)	210 (4.5)
6	Diverticulitis	208,015	+7%	4.0	977,671	6,406	8,052,870,324	2,132,777,795	785 (0.4)
7	Appendicitis	195,330	−35%	1.0	585,990	7,724	7,892,884,821	2,036,901,240	215 (0.1)
8	Obesity	151,400	+32%	2.0	302,800	11,049	7,404,847,404	1,866,913,400	75 (0.05)
9	Colorectal cancer	128,385	−14%	6.0	975,726	16,904	9,858,093,695	2,590,809,300	3,910 (3.0)
10	Noninfectious gastroenteritis/colitis	118,825	−20%	3.0	380,240	5,007	2,915,143,399	744,082,150	300 (0.3)
11	Abdominal pain	116,680	−40%	2.0	338,372	4,794	2,845,489,883	723,416,000	410 (0.4)
12	Clostridium difficile infection	107,760	+46%	4.0	625,008	6,675	3,873,484,119	1,003,784,400	1,800 (1.7)

Rank	Principal diagnoses[b]	Annual # admissions	% Δ from 2005	Median LOS (days)	Total hospital days)[c]	Median costs (USD)	Aggregate charges (USD) "National bill"	Aggregate cost (USD)	In hospital deaths n (%)
13	Functional/motility disorders[f]	106,695	+2%	2.0	405,441	4,433	3,121,346,077	22,618,450	455 (0.4)
14	Gastrointestinal infection[g]	106,490	−7%	2.0	330,119	4,305	2,415,213,189	52,357,740	235 (0.2)
15	Inflammatory bowel diseases	99,370	+13%	3.0	526,661	5,782	4,063,858,790	1,082,238,670	275 (0.3)
	Crohn's disease	61,805	+13%	3.0	302,845	5,782	631,647,100	130 (0.2)	130 (0.2)
	Ulcerative colitis	37,565	+14%	4.0	217,877	7,443	450,817,565	145 (0.4)	145 (0.4)
Total		**3,010,030**			17,709,474		133,134,979,999	**$30,594,018,855**	

Source: Healthcare Cost and Utilization Project National Inpatient Sample (http://hcup.ahrq.gov/hcupnet.jsp)

[a]Weighted national estimates from HCUP National Inpatient Sample (NIS), 2014 Agency for Healthcare Research and Quality (AHRQ).

Total number of weighted discharges in the U.S. based on HCUP NIS = 35,358,818

[b]See supplementary table for specific groupings of ICD-9 CM codes for each category. In diagnosis categories represented by multiple ICD-9-CM codes, median LOS and median costs are presented for most common ICD-9-CM code in these categories. Rate of visits, admissions and deaths represent the sum from all codes

[c]Total hospital days per year for all persons with each diagnosis, estimated by the product of number of discharges and mean LOS

[d]The code "Gastrointestinal hemorrhage NOS" (578.9) was included in the overall GI bleeding category but was not included in subcategories of upper and lower GI bleeding, because it is nonspecific.

[e]Category may not include hepatic encephalopathy associated with viral hepatitis

[f]Includes esophageal (e.g. achalasia), gastric (e.g. dyspepsia), and intestinal (e.g. irritable bowel syndrome) functional/motility syndromes, as well as constipation and diarrhea

[g]Includes Salmonella, Shigella, E.coli, and other viral, bacterial, and parasitic GI infections. Does not include Clostridium difficile infections (reported separately).

[h]Part of measured increase since 2006 may be due to coding change in 2007 for ascites

Abbreviations: ICD-9-CM: International Classification of Diseases, 9th edition, Clinical Modification; %Δ: percent change; LOS length of stay; USD: US dollars ($); SBP: spontaneous bacterial peritonitis; NE: no estimate due to few data

Table 5.

All-cause 30-day Readmissions Ranked by Most Frequently Readmitted Gastrointestinal, Liver or Pancreatic Conditions in US Hospitals, 2015[a]

Rank	Principal diagnosis[b] for index hospital stay	Number of index stays	Number of 30-day all cause readmissions	% Readmitted	Median Charge per Index stay (USD)	Median Charge per Readmission (USD)
1	Gastrointestinal hemorrhage	669,488	96,945	14.5	28,819	30,800
	Upper[c]	312,081	43,734	14.0	26,019	27,717
	Lower[c]	241,349	37,361	15.5	36,385	36,231
2	Cholelithiasis and cholecystitis	585,770	85,257	14.6	31,622	33,990
3	Intestinal obstruction	433,873	54,409	12.5	23,472	27,837
4	Pancreatitis	393,913	56,148	14.3	28,477	30,201
	Acute	371,503	53,261	14.3	28,633	30,507
	Chronic	22,614	2,919	12.9	25,140	25,503
5	Appendicitis	294,012	42,197	14.4	29,657	31,231
6	Obesity	230,476	31,884	13.8	33,607	34,871
7	Inflammatory bowel disease	175,917	23,881	13.6	26,345	27,735
	Ulcerative colitis	120,017	16,401	13.7	28,766	27,158
	Crohn's disease	55,900	7,480	13.4	25,222	29,586
8	Diverticulitis	143,050	19,733	13.8	25,912	29,562
9	Liver disease and viral hepatitis	139,971	20,936	15.0	29,692	30,607
	Alcoholic liver disease	23,202	3,439	15.3	28,519	29,678
	Hepatitis C	12,422	1,865	15.5	29,371	31,838
	Hepatitis B	1,704	261	16.3	30,637	37,120
	Ascites or SBP	6,142	895	14.4	28,058	29,857
	Hepatic Encephalopathy	19,563	2,847	14.8	27,816	30,250
10	Clostridium difficile infection	130,895	18,382	14.0	22,550	25,939
11	Gastritis	114,861	16,118	14.0	28,349	31,111
12	Gastroesophageal reflux disease	86,188	11,413	13.4	34,513	38,956
13	Gastrointestinal infection[d]	86,183	12,302	14.3	26,338	26,690
14	Non-infectious gastroenteritis/colitis	82,128	11,834	14.4	26,396	29,428

Rank	Principal diagnosis[b] for index hospital stay	Number of index stays	Number of 30-day all cause readmissions	% Readmitted	Median Charge per Index stay (USD)	Median Charge per Readmission (USD)
15	Functional/motility disorders[e]	70,963	10,058	14.2	25,583	28,071
16	Abdominal pain	62,758	8,969	14.3	28,562	30,752
Total			**540,466**			

Source: Healthcare Cost and Utilization Project Nationwide Readmissions Database (https://hcupnet.ahrq.gov)

[a]Weighted national estimates from HCUP Nationwide Readmissions Database (NEDS) 2015, Agency for Healthcare Research and Quality (AHRQ).

[b]See supplementary table for specific groupings of ICD-9 CM codes for each category

[c]The code “Gastrointestinal hemorrhage NOS” (578.9) was included in the overall GI bleeding category but was not included in subcategories of upper and lower GI bleeding, because it is nonspecific.

[d]Includes Salmonella, Shigella, E.coli, and other viral, bacterial, and parasitic GI infections. Does not include Clostridium difficile infections

[e]Includes esophageal (e.g. achalasia), gastric (e.g. dyspepsia), and intestinal (e.g. irritable bowel syndrome) functional/motility syndromes, as well as constipation and diarrhea

Abbreviations: USD: US dollars ($); SBP: spontaneous bacterial peritonitis

Table 6.

Estimated Chronic Hepatitis C Virus Infection in the United States, 2009–2016

Characteristic	HCV Status			
	Never exposed (Anti-HCV Ab Negative) N= 29,170		Chronic Hepatitis C (HCV RNA Positive) N=248	
	n	%	n	%
Age at interview				
<18	7,544	27	0	0
18–34	6,093	22	9	4
35–50	5,342	19	54	23
51–69	5,930	21	162	68
>=70	3,323	12	15	6
Sex				
Male	14,317	49	169	68
Female	14,853	51	79	32
Race/Ethnicity				
Non-Hispanic White	10,744	37	84	34
Non-Hispanic Black	6,249	21	101	41
Hispanic	8,408	29	51	21
Other/Multi-racial	3,769	13	12	5
Highest Level Education (age>20 years)				
<9th grade	2,163	11	24	10
9–11 grade	2,792	14	69	28
High school grad/GED	4,512	22	69	28
Some college	6,108	30	70	28
College grad or above	4,957	24	14	6
Refused/Don’t Know	18	0	2	1
Annual Household Income				
<$14,999	3,692	14	64	29
$15,000–34,999	7,539	29	95	42
$35,000–54,999	4,951	19	31	14
$55,000–74,999	2,926	11	16	7
$75,000–99,999	2,553	10	7	3
>100,000	4,707	18	11	5

Source: National Health and Nutrition Examination Survey (NHANES)

Abbreviations: Anti-HCV Ab = antibody to Hepatitis C Virus; HCV = Hepatitis C Virus;

Table 7.

Age-adjusted (2000 U.S. Standard Population) Incidence and Mortality of Gastrointestinal, Pancreatic and Liver Cancers in the United States, 2014

Cancer Site	Number of new cases	Rate per 100,000	Number of deaths	Rate per 100,000
Colon and Rectum	139,773	53.7	51,646	19.8
Pancreas	46,477	17.6	40,413	15.3
Liver and Intrahepatic Bile Ducts	31,181	11.3	24,659	9.1
Stomach	23,696	9.1	11,306	4.4
Esophagus	16,910	6.3	14,933	5.6
Small Intestine	8,527	3.3	1,349	0.5
Total	**266,564**		**144,306**	

Source: United States Cancer Statistics: 1999 – 2014 Incidence and Mortality Web-based Report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2017. Available at: www.cdc.gov/uscs.

Table 8.

Causes of Death from Non-Malignant Gastrointestinal, Pancreatic and Liver Diseases in the United States, 2016

		Women			Men			Total		
Rank	**Disease**[a]	**Deaths underlying**	**Deaths contributing**	**Crude mortality rate (per 100,000)**[a]	**Deaths underlying**	**Deaths contributing**	**Crude mortality rate (per 100,000)**[a]	**Deaths underlying**	**Deaths contributing**	**Crude mortality rate (per 100,000)**[a]
1	Alcoholic liver disease	6,665	8,264	4.1	15,150	20,331	9.5	21,815	28,595	6.8
2	Hepatic fibrosis/cirrhosis (all-cause)	8,047	16,191	4.9	10,629	24,247	6.7	18,676	40,438	5.8
3	Gastrointestinal hemorrhage, unspecified	4,415	15,046	2.7	4,411	17,925	2.8	8,826	32,971	2.7
4	Vascular disorders of the Intestine	4,785	8,852	2.9	2,945	6,114	1.9	7,730	14,966	2.4
5	*Clostridium difficile* colitis	4,045	6,733	2.5	2,723	4,846	1.7	6,768	11,579	2.1
6	Paralytic ileus and intestinal obstruction	3,890	9,800	2.4	2,659	7,425	1.7	6,549	17,225	2.0
7	Chronic hepatitis C	1,992	5,270	1.2	3,734	12,800	2.3	5,726	18,070	1.8
8	Hepatic failure (acute and chronic)	1,867	11,417	1.1	2,316	14,972	1.5	4,183	26,389	1.3
9	Ulcers (gastric/duodenal/ peptic)	1,561	3,056	1.0	1,647	3,354	1.0	3,208	6,410	1.0
10	Acute pancreatitis	1,159	2,310	0.7	1,743	3,257	1.1	2,902	5,567	0.9
11	Diverticular disease	1,951	2,950	1.2	984	1,652	0.6	2,935	4,602	0.9
12	Perforation of intestine (non-traumatic)	1,537	3,874	0.9	949	2,784	0.6	2,486	6,658	0.8
13	Cholecystitis	1,265	1,893	0.8	1,244	1,948	0.8	2,509	3,841	0.8
14	Fatty change of liver-not elsewhere specified	1,486	2,616	0.9	888	2,058	0.6	2,374	4,674	0.7
15	Cholangitis	504	959	0.3	507	1,101	0.3	1,011	2,060	0.3
Total								**97,698**	**224,045**	

Source: Centers for Disease Control Wide-ranging Online Data for Epidemiologic Research (http://wonder.cdc.gov). See supplementary table for specific groupings of ICD-10 CM codes for each category

[a]Crude rate per 100,000 deaths was calculated by dividing the number of deaths listed as an underlying cause by the total U.S. population in the United States in 2016 then multiplying by 100,000

Table 9.

Estimated Annual Number of Endoscopic Procedures in the United States, 2013

Procedure	Number
Colonoscopy	10,964,034
Upper endoscopy	6,069,647
Flexible sigmoidoscopy	313,045
Upper endoscopic ultrasound	178,417
Endoscopic retrograde cholangiopancreatography	169,510
Lower endoscopic ultrasound	17,727
Total	**17,712,380**

Source: MarketScan Commercial Claims and Encounters and Medicare

Table 10.

Immediate Risk of Adverse Events During Colonoscopy and Upper Endoscopy, 2014–2016

	Screening & Surveillance Colonoscopy		Screening, Surveillance and Diagnostic Colonoscopy		Upper Endoscopy	
	N= 2,809,509		N= 3,916,419		N= 564,691	
	Events (n)	Event Rate per 10,000	Events (n)	Event Rate per 10,000	Event (n)	Event Rate per 10,000
Bowel perforation	134	0.48	237	0.61	15	0.27
Bleeding (unplanned intervention or	281	1.00	433	1.11	67	1.19
Emergency department visit	69	0.25	128	0.33	15	0.27
Hospital admission	63	0.22	110	0.28	17	0.30
Sedation related (unplanned intervention)	276	0.98	360	0.92	56	0.99
Death	8	0.03	9	0.02	6	0.11

Source: GI Quality Improvement Consortium Endoscopy

Table 11.

Colonoscopy Findings in the Total Population and Screening Population in GI Quality Improvement Consortium Endoscopy, 2014–2016

	Total population (n = 3,901,576)		Screening only, ages 50–75 y, average risk (n = 1,476,145)	
Pathology	**n**	**%**	**n**	**%**
Adenocarcinoma	22,118	0.6	5409	0.4
Adenomatous polyps	1,328,060	34.0	510,539	34.6
1 or 2 tubular adenomas <10 mm	945,263	24.2	371,706	25.2
3 or more tubular adenomas <10 mm	245,223	6.3	84,707	5.7
≥10 mm, high-grade dysplasia, villous component	178,217	4.6	69,304	4.7
Serrated polyps	211,915	5.4	83,410	5.7
<10 mm with no dysplasia	150,866	3.9	59,771	4.1
>10 mm or with dysplasia or traditional serrated adenoma	56,801	1.5	21,997	1.5
Hyperplastic polyps	695,155	17.8	275,809	18.7
Other pathology	540,268	13.9	120,157	8.1

Source: GI Quality Improvement Consortium Endoscopy.

Table 12.

Total Expenses Gastrointestinal, Pancreatic and Liver Diseases in the United States, 2015

		Percent Distribution by Type of Service					
Condition Category	**Total Expenses ($) (in millions)**	**Office-Based Visits**	**Outpatient Department Visits**	**Hospital Inpatient Stays**	**EEmergency Room Visits**	**Prescribed Medicines**	**Home Health**
Hepatitis	23,301	1.4%	0.3%	1.7%	0.2%	96.4%	NE
Intestinal infection	6,448	10.2%	0.4%	70.1%	8.0%	11.3%	0.1%
Colon cancer	4,059	18.7%	3.9%	68.1%	0.6%	0.1%	8.5%
Cancer of other GI organs	6,106	14.6%	22.6%	56.5%	0.4%	2.7%	3.2%
Esophageal disorders	18,113	13.6%	9.7%	12.7%	1.8%	54.4%	7.8%
Gastritis and duodenitis	1,187	23.5%	15.4%	15.0%	10.2%	22.5%	13.4%
Gastroduodenal ulcer	777	19.2%	11.4%	43.5%	0.4%	24.4%	1.2%
Other disorders of stomach and duodenum	7,010.	24.6%	10.5%	21.1%	15.8%	23.1%	4.8%
Appendicitis	4,528.	2.8%	2.3%	74.7%	19.8%	0.4%	NE
Abdominal hernia	6,762.	19.7%	31.0%	38.2%	6.5%	2.5%	2.0%
Crohn’s disease and ulcerative colitis	7,248	19.3%	10.4%	14.3%	3.3%	52.4%	0.1%
Noninfectious gastroenteritis	1,765	15.3%	3.4%	13.4%	17.8%	17.1%	32.9%
Intestinal obstruction without hernia	3,970.3	2.2%	0.3%	77.9%	14.6%	3.4%	1.6%
Diverticulosis and diverticulitis	5,461	6.0%	9.3%	65.4%	11.1%	7.0%	1.2%
Anal and rectal conditions	4,355	6.9%	1.4%	69.5%	1.0%	2.3%	18.9%
Hemorrhoids	877	64.1%	19.2%	NE	3.9%	12.8%	NE
Other liver disease	5,174	14.1%	9.9%	55.4%	4.2%	12.2%	4.1%
Biliary tract disease	10,296	8.2%	14.0%	64.3%	11.8%	1.2%	0.5%
Pancreatic disorders	2,386	5.2%	8.9%	71.2%	7.8%	5.5%	1.4%
Gastrointestinal hemorrhage	2,794	20.7%	5.4%	59.4%	9.3%	1.7%	3.7%
Nausea and vomiting	3,053	10.7%	13.4%	41.0%	18.1%	14.6%	2.1%
Abdominal pain	10,246	6.2%	6.5%	77.9%	7.6%	0.8%	1.0%
Total	**$135,926**						

Source: Medical Expenditure Panel Survey data, Household Component 2015 survey (https://meps.ahrq.gov/)

[a] All estimates were weighted by the MEPS person-level weight to produce national estimates of expenditures.

[b] The condition categories were defined using the Clinical Classification Software (CCS), which is a tool, developed by Agency for Healthcare Research and Quality for clustering diagnoses into a manageable number of clinically meaningful policy-relevant categories

Abbreviations: NE: No survey participants reported services from which expenditures can be extrapolated

Table 13.

Total Expenditures in Millions By Prescribed Acid Suppressing Drug in the United States, 2001–2015

Prescribed drug	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dexlansoprazole[a]	--	--	--	--	--	--	--	--	--	--	646	709	681	--	1,131
Famotidine	562	295	225	202	316	184	332	349	128	214	144	141	267	236	140
Lansoprazole	2,250	2,633	2,983	3,031	3,517	3,122	3,654	3,478	3,601	1,559	1,079	894	857	688	509
Omeprazole	3,161	2,103	1,797	1,604	1,328	2,267	2,225	2,567	2,318	3,638	3,034	2,944	3,099	3,185	3,298
Pantoprazole	539	840	1,348	1,640	2,129	1,973	2,512	2,056	1,906	1,908	689	644	974	1,102	1,528
Rabeprazole[a]	383	720	1,316	1,098	1,105	973	1,039	1,340	1,168	672	--	--	--	--	--
Esomeprazole	181	1,083	2,049	3,264	4,412	3,006	6,050	7,586	6,257	6,731	6,250	5,338	6,016	6,448	5,326
Ranitidine	866	838	893	711	1,250	1,150	990	561	320	225	221	326	280	517	505
Total	**7,942**	**8,512**	**10,611**	**11,550**	**14,057**	**12,675**	**16,802**	**17,937**	**15,698**	**14,947**	**12,063**	**10,996**	**12,174**	**12,176**	**12,437**

Source: Center for Financing, Access and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey

[a]-- Estimates suppressed due to inadequate precision

Table 14.

National Institutes of Health Estimates of Funding for Select Research, Condition, and Disease Categories, 2013–2018

Research/Disease Areas[a] (US Dollars in millions and rounded)	2013 Actual	2014 Actual	2015 Actual	2016 Actual	2017 Estimated (Enacted)	2018 Estimated
Digestive Diseases	1,575	1,607	1,684	1,745	1,832	1,416
Inflammatory Bowel Disease	114	125	128	126	130	100
Colorectal Cancer	281	271	309	274	296	232
Pancreatic Cancer	125	123	174	168	183	143
Liver Cancer	71	74	85	83	89	69
Liver Disease	594	605	616	635	661	509
Hepatitis	195	251	262	267	277	212
Hepatitis - A	2	3	4	3	3	2
Hepatitis - B	48	48	42	47	49	37
Hepatitis - C	101	111	96	107	111	86
Organ	140	142	148	153	159	122
Obesity	812	857	900	965	997	780
Alcohol	437	475	473	486	503	375

Source: National Institutes of Health Research Portfolio Online Reporting Tools. NIH Categorical Spending. Table Published. July 3, 2017. Available at: https://Report.nih.gov

[a]Categories are not mutually exclusive.