RESEARCH

Administrative Claims Analysis of All-Cause Annual Costs of Care and Resource Utilization by Age Category for Ulcerative Colitis Patients

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ABSTRACT

BACKGROUND: Ulcerative colitis (UC) is a chronic inflammatory disease with peak incidence in the third decade of life and a second peak in the sixth or seventh decade. While drug therapy can be used to control the inflammation and reduce symptoms, patients with UC may be treated surgically. There is little information in the published literature evaluating the all-cause health care costs of patients with UC according to age.

OBJECTIVE: To assess from administrative claims the direct all-cause (not disease-related) costs of care and resource utilization for patients with UC compared with members without UC by 3 age categories.

METHODS: A retrospective analysis was conducted using the PharMetrics database of patients with a diagnosis of UC (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] code 556.x) from January 1, 2000, through June 30, 2005. This database contains enrollment data and pharmacy and medical claims from more than 85 different managed care organizations and more than 55 million patients in the United States. Patients had to be continuously enrolled for 6 months before and 12 months after the initial UC diagnosis and have at least 2 distinct claims with a diagnosis code for UC. The mean per-patient health care resource utilization and costs were calculated for patients in the year following their initial UC diagnosis and compared with the same measures for a group of age- and gender-matched members (without UC claims) at a ratio of 4:1. Three age groups were analyzed: pediatric-adolescent (aged <18 years), adults (aged 18 to 64 years), and older adults (aged ≥65 years). Differences in the measures of all-cause health care resource utilization (claims and costs) between the UC and non-UC groups were tested for statistical significance using the Wilcoxon signed-rank test, a non-parametric alternative to the paired *t* test. Differences between the 3 age cohorts were tested using the Mann-Whitney *U* test.

RESULTS: Data were collected for 15,105 patients with UC and for 59,159 members in the comparator cohort without UC matched by age and gender. The average age for both cohorts was 44 years, and 54% were female. Mean ([SD], median) annual all-cause total health care costs in 2005 dollars for patients with UC were $13,233 ([$40,715], $5,190) versus $3,214 ([$12,741], $753) for the comparator group ($P<0.001$). For all UC patients, all-cause inpatient hospitalization costs constituted the largest component ($5,771, 43.6%) of the mean annual total costs, followed by prescription medications ($2,423, 18.3%); miscellaneous services, such as hospice, psychiatric facility, and nursing home care ($2,092, 15.8%); outpatient hospital visits ($1,310, 9.9%); physician office visits ($899, 6.8%); laboratory procedures ($470, 3.6%); and emergency department visits ($268, 2.0%). Resource utilization (e.g., physician visits, laboratory claims, pharmacy claims) was highest for older adults aged ≥65 years, followed by pediatric-adolescent patients and adults aged 18 to 64 years (all comparisons $P<0.01$). The mean ([SD], median) all-cause total health care costs were highest for pediatric-adolescent patients with UC (n=589, 3.9%) at $23,113 ([$70,999], $6,214), followed by older adults (n=650, 4.3%) at $15,811 ([$23,882], $6,886, $P<0.001$), while adults aged 18 to 64 years (n=13,866, 91.8%) incurred the lowest cost at $12,693 ([$39,505], $5,108, $P<0.001$).

CONCLUSION: Patients with UC identified from medical claims incurred significantly higher all-cause health care costs for all 3 age categories than did the comparator group of health plan members without diagnosis for UC.

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What is already known about this subject

- Ulcerative colitis (UC) is a chronic disease that can affect patients of any age and leads to high direct costs, with hospitalizations and physician visits accounting for 59.9% and 19.3%, respectively, of all costs incurred by patients with UC.
- Distribution of total costs for UC patients is skewed, with the top 2% of high-cost patients accounting for 36% of total provider charges and 39% of health plan payments for UC.
- Among UC patients who were referred to a university hospital for treatment, 12% were hospitalized during the following 6 months, and 80% of those patients required surgery. In general, hospitalization costs account for 45% to 49% of the total disease-related costs of UC, estimated to be $1,488 per patient per year in 1990 dollars.

What this study adds

- Patients with 2 or more claims for UC had mean [median] all-cause (not disease-specific) health care costs in 12 months in 2005 dollars ($13,233 [$5,190]) that were more than 4 times higher than the mean [median] costs for members without these diagnosis codes ($3,214 [$753]).
- For UC patients, mean all-cause inpatient hospitalization costs accounted for 43.6% ($5,771) of total all-cause health care costs in 12 months after the index diagnosis, followed by outpatient prescription drugs ($2,423, 18.3%); miscellaneous services, such as psychiatric facility, nursing home, and hospice care ($2,092, 15.8%); outpatient hospital visits ($1,310, 9.9%); physician office visits ($899, 6.8%); laboratory procedures ($470, 3.6%); and emergency department visits ($268, 2.0%).
- Resource utilization as measured by visits and claims was highest for older adults aged ≥65 years, followed by pediatric-adolescent patients and adults aged 18 to 64 years (all comparisons $P<0.01$), but the mean [SD], median all-cause total health care costs were highest for pediatric-adolescent patients with UC ($23,113 [$70,999], $6,214), followed by older adults aged ≥65 years ($15,811 [$23,882], $6,886, $P<0.001$), and adults aged 18 to 64 years ($12,693 [$39,505], $5,108, $P<0.001$).

Ulcerative colitis (UC) is a chronic inflammatory disorder of unknown etiology, primarily involving the colonic mucosa. The inflammation is uniform and continuous with no intervening areas of normal mucosa and extends proximally from the rectum.[1] The disease is characterized by a chronic course of unpredictable flares of intestinal inflammation, which result in diarrhea, abdominal pain, fecal urgency, and rectal bleeding.[1,2] There is also an increased risk of colorectal cancer with UC.[3,4] The incidence and prevalence of UC in North America have been estimated at 2.2-14.3/100,000 person years and 37.5-229 per 100,000 people, respectively.[5]

UC can affect people of any age, but it generally follows a bimodal age distribution, with a peak incidence in the third decade of life followed by a second peak in the sixth or seventh decade.[5] Some studies suggest that UC is more prevalent in men than women,[6,7] while other research has found no gender predominance.[8] A familial link has been observed.[1,2,9] Approximately 5% to 10% of patients with UC have a first-degree relative who is also affected,[2] and among children with UC, up to 40% have a relative with the disease.[1] Many patients have long periods of complete remission; however, there is a 90% probability of having a relapse. Relapses are unpredictable, but 70% to 80% of patients with disease activity in the prior 2 years have disease activity the following year.[10] In general, UC does not affect life expectancy,[11,12] although an increased mortality rate has been associated with disease onset after the age of 50 and with severe disease.[11]

Current treatment guidelines for UC emphasize the control of inflammation, reduction of symptoms, and healing of the mucosal lining in order to maintain remission.[13] Surveillance procedures to check for pre-cancerous lesions are performed every 1 to 2 years in patients with long-standing disease. The specific treatments chosen depend on disease severity, location of inflammation, and associated complications of the disease. Some medications are used for the potential to lower the risk of cancer. Drug therapy options include aminosalicylates, corticosteroids, immunomodulators, and biologic agents. Many patients with UC require elective or emergency surgery,[14] and the most common elective procedure is the ileal pouch-anal anastomosis (IPAA).[15] While IPAA often results in an overall improvement in quality of life,[16] there are several short-term and long-term complications of surgery for UC that vary according to the procedure. For all surgical procedures for UC, the most common early complications are small bowel obstruction, affecting 11% to 26% of patients, and sepsis, affecting 3% to 15% of patients.[14] Pouchitis is the most common late complication of IPAA in patients with UC.[14] A large study of 1,310 patients who had undergone IPAA with a J-shaped pouch found that the cumulative risk of pouchitis was 18% after 1 year and 48% at 10 years.[17] Sepsis and pouchitis are leading causes of pouch failure, requiring pouch removal or an ileostomy.[18] Other surgery-related complications include anal seepage,[14] incontinence,[14] fistulas,[15] and a decrease in female fertility.[19,20]

The lost time at work, hospitalizations, and other indirect costs to society contribute to the economic burden of UC.[21] In 1990 dollars, the estimated per-patient annual disease-related health care cost of UC was $1,488, with an estimated $3,345 spent during the first year after diagnosis.[22] The total direct cost of treating UC in the United States across all health care settings was estimated to be between $400 million and $600 million in 1990 dollars, with the largest costs incurred from hospitalizations (59.9%) and physician visits (19.3%).[23] In addition, a small proportion of patients with UC account for a large proportion of cost; the top 2% of high-cost patients account for 36% of provider charges and 39% of health plan payments for UC.[23] Hospitalizations and surgeries account for a large proportion of UC treatment costs. Of patients with UC who were referred to a university hospital, 12% required hospitalization within 6 months, and 80% of those patients required surgery.[24] The hospitalization costs in that study made up 49% of the total treatment cost for UC, while the cost of drug treatment accounted for less than 25%.[24] Another study found that, over a 10-year period, the cost of hospitalization was 45% of the total cost of UC treatment.[25] Also, data from the Healthcare Cost and Utilization Project (HCUP) showed that the mean length of stay and the mean cost of hospitalization for inflammatory bowel diseases, including UC, were higher than for all conditions combined, using pooled data (6.1 days vs. 4.6 days and $9,200 vs. $7,700, respectively).[26]

The present study sought to identify the total all-cause health care costs incurred by patients with UC, using a large database containing information from managed care plans in different regions of the United States, and to identify component cost categories for 3 age-stratified subgroups.

Methods

A retrospective analysis of the PharMetrics Patient-Centric Database, evaluating patients with UC who were identified by health care claims containing *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code 556.x from January 1, 2000, through June 30, 2005, was conducted (Table 1). The PharMetrics database contains enrollment data and pharmacy and medical claims from more than 85 different managed care organizations (MCOs), consisting of more than 55 million patients in the United States.[27] The database is geographically diverse and is considered to be representative of the commercially insured population in the United States.[28] New information from contributing plans is accepted as frequently as every month, and all data undergo quality assurance checks. Before inclusion, each new data submission is compared with expected values for the data fields, based on the complete production database.[29] New data submissions with unexplained variances or identified problems are excluded from the database.

Eligible patients were continuously enrolled for 6 months prior to and 12 months after the index diagnosis date (date of

FIGURE 1 Derivation of Sample for Analysis of Patients With Ulcerative Colitis (UC)

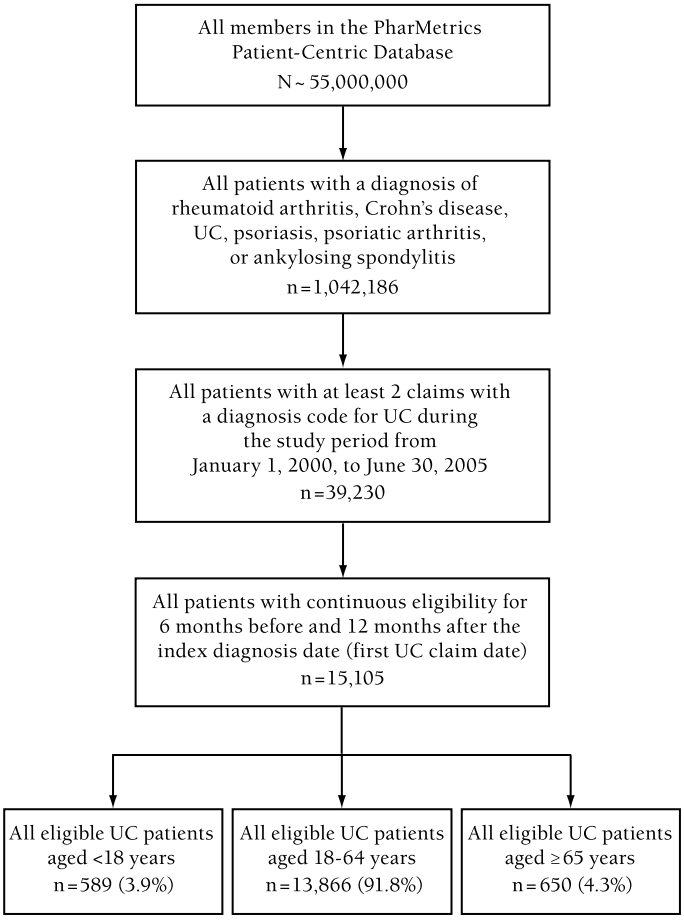


TABLE 1 ICD-9-CM Codes Used to Identify Ulcerative Colitis

556.0	Ulcerative enterocolitis
556.1	Ulcerative ileocolitis
556.2	Ulcerative proctitis
556.3	Ulcerative proctosigmoiditis
556.4	Pseudopolyposis colon
556.5	Leftsided ulcerative colitis
556.6	Universal ulcerative colitis
556.8	Other ulcerative colitis
556.9	Ulcerative colitis, unspecified

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.

the first claim with a UC diagnosis) and had at least 2 distinct claims for UC during the study period (Figure 1). Health care resource utilization, including inpatient hospital, outpatient hospital, emergency department, physician, and laboratory services, and the mean and median health care costs paid by the health plans for services during the 12 months after the index diagnosis date were calculated. The type of service was obtained by applying an algorithm supported by PharMetrics that consisted of the use of a place-of-service variable, record type, Current Procedural Terminology code, Healthcare Common Procedure Coding System code, and revenue center code. A comparator group of members who did not have claims with a diagnosis code for UC was matched 4:1 to the study cohort based on age and gender to define a comparison group that was demographically similar to the UC patient group. Costs were defined as the amount paid by the health plan (i.e., after subtraction of member cost share) and were reported in 2005 dollars. Costs from other years were adjusted for inflation to 2005 dollars. In order to determine the factors that contributed the most to the total health care cost, subgroup analyses were conducted for 3 distinct age groups: pediatric-adolescent (aged <18 years), adults (aged 18 to 64 years), and older adults (aged ≥65 years).

Descriptive statistics were used to describe the cohorts. The variables included cost measures, including inpatient, outpatient, emergency department, physician office, laboratory, pharmacy, and total all-cause health care expenditures (which is the sum of the costs for each of the measures), and medical utilization measures, including the numbers of inpatient, outpatient hospital, emergency department, and physician office visits, and laboratory and pharmacy claims. Outcomes were calculated for all UC patients versus the comparator group and for each UC age group versus its own matched comparator cohort. Chi square tests with Yates correction were used to detect differences in the percentage of females in each of the cohorts. The Wilcoxon signed-rank test, a non-parametric alternative to the *t* test for paired samples, was used to test for differences between the mean costs and utilization rates for the UC and comparator groups. The Mann-Whitney *U* test, a non-parametric alternative to a *t* test for independent samples, was used to compare the 3 age groups. Comorbidity level was based on the Charlson Comorbidity Index (CCI) score, which is the sum of weights related to each condition for which the patient has claims.[30,31] The CCI score was determined based on the ICD-9-CM codes during the 6 months before and 12 months after the index diagnosis date. The SAS statistical software package SAS 9 (9.1 TS1M2) was used for all analyses (SAS Institute, Inc., Cary, NC).

Results

The study included data from 15,105 patients with UC and 59,519 age- and gender-matched comparison members. Both the UC and comparator groups had a mean age of 44.4 years, and 54% were female. The UC group had a mean (standard deviation

TABLE 2 Characteristics and 12-Month All-Cause Resource Utilization and Costs for UC Patients Versus Age- and Gender-Matched Non-UC Members[a]

Median (Range) Mean [SD]	UC N = 15,105	Non-UC N = 59,519	*P* Value[b]
Age—average [SD]	44.4 [14.1]	44.4 [13.7]	<0.001
% females (number)	53.6 (8,097)	53.9 (32,051)	0.594
CCI score—mean [SD]	1.33 [1.98]	0.42 [1.10]	<0.001
Inpatient hospitalizations	0 (0-15)	0 (0-9)	
	0.36 [0.92]	0.06 [0.32]	<0.001
Inpatient hospital costs	0 (0-976,763)	0 (0-1,480,805)	
	5,771 [28,378]	966 [10,024]	<0.001
Physician visits	8.0 (0-154)	3 (0-158)	
	10.87 [10.78]	4.90 [7.49]	<0.001
Physician costs	522 (0-82,746)	170 (0-101,181)	
	899 [1,663]	402 [1,082]	<0.001
Laboratory claims	3.0 (0-110)	1 (0-87)	
	4.24 [5.01]	1.58 [2.74]	<0.001
Laboratory costs	262 (0-24,342)	19 (0-55,445)	
	470 [775]	123 [433]	<0.001
Pharmacy claims	16.0 (0-331)	3 (0-352)	
	23.29 [25.90]	10.27 [17.43]	<0.001
Pharmacy costs	1,099 (0-2,762,952)[c]	65 (0-139,726)	
	2,423 [23,038]	593 [2,089]	<0.001
Emergency department visits	0 (0-27)	0 (0-66)	
	0.38 [1.13]	0.17 [0.71]	<0.001
Emergency department costs	0 (0-144,498)	0 (0-67,751)	
	268 [1,599]	100 [617]	<0.001
Other outpatient hospital visits	1 (0-95)	0 (0-150)	
	2.03 [4.17]	0.76 [2.62]	<0.001
Other outpatient hospital costs	158 (0-209,988)	0 (0-186,665)	
	1,310 [4,199]	411 [2,298]	<0.001
Total medical and facility visits[d]	10 (0-204)	3 (0-184)	
	13.65 [13.21]	5.91 [8.87]	<0.001
Total medical and facility costs[d]	5,190 (0-2,770,192)	753 (0-1,543,378)	
	13,233 [40,715]	3,214 [12,741]	<0.001

[a] *Costs are adjusted to 2005 dollars.*

[b] *The statistical tests were chi square with Yates correction for difference in % female and Wilcoxon signed-rank test for differences in the distributions of continuous variables (claims, visits, and costs) for the UC and comparator cohorts.*

[c] *One patient had a total pharmacy cost of $2,762,952 due to a large number of prescriptions from a specialty pharmacy. When this patient's pharmacy claims were excluded from the analysis, the following values were obtained for pharmacy costs for the UC cohort: median = $1,098, minimum = $0, maximum = $200,130, mean=$2,240, standard deviation = $5,118. Thus, inclusion of the outlier did not influence study results.*

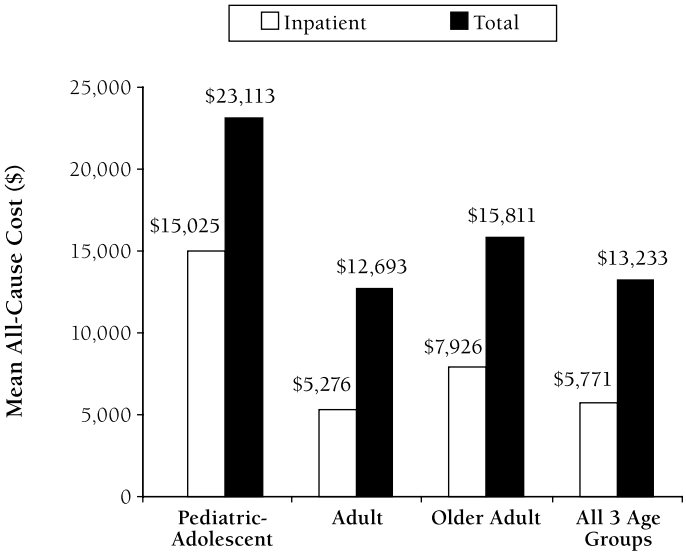
[d] *Total cost and utilization include miscellaneous services other than the main categories listed, such as nursing home or substance abuse treatment costs. These costs accounted for $2,092 and $619 of the total all-cause costs for UC patients and non-UC members, respectively.*

CCI = Charlson Comorbidity Index; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; UC = ulcerative colitis.

[SD]) CCI score of 1.33 [1.98], compared with 0.42 [1.10] for the comparator group ($P<0.001$, Table 2).

The mean and median resource utilization and costs for the UC and comparator cohorts are reported in Table 2. The median annual total all-cause health care cost for all patients with UC was more than 5 times greater than that of the comparator group ($5,190 vs. $753, respectively). The mean [SD] costs were also substantially higher for the UC group ($13,233 [$40,715]) than for the comparator group ($3,214 [$12,741]). Inpatient hospitalization costs constituted the largest component of the mean total costs for both the UC cohort ($5,771, 43.6%; Table 2; Figure 2) and the comparator group ($966, 30.1%). The cost of

FIGURE 2 Mean Inpatient and Total All-Cause 12-Month Health Care Costs (2005 Dollars) for Patients With Ulcerative Colitis



prescription medications was also a significant contributor to the mean total cost for both the UC ($2,423, 18.3%) and comparator groups ($593, 18.5%). Not all health care costs and utilization were captured in the pre-defined categories (inpatient, physician, laboratory, pharmacy, emergency department, and other outpatient hospital). Thus, a miscellaneous category was created to capture those services that were not previously accounted for and included home health care, skilled nursing facility, hospice, psychiatric facility, substance abuse treatment center, and other similar treatment settings. This category accounted for 15.8% ($2,092) of costs for UC patients and 19.3% ($619) of costs for members without UC.

Subgroup analyses were conducted for each age group to determine the components that had the largest contribution to the total health care costs. The mean age of the pediatric-adolescent UC subgroup (n=589) was 12.79 years, and the mean age of the pediatric-adolescent comparator group (n=2,233) was 13.02 years ($P=0.321$); 47.5% of the UC cohort and 47.1% of the comparator group were female (Table 3, $P=0.882$). Based on the mean CCI scores, the pediatric-adolescent UC cohort had significantly more comorbidities than did the comparator group (1.44 vs. 0.17, respectively, $P<0.001$). The mean [SD] annual total all-cause cost for all pediatric-adolescent UC patients was $23,113 [$70,999], which was significantly higher than for the pediatric-adolescent comparator group, at $1,162 [$5,836], $P<0.001$. Inpatient hospitalization costs constituted the largest component (65.0%) of the mean [SD] annual total all-cause cost for all pediatric-adolescent UC patients (Table 3; Figure 2) and were significantly higher than the inpatient costs for the pediatric-adolescent comparator group ($15,025 [$63,927] vs. $294 [$4,050], respectively, $P<0.001$). Other mean [SD] costs for the pediatric-adolescent UC patients were prescription medications ($2,207 [$3,931], 9.5%), outpatient hospital visits ($1,413 [$3,502], 6.1%), physician office visits ($1,088 [$2,568], 4.7%), and laboratory procedures ($677 [$1,452], 2.9%) (Table 3).

The adult UC subgroup was the largest subgroup, comprising 13,866 patients matched to a comparator group of 55,186 non-UC members (Table 4). The mean ages of this patient cohort and the corresponding comparator group were 44.25 years and 44.46 years ($P<0.001$), respectively, and 54% of each group was female. The adult UC group had a mean [SD] CCI score of 1.25 [1.91], compared with 0.39 [1.06] for the corresponding comparator group ($P<0.001$), indicating a heavier comorbidity burden for the UC group. Cost and health care resource utilization trends among the adult UC group were similar to those of the pediatric-adolescent group. The mean [SD] annual total all-cause cost for adult patients with UC was $12,693 [$39,505], compared with $3,147 [$12,722] for the adult non-UC comparator group ($P<0.001$). Again, inpatient hospitalization costs constituted the largest component (41.6%) of the annual total mean [SD] all-cause cost for adult patients with UC ($5,276 [$26,170]; Table 4; Figure 2) and were significantly higher than those for the corresponding comparator group ($903 [$10,024], $P<0.001$; Table 4).

The subgroup of 650 older adult patients with UC had a mean age of 75.40 years, and 58.0% were female, a demographic profile that was similar to that of the comparator group (76.50 years, 58.6% female) (Table 5). The mean [SD] CCI score was 2.87 [2.84] and was significantly higher than the comparator group's mean of 1.44 [1.95], $P<0.001$. The mean [SD] annual total all-cause cost for older adult patients with UC ($15,811 [$23,882]) was significantly higher than for the comparator group ($7,171 [$17,060], $P<0.001$), and mean total utilization (total medical plus facility visits) was also significantly higher (19.31 vs. 10.26 visits, respectively, $P<0.001$). Inpatient hospitalization costs constituted the largest component ($7,926; 50.1%; Table 5; Figure 2) of the mean annual total all-cause cost for older adult patients with UC, followed by outpatient hospital costs ($1,941, 12.3%) and pharmacy costs ($1,641, 10.4%; Table 5).

In general, cost and utilization trends were similar among the UC cohorts, with the largest costs incurred from inpatient and outpatient hospital services, physician visits, and pharmacy claims for UC claimants in all 3 age groups (Table 6). Overall, the pediatric-adolescent UC group had the highest costs, followed by the older adult UC group and the adult UC group. However, the older adult UC group generally had higher utilization rates in key service categories (e.g., inpatient hospital stays, physician visits,

TABLE 3 Characteristics and 12-Month All-Cause Resource Utilization and Costs for Pediatric-Adolescent (Aged <18 Years) UC Patients Versus Age- and Gender-Matched Members Without UC[a]

Median (Range) Mean [SD]	UC N = 589	Non-UC N = 2,233	*P* Value[b]
Age—mean [SD]	12.79 [4.15]	13.02 [3.96]	0.321
% females (number)	47.5 (280)	47.1 (1,051)	0.882
CCI score [SD]	1.44 [1.77]	0.17 [0.44]	<0.001
Inpatient hospitalizations	0 (0-12) 0.58 [1.18]	0 (0-5) 0.02 [0.20]	<0.001
Inpatient hospital costs	0 (0-976,763) 15,025 [63,927]	0 (0-121,964) 294 [4,050]	<0.001
Physician visits	8 (0-154) 11.19 [12.13]	2 (0-90) 3.27 [5.26]	<0.001
Physician costs	624 (0-45,559) 1,088 [2,568]	113 (0-14,072) 257 [585]	<0.001
Laboratory claims	3 (0-110) 4.95 [6.87]	0 (0-13) 0.69 [1.27]	<0.001
Laboratory costs	268 (0-24,342) 677 [1,452]	0 (0-5,767) 37 [186]	<0.001
Pharmacy claims	15 (0-163) 18.64 [18.08]	1 (0-79) 3.16 [6.23]	<0.001
Pharmacy costs	1,184 (0-32,115) 2,207 [3,931]	3.92 (0-27,425) 169 [905]	<0.001
Emergency department visits	0 (0-12) 0.50 [1.11]	0 (0-6) 0.21 [0.60]	<0.001
Emergency department costs	0 (0-13,939) 283 [911]	0 (0-10,650) 89 [402]	<0.001
Other outpatient hospital visits	1 (0-69) 2.53 [6.48]	0 (0-59) 0.29 [1.77]	<0.001
Other outpatient hospital costs	107 (0-53,915) 1,413 [3,502]	0 (0-18,546) 103 [806]	<0.001
Total medical and facility visits[c]	10 (0-196) 14.79 [16.71]	2 (0-93) 3.79 [6.06]	<0.001
Total medical and facility costs[c]	6,214 (132-1,030,343) 23,113 [70,999]	256 (0-193,492) 1,162 [5,836]	<0.001

[a] *Costs are adjusted to 2005 dollars.*
[b] *The statistical tests were chi square with Yates correction for difference in % female and Wilcoxon signed-rank test for differences in the distributions of continuous variables (claims, visits, and costs) for the UC and comparator cohorts.*
[c] *Total cost and utilization include miscellaneous services other than the main categories listed, such as nursing home or substance abuse treatment costs. These costs accounted for $2,420 and $213 of the total all-cause costs for UC patients and non-UC members, respectively.*
CCI = Charlson Comorbidity Index; UC = ulcerative colitis.

laboratory procedures, and pharmacy claims) than did the other UC groups.

Discussion

The expected cost of care for patients with chronic diseases such as UC is critical to MCOs. This study demonstrated that all-cause resource utilization was highest in the older adult population; however, the pediatric-adolescent patients with UC incurred the highest mean annual total all-cause cost, which was approximately twice the mean total all-cause cost for the other age groups. These high costs in the pediatric-adolescent UC group were largely due to inpatient hospitalizations. Previous research indicated an increased risk of surgery in pediatric-adolescent patients with severe UC, although it is unclear if any of the hospitalizations or possible surgeries in the present study's pediatric-adolescent patients were due to their UC diagnosis.[32]

TABLE 4 Characteristics and 12-Month All-Cause Resource Utilization and Costs for Adult (Aged 18-64 Years) UC Patients Versus Age- and Gender-Matched Members Without UC[a]

Median (Range) Mean [SD]	UC N = 13,866	Non-UC N = 55,186	*P* Value[b]
Age—mean [SD]	44.25 [11.23]	44.46 [10.99]	<0.001
% females (number)	53.7 (7,440)	53.9 (29,770)	0.549
CCI score [SD]	1.25 [1.91]	0.39 [1.06]	<0.001
Inpatient hospitalizations	0 (0-15) 0.33 [0.88]	0 (0-9) 0.06 [0.30]	<0.001
Inpatient hospital costs	0 (0-828,630) 5,276 [26,170]	0 (0-1,480,805) 903 [10,024]	<0.001
Physician visits	7 (0-143) 10.68 [10.66]	2 (0-158) 4.85 [7.53]	<0.001
Physician costs	508 (0-82,746) 884 [1,629]	167 (0-101,181) 400 [1,101]	<0.001
Laboratory claims	3 (0-95) 4.12 [4.73]	1 (0-87) 1.56 [2.67]	<0.001
Laboratory costs	265 (0-18,718) 467 [730]	20 (0-55,445) 126 [444]	<0.001
Pharmacy claims	16 (0-331) 23.26 [26.01]	3 (0-352) 10.26 [17.39]	<0.001
Pharmacy costs	1,117 (0-2,762,952)[c] 2,469 [24,015]	68 (0-139,726) 601 [2,119]	<0.001
Emergency department visits	0 (0-27) 0.38 [1.14]	0 (0-66) 0.17 [0.72]	<0.001
Emergency department costs	0 (0-144,498) 264 [1,643]	0 (0-67,751) 98 [625]	<0.001
Other outpatient hospital visits	1 (0-95) 1.95 [3.94]	0 (0-116) 0.74 [2.44]	<0.001
Other outpatient hospital costs	143 (0-209,988) 1,276 [4,158]	0 (0-186,665) 405 [2,294]	<0.001
Total medical and facility visits[d]	9 (0-204) 13.34 [12.91]	3 (0-163) 5.82 [8.80]	<0.001
Total medical and facility costs[d]	5,108 (0-2,770,192) 12,693 [39,505]	755 (0-1,543,378) 3,147 [12,722]	<0.001

[a] *Costs are adjusted to 2005 dollars.*

[b] *The statistical tests were chi square with Yates correction for difference in % female and Wilcoxon signed-rank test for differences in the distributions of continuous variables (claims, visits, and costs) for the UC and comparator cohorts.*

[c] *One patient had a total pharmacy cost of $2,762,952 due to a large number of prescriptions from a specialty pharmacy. When this patient's pharmacy claims were excluded from the analysis, the following values were obtained for pharmacy costs for the UC cohort: median = $1,098, minimum = $0, maximum = $200,130, mean = $2,240; standard deviation = $5,118. Thus, inclusion of the outlier did not influence study results.*

[d] *Total cost and utilization include miscellaneous services other than the main categories listed, such as nursing home or substance abuse treatment costs. These costs accounted for $2,057 and $614 of the total all-cause costs for UC patients and non-UC members, respectively.*

CCI = Charlson Comorbidity Index; UC = ulcerative colitis.

Although the pediatric-adolescent cohort was the smallest cohort, the cost of long-term care for these patients will be significant. The average life expectancy of a person with UC is approximately 70 to 75 years,[11] so the total cost of care for pediatric or adolescent patients over the course of a patient's lifetime could be substantial.

Across all age groups, hospitalization accounted for the largest proportion of the mean annual total all-cause costs incurred by the UC cohort (43.6% overall, 65.0% for pediatric-adolescent patients, 41.6% for adult patients, and 50.1% for older adult patients). These results underscore the opportunity for future therapies to reduce the need for hospitalization and

TABLE 5 Characteristics and 12-Month All-Cause Resource Utilization and Costs for Older Adult (Aged ≥65 Years) UC Patients Versus Age- and Gender-Matched Members Without UC[a]

Median (Range) Mean [SD]	UC N = 650	Non-UC N = 2,100	*P* Value[b]
Age—mean [SD]	75.40 [6.98]	76.50 [7.18]	0.178
% females (number)	58.0 (377)	58.6 (1,230)	0.832
CCI score [SD]	2.87 [2.84]	1.44 [1.95]	<0.001
Inpatient hospitalizations	0 (0-8) 0.75 [1.27]	0 (0-6) 0.25 [0.65]	<0.001
Inpatient hospital costs	0 (0-138,032) 7,926 [17,868]	0 (0-209,903) 3,356 [13,553]	<0.001
Physician visits	12 (0-91) 14.74 [11.37]	6 (0-64) 7.96 [7.60]	<0.001
Physician costs	725 (0-15,756) 1,052 [1,292]	382 (0-26,115) 602 [957]	<0.001
Laboratory claims	4 (0-86) 5.98 [7.70]	2 (0-44) 3.18 [4.58]	<0.001
Laboratory costs	218 (0-16,922) 357 [799]	69 (0-5,084) 150 [271]	<0.001
Pharmacy claims	21 (0-201) 28.21 [28.59]	10 (0-158) 18.02 [22.53]	<0.001
Pharmacy costs	730 (0-75,116) 1,641 [4,143]	205 (0-35,711) 844 [2,156]	<0.001
Emergency department visits	0 (0-8) 0.48 [1.06]	0 (0-7) 0.23 [0.64]	<0.001
Emergency department costs	0 (0-8,694) 332 [1,005]	0 (0-10,580) 152 [615]	<0.001
Other outpatient hospital visits	1 (0-58) 3.33 [5.77]	0 (0-150) 1.82 [5.76]	<0.001
Other outpatient hospital costs	692 (0-112,877) 1,941 [5,428]	0 (0-64,246) 921 [3,202]	<0.001
Total medical and facility visits[c]	16 (0-114) 19.31 [14.57]	7 (0-184) 10.26 [11.47]	<0.001
Total medical and facility costs[c]	6,886 (100-165,685) 15,811 [23,882]	2,131 (0-245,169) 7,171 [17,060]	<0.001

[a] *Costs are adjusted to 2005 dollars.*

[b] *The statistical tests were chi square with Yates correction for difference in % female and Wilcoxon signed-rank test for differences in the distributions of continuous variables (claims, visits, and costs) for the UC and comparator cohorts.*

[c] *Total cost and utilization include miscellaneous services other than the main categories listed, such as nursing home or substance abuse treatment costs. These costs accounted for $2,562 and $1,146 of the total all-cause costs for UC patients and non-UC members, respectively.*

CCI = Charlson Comorbidity Index; UC = ulcerative colitis.

surgery and perhaps decrease the total health care costs for patients with UC.

To further assess the economic impact of UC on patients, studies that incorporate indirect costs, such as lost school and work days, lost earnings, and out-of-pocket expenditures, should be conducted. The direct impact of therapy options on health care costs for patients with UC should be examined to determine the cost-effectiveness of these options.

Limitations

Foremost among the study limitations was that we analyzed all-cause health care costs. The degree to which these costs are attributable to UC is unknown. Second, because this analysis was based on claims data, the contribution of UC to the CCI score and the cause of the comorbidities (UC or other) could not be determined. Third, the comparison group in the present study comprised members who may not have had any medical

TABLE 6 Comparison of All-Cause Resource Utilization and Costs for Pediatric-Adolescent, Adult, and Older Adult Patients With UC[a]

Mean [SD] (Median)	Pediatric-Adolescent (Aged <18 Years) N = 589	Adult (Aged 18-64 Years) N = 13,866	Older Adult (Aged ≥65 Years) N=650
Inpatient hospitalizations	0.58 [1.18] (0)	0.33 [0.88] (0)	0.75 [1.27] (0)
P value versus pediatric-adolescent[b]		<0.001	<0.001
P value versus adult[b]			<0.001
Inpatient hospital costs	15,025 [63,927] (0)	5,276 [26,170] (0)	7,926 [17,868] (0)
P value versus pediatric-adolescent		<0.001	<0.001
P value versus adult			<0.001
Physician visits	11.19 [12.13] (8)	10.68 [10.66] (7)	14.74 [11.37] (12)
P value versus pediatric-adolescent		0.005	<0.001
P value versus adult			<0.001
Physician costs	1,088 [2,568] (624)	884 [1,629] (508)	1,052 [1,292] (725)
P value versus pediatric-adolescent		<0.001	<0.001
P value versus adult			<0.001
Laboratory claims	4.95 [6.87] (3)	4.12 [4.73] (3)	5.98 [7.70] (4)
P value versus pediatric-adolescent		0.032	<0.001
P value versus adult			<0.001
Laboratory costs	677 [1,452] (268)	467 [730] (265)	357 [799] (218)
P value versus pediatric-adolescent		0.153	<0.001
P value versus adult			<0.001
Pharmacy claims	18.64 [18.08] (15)	23.26 [26.01] (16)	28.21 [28.59] (21)
P value versus pediatric-adolescent		0.014	<0.001
P value versus adult			<0.001
Pharmacy costs	2,207 [3,931] (1,184)	2,469 [24,015] (1,117)	1,641 [4,143] (730)
P value versus pediatric-adolescent		0.805	<0.001
P value versus adult			<0.001
Emergency department visits	0.50 [1.11] (0)	0.38 [1.14] (0)	0.48 [1.06] (0)
P value versus pediatric-adolescent		<0.001	0.008
P value versus adult			0.005
Emergency department costs	283 [911] (0)	264 [1,643] (0)	332 [1,005] (0)
P value versus pediatric-adolescent		<0.001	0.009
P value versus adult			0.005
Other outpatient hospital visits	2.53 [6.48] (1)	1.95 [3.94] (1)	3.33 [5.77] (1)
P value versus pediatric-adolescent		0.523	<0.001
P value versus adult			<0.001
Other outpatient hospital costs	1,413 [3,502] (107)	1,276 [4,158] (143)	1,941 [5,428] (692)
P value versus pediatric-adolescent		0.635	<0.001
P value versus adult			<0.001
Total medical and facility visits[c]	14.79 [16.71] (10)	13.34 [12.91] (9)	19.31 [14.57] (16)
P value versus pediatric-adolescent		0.001	<0.001
P value versus adult			<0.001
Total medical and facility costs[c]	23,113 [70,999] (6,214)	12,693 [39,505] (5,108)	15,811 [23,882] (6,886)
P value versus pediatric-adolescent		0.002	<0.001
P value versus adult			<0.001

[a] *Costs are adjusted to 2005 dollars.*
[b] *P values determined using Mann-Whitney U test.*
[c] *Total cost and utilization include miscellaneous services other than the main categories listed, such as nursing home or substance abuse treatment costs.*
UC = ulcerative colitis.

claims; in other words, the comparison group comprised health plan members without medical claims as well as patients with medical claims.

Fourth, previous research has shown that UC is an episodic disease with long periods of remission in some patients: 5% to 17% of patients in clinical trials experience spontaneous remission.[33] Therefore, our examination of total health care costs for only 12 months following diagnosis of UC may not predict longer-term costs, and studies beyond 12 months are needed. Fifth, the cost analysis was based on the amount paid and, therefore, excludes member costs and indirect costs. Sixth, the PharMetrics database is considered representative of the commercially insured population in the United States but may not be representative of Medicare and Medicaid patients, the uninsured, or populations outside the United States. Although this analysis controlled for the effects of age and comorbidities, regional differences in health care costs or the differences in amounts paid according to health plan type were not analyzed.

Conclusion

All-cause health care costs for patients with 2 or more claims with a diagnosis of UC were more than 4 times that of a comparator group of members without UC. Total all-cause costs were highest in the pediatric-adolescent UC group, while resource utilization as measured by visits and claims was greatest in the older adult UC groups.

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DISCLOSURES

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