



Research Article

Trends in Hospitalization Rates for Ulcerative Colitis and Crohn's Disease in Spain between 1997 and 2012 - An Observational Study

Ruth Gil-Prieto^{1*}, Carlos Taxonera², Jesus San Roman-Montero³, Raquel Pascual-García¹, Javier Castrodeza-Sanz⁴ and Angel Gil-de-Miguel¹

¹Area of Preventive Medicine and Public Health, Rey Juan Carlos University, Madrid, Spain

²Inflammatory Bowel Disease Unit, Department of Gastroenterology, Hospital Clínico San Carlos and Instituto de Investigación del Hospital Clínico San Carlos (IdISSC), Madrid, Spain

³Area of Medicine, Rey Juan Carlos University, Madrid, Spain

⁴Preventive Medicine and Public Health Department, Valladolid University, Madrid, Spain

Abstract

The inflammatory bowel disease is a highly prevalent disorder in Spain. Incident cases have been increasing during the last decades. In this study we sought to determine rates and temporal patterns of hospitalizations related both to ulcerative colitis and Crohn's disease in a 16-year period in Spain. All hospital discharges related to ulcerative colitis and Crohn's disease among general population reported to the national information system for hospital data during a 16-year period (January 1, 1997 through December 31, 2012) were obtained. Most frequent co-morbidities, diagnostic procedures and surgeries were also reported. A total of 26,948 hospital discharges due to ulcerative colitis and 87,752 due to Crohn's disease were reported in the 16 years study period in Spain. Mean age was 45.3 (SD = 20.5) and 38.0 (SD = 17.3) years, respectively. There were a total of 392 deaths among ulcerative colitis hospitalized patients and 565 among Crohn's disease patients.

*Corresponding author: Ruth Gil-Prieto, Area of Preventive Medicine and Public Health, Rey Juan Carlos University, Madrid, Spain, Tel: + 34 914888625; E-mail: Ruth.gil@urjc.es

Citation: Gil-Prieto R, Taxonera C, Roman-Montero JS, Pascual-García R, Castrodeza-Sanz J, et al. (2017) Trends in Hospitalization Rates for Ulcerative Colitis and Crohn's Disease in Spain between 1997 and 2012 - An Observational Study. J Gastroenterol Hepatology Res 2: 009.

Received: September 06, 2017; **Accepted:** October 14, 2017; **Published:** November 03, 2017

The annual hospitalization rate was 3.94 (CI 95% 3.90 - 3.99) per 100,000 population for ulcerative colitis and 12.84 (CI 95%:12.76 - 12.93) per 100,000 population for Crohn's disease. The hospitalization rate significantly increased during the study period in the Crohn's disease group, but remained constant in the ulcerative colitis group. While hospitalization rate in ulcerative colitis constantly increased with age, it peaked for Crohn's disease in young adults. The hospitalization rate for Crohn's disease has significantly increased within a 16-year period in Spain, remaining the hospitalization rate stable for ulcerative colitis. The reported trends in hospitalizations for Crohn's disease describe an important burden on health and economic cost to the Spanish health system.

Keywords: Crohn's disease; Epidemiology; Hospitalizations; Inflammatory bowel disease; Spain; Ulcerative colitis

Introduction

The Inflammatory Bowel Disease (IBD), comprised of Ulcerative Colitis (UC) and Crohn's Disease (CD), are idiopathic immune mediated disorders that affect an increasing number of population. The average incidence in Western Europe is estimated to be 10 per 100 000 but the overall incidence varies considerably throughout the world [1]. In the US, the incidence of IBD is rising since the 1940 with an estimated prevalence of 1 million people [2-6]. IBD is a highly prevalent disorder in Spain, with a prevalence in adults of 99.84 per 100 000 inhabitants for ulcerative colitis and 137.17 per 100 000 inhabitants for Crohn's disease [7]. Incident cases have been increasing during the last decades as seen in several studies including a review of prospective and population based Spanish studies over time. [8-10]. With an average annual incidence rate during the period 2000 - 2012 of 5.6 per 100 000 and 8.9 per 100 000 for ulcerative colitis and Crohn's disease, respectively [7]. Spain is reaching figures similar to those from Northern European countries.

The presentations of IBDs may vary from a single attack to chronic disabling symptoms, is often characterized by frequent hospitalizations due to relapses that might require bowel surgery, and reduce quality of life [11,12]. Whether or not the disease carries a higher mortality risk has not been fully established; some studies have shown lower and others higher mortality than background populations [13,14]. In addition, there may be subgroups of patients at risk of death from disease related conditions [15].

The use of Tumor Necrosis Factor (TNF) antagonist for IBD is associated with a reduction in the rates of hospitalizations and surgical procedures for ulcerative colitis [16-18] and Crohn's disease [19-21].

Although the impact of anti-TNF therapy on hospitalization and surgery rates have not been demonstrated at a national level in Spain, two observational studies found a reduction in the need for hospitalizations and for surgery in clinical practice [22,23]. A Canadian study showed that nationwide hospitalization rates had modestly decreased for Crohn's disease and remained stable for ulcerative colitis between 1994 and 2001 [24]. An increase in temporal hospitalizations and surgery rates can be partly explained by nationwide increases in prevalence of both Crohn's disease and ulcerative colitis, but it remains

unclear whether this tendency could be balanced by the use of more effective biologic therapies.

In this study we sought to determine rates and temporal patterns of hospitalizations related both to ulcerative colitis and Crohn's disease in a 16-year period in Spain. Our secondary goal was to characterize temporal patterns in surgical utilization, length of stay and economic burden of IBD for the same time period. Hospital data cannot, of course, be used to estimate the prevalence of IBD. Nonetheless, hospital discharge data are a means of identifying and quantifying those patients who require substantial health care resources. With information from Spanish Hospital Discharged Database, this article tracks hospitalizations for IBD at the national level.

Materials and Methods

A retrospective study using the national information system for hospital data (Conjunto *Mínimo Básico* de Datos (CMBD)) from the Ministry of Health was performed. This system uses clinical codes from the Spanish version of the 9th International Classification of Diseases (ICD-9-MC) and includes an estimated 98% of admissions in public hospitals and 99.5% of the Spanish population [25].

All hospital discharges related to ulcerative colitis and Crohn's disease among general population reported during a 16-year period (January 1, 1997 through December 31, 2012) were obtained (Table 1). Selected ICD 9 CM codes were: 555.0: regional enteritis of small intestine, 555.1: regional enteritis of large intestine, 555.2: regional enteritis of small intestine with large intestine, 555.9: regional enteritis of unspecified site and 556.9: ulcerative colitis unspecified, Two different groups were analyzed:

ICD-9-CM Code	N	% (over the total number of hospitalizations)	
45.72	Open and other cecectomy	3514	4
45.62	Other partial resection of small intestine	3456	3.94
45.93	Other small-to-large intestinal anastomosis	3377	3.85
45.73	Open and other right hemicolectomy	2459	2.8
45.79	Other and unspecified partial excision of large intestine	1118	1.27
46.2	Ileostomy, nototherwisespecified	1056	1.2
45.91	Small-to-small intestinal anastomosis	568	0.65
49.01	Incision of perianal abscess	531	0.61
46.1	Colostomy, nototherwisespecified	445	0.51
45.76	Open and othersigmoidectomy	419	0.48
45.94	Large-to-large intestinal anastomosis	309	0.35
49.12	Anal fistulectomy	216	0.25
49.11	Anal fistulotomy	164	0.19

Table 1: Most frequent surgical procedures for ulcerative colitis and Crohn's disease hospitalizations in Spain (1997-2012).

Group 1: Ulcerative colitis, defined as ICD 9 CM code 556.9 in primary diagnosis position or 558.9 in any diagnosis position plus 556.9 in any diagnosis position.

Group 2: Crohn's disease, defined as ICD 9 CM code 555.0, 555.1, 555.2 or 555.9 in primary diagnosis position or 558.9 in any diagnosis position plus 555.0, 555.1, 555.2 or 555.9 in any diagnosis position.

For each case, specific data were gathered on age, sex and region. Groups of age for study were: < 12, (12-18), (19-34), (35-54) and > 54

years old. Most frequent co-morbidities, diagnostic procedures and surgeries were also reported.

Statistical methods

The average number of hospitalizations, the Average Length Of Stay in the hospital (ALOS) and the average cost (euros) of hospital stay were calculated. ANOVA and Kruskal-Wallis tests were used for multiple comparisons by year and group of age. The annual hospitalization rate (per 100,000 inhabitants), Average Length Of Stay in the hospital (ALOS), mortality rate (per 100,000 inhabitants) and case-fatality rate (%) were calculated together with 95% confidence intervals. Data from the municipal records corrected by the CMBD National coverage were used as denominator. The distribution by age of the population covered in this study is considered to be equal to the general population.

Binomial regression (Generalized Linear Regression (GLM) with a log link and binomial distribution for the error) was used to assess differences in the rates of hospitalization (per 100,000 inhabitants) and mortality rate (per 100,000 inhabitants) by year, group of age, gender and region. Differences in proportions of case-fatality rate (%) were assessed by the Chi-square test.

The costs of these hospitalizations to the health care systems are estimation from the Ministry of Health. The cost was calculated by considering the diagnostic cost group, the total cost and the number of discharges. Diagnostic cost group was based on the Diagnosis Related Group (DRG) for hospitalized patient depending on discharge ICD classification, age, sex and resources consumption. Each group has similar weight in hospital costs and can be apply to each related patient. DRG's calculations are made by 3M with Core Grouping System Software [26].

In all tests the significance level used was $p < 0.05$. Statistical analyses were performed using SAS University Edition and R Studio version 3.0.3.

The present study received a waiver for informed consent from the local ethics committee (Comité de Ética de la Investigación de la Universidad Rey Juan Carlos). The patient information was anonymized and de-identified prior to the analysis.

Results

A total of 114,700 hospital discharges due to ulcerative colitis or Crohn's disease were reported in the 16 years study period in Spain. Of those, 26,948 (23.5%) were coded as ulcerative colitis and 87,752 (76.5%) as Crohn's disease. Mean age was 45.3 (SD = 20.5) and 38.0 (SD = 17.3) years, respectively and 55% and 50% were female, respectively. There were a total of 957 deaths among these hospitalized patients during the study period, 392 (mean age 72 years) in ulcerative colitis and 565 (mean age 66 years) in Crohn's disease.

Trends in hospitalization rates

The annual hospitalization rate was 3.94 (CI 95% 3.90 - 3.99) per 100,000 population for ulcerative colitis and 12.84 (CI 95%:12.76 - 12.93) per 100,000 population for Crohn's disease. The hospitalization rate significantly increased during the study period in the Crohn's disease group ($p < 0.001$), but remained constant in the ulcerative colitis group, were variations were not significant ($p = 0.183$) (Figure 1).

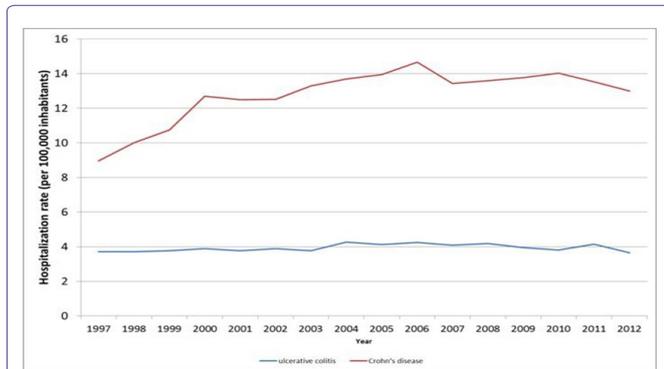


Figure 1: Hospitalization rate (per 100 000 inhabitants) related to ulcerative colitis and Crohn's disease in Spain (1997-2012).

Table 2 shows the hospitalization rate for Crohn's disease and ulcerative colitis by group of age. While hospitalization rate in ulcerative colitis constantly increased with age ($p < 0.001$), for Crohn's disease the hospitalization rate peaked in young adults (19 - 34 years old).

Mortality and case-fatality rates

The mortality rate was 0.057 (CI 95% 0.052 - 0.063) per 100,000 population for ulcerative colitis and 0.083 (CI 95%:0.076 - 0.090) per 100,000 population for Crohn's disease. The mortality rate significantly increased during the study period in the Crohn's disease group ($p = 0.023$) but remained stable ($p = 0.218$) for the ulcerative colitis group. There was also a significant increase of mortality rate in both groups by age ($p < 0.001$) (Table 2).

The case-fatality rate was 1.46% (CI 95% 1.31 - 1.16) for ulcerative colitis and 0.64% (CI 95% 0.59 - 0.70) for Crohn's disease. The case-fatality rate significantly increased during the study period in the Crohn's disease group ($p = 0.003$), but did not vary ($p = 0.802$) for the ulcerative colitis group. Case-fatality rate dramatically increased by group of age for both groups, reaching in patients aged 55 and older 3.88% (CI 95% 3.482 - 4.279) for ulcerative colitis and 2.82% (CI 95% 2.56 - 3.08) for Crohn's disease.

Length of stay and cost of hospitalization

The Average Length Of Stay at the hospital (ALOS) was significantly higher ($p < 0.001$) in those patients with ulcerative colitis (12.59 days; SD = 13.18) than in those with Crohn's disease (11.37 days; SD = 12.32; $p < 0.001$). The ALOS significantly decreased during the study period ($p < 0.001$) and increased with age ($p < 0.001$) in both groups. Hospitalization costs were higher for Crohn's disease

related hospitalizations (€4442; SD = €3708) than for ulcerative colitis (€3930; SD = €3054). Costs were significantly higher in older patients in both groups.

Comorbidities

Most frequent comorbidities in Crohn's disease group were: iron deficiency 7.4%, diabetes mellitus 3.2%, cholelithiasis and cholecystitis 2.3%, osteoporosis 1.6%, perianal abscess 1.5%, constipation 1.5% and hypercholesterolemia 1%. Most frequent comorbidities in ulcerative colitis group were: iron deficiency 8.8%, diabetes mellitus 6.5%, hypercholesterolemia 2.3%, osteoporosis 1.9%, cholelithiasis and cholecystitis 1.5% and constipation 1.3%.

Procedures

Among all the 87,752 hospitals discharged related to Crohn's disease recorded in this study, 33% had at least a diagnostic procedure, mainly gastroscopy and colonoscopy with or without biopsy. This figure reaches the 51% in hospital discharges related to ulcerative colitis. When looking for surgical procedures, 12,417 (14%) of the patients hospitalized with Crohn's disease had at least one surgical procedure during the hospital stay, compared with 1,871 (7%) of the patients hospitalized with ulcerative colitis. Abdominal surgery was more frequent in Crohn's disease. The most frequent surgery for Crohn's disease were cecectomy, partial resection of small intestine, small-to-large intestinal anastomosis and right hemicolectomy. On the other hand, colectomy was more frequent in ulcerative colitis. Other common surgeries for Crohn's disease patients were ileostomy and perianal surgery.

Discussion

The results presented in this study are the first tracking hospitalizations for IBD on a national level in Spain and can contribute to evaluate the real burden of IBD. They showed an increase in hospitalizations for Crohn's disease and a stable trend for ulcerative colitis during the 16 years study period between 1997 and 2012. Previous data published in Spain show an incidence rate of 3.8 per 100,000 inhabitants and year for ulcerative colitis and 1.9 per 100,000 inhabitants and year for Crohn's disease in the late 1990s, with important regional variations and an increasing temporal trend, especially for Crohn's disease [8,27]. This increase for Crohn's disease has also been observed in other western countries [28].

Meanwhile ulcerative colitis related hospitalization rate increase continuously with age, Crohn's disease highest hospitalization rate occurs in very young adults. This age pattern is in line with data published in IBD patients in Wales [29]. While previous studies showed

	Hospitalization rate (/100,000)				Mortality rate (/100,000)				Case-fatality rate (%)			
	Ulcerative colitis		Crohn's disease		Ulcerative colitis		Crohn's disease		Ulcerative colitis		Crohn's disease	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
< 12 years	1.03	0.96-1.10	1.97	1.87-2.07	0.001	0.00-0.004	0.003	0.00-0.006	0.124	-0.485	0.129	0.000-0.308
12 years - 18 years	2.83	2.69-2.98	12.36	12.05-12.66	0.002	0.00-0.006	0.004	0.00-0.009	0.068	-0.269	0.031	0.000-0.075
19 years - 34 years	4.29	4.19-4.39	21.19	20.97-21.41	0.005	0.001-0.008	0.018	0.011-0.024	0.11	0.034-0.186	0.084	0.054-0.113
35 years - 54 years	4.5	4.40-4.59	15.45	15.27-15.62	0.017	0.011-0.023	0.056	0.046-0.067	0.381	0.250-0.513	0.364	0.295-0.434
>54 years	4.85	4.75-4.95	8.12	7.99-8.25	0.188	0.168-0.208	0.229	0.207-0.251	3.88	3.482-4.279	2.82	2.556-3.084
TOTAL	3.94	3.90-3.99	12.84	12.76-12.93	0.057	0.052-0.063	0.083	0.076-0.090	1.455	1.312-1.598	0.644	0.591-0.697

Table 2: Hospitalization rate (per 100.000 inhabitants), mortality rate (per 100.000 inhabitants) and case-fatality rate (%) related to ulcerative colitis and Crohn's disease in Spain (1997 - 2012) by group of age.

that women were considerably more likely than men to be hospitalized for Crohn's disease, we did not find differences in gender distribution of hospital admissions for Crohn's disease [29,30]. On the contrary, for ulcerative colitis, our results showed that men were more likely than women to be hospitalized something that was not reported in previous published data [29]. Mortality rate, calculated with a population denominator, was higher for Crohn's disease patients than for ulcerative colitis patients, according to the higher hospitalization rate. On the other hand case-fatality rate was higher in ulcerative colitis patients, showing the higher severity of the ulcerative colitis flares. A potential explanation for these differences found in case-fatality rate could be the 7 year higher mean age of the patients with ulcerative colitis.

As shown in previous publications, older patients with IBD-related hospitalizations have substantial morbidity and higher mortality than younger patients [31]. Our study also showed increasing mortality and case-fatality rate with age, which is consistent with a previous European study [29]. Surprisingly, despite population ageing, no rise in neither mortality, nor case-fatality rates was found in our study during the analyzed period, again in line with previous data in Europe [32].

In Crohn's disease absolute indications for surgery include stenosing and penetrating disease not responsive to medical therapy, complex perianal disease, high grade dysplasia and cancer [33]. Ulcerative colitis surgery is limited to colectomy for not responsive severe disease, high grade dysplasia and cancer. In line with other studies our data showed that the likelihood of surgery during hospital admission was higher in ulcerative colitis patients [28].

Therapy with TNF antagonist has been associated with a significant reduction in the rates of hospitalizations and surgery for ulcerative colitis and Crohn's disease [16-18]. However, the results of our study did not show a significant reduction in the hospitalization rate during the study period in Spain. The two TNF antagonist marketed in Spain, infliximab and adalimumab, were approved for the use in Crohn's disease in 1999 and 2007, respectively and for ulcerative colitis in 2006 and 2013, respectively. The prescription of both drugs was initially limited and progressively raised over time, making it difficult to determine its true impact. In our study the rate of hospital admissions for Crohn's disease peaked in 2006 and slightly decreased thereafter until 2012.

Taking into account the increasing prevalence of Crohn's disease in Spain it seems plausible that anti-TNF therapy is contributing to stabilize the hospitalization rate for Crohn's disease after 2006 in Spain. IBD related hospitalizations pose an important economic cost to the Spanish health system, as seen in other Western countries, like the US [28].

Strengths and Limitations

The main strength of this study is the representativeness of the CMBD hospital discharge dataset. However, use of administrative data in general has several limitations. The CMBD does not contain any personal identifiers that would allow validation of diagnostic coding with a subset of medical records. Results from different Canadian studies have demonstrated the accuracy of administrative IBD coding for research purposes [34,35]. Although this has yet to be validated in Spain for IBD, several population base studies using the CMBD data base have been performed [36-38]. The CMBD includes only patients

who were admitted to hospital. Those treated in hospital but not admitted for an overnight stay are excluded, as are people treated on an outpatient basis, or primary care. Consequently, this article underestimates the true burden of inflammatory bowel disease, as it reflects only the more acute and severely symptomatic cases. Another limitation of the study is that the unit of observation is a hospitalization and not a unique patient. Therefore, we cannot distinguish whether rising trends in hospitalizations are due to increases in the number of patients who are hospitalized, readmissions, or both. It has to be taken into account that we only considered direct healthcare costs. The indirect costs related, essentially, to the patient's loss of productivity, were not included.

In conclusion, we have shown by using nationwide hospital discharge data that the hospitalization rate for Crohn's disease has significantly increased within a 16-year period in Spain, remaining the hospitalization rate stable for ulcerative colitis. It remains unclear whether the increase in IBD hospitalizations can be attributed to an increase in the prevalence of IBD. If that was the case, prevention research must focus on identifying modifiable environmental and life style factors and design strategies to identify individuals at risk of hospitalization due to the underlying disease process. Our findings reinforce the need for effective treatment strategies to reduce IBD complications.

Acknowledgments

Thanks to the *Subdirección* General del Instituto de *Información* Sanitaria for providing the information upon which this study is based.

Funding

The cathedra "Evaluación de Result adosen Salud. Rey Juan Carlos University" is sponsored by Abbvie.

References

1. Russel MG (2000) Changes in the incidence of inflammatory bowel disease: what does it mean? *Eur J Intern Med* 11: 191-196.
2. Loftus EV (2004) Clinical epidemiology of inflammatory bowel disease: incidence, prevalence, and environmental influences. *Gastroenterology* 126: 1504-1517.
3. Loftus EV, Silverstein MD, Sandborn WJ, Tremaine WJ, Harmsen WS, et al. (2000) Ulcerative colitis in Olmsted County, Minnesota, 1940-1993: incidence, prevalence, and survival. *Gut* 46: 336-343.
4. Loftus EV, Silverstein MD, Sandborn WJ, Tremaine WJ, Harmsen WS, et al. (1998) Crohn's disease in Olmsted County, Minnesota, 1940-1993: incidence, prevalence, and survival. *Gastroenterology* 114: 1161-1168.
5. Loftus CG, Loftus EV, Harmsen WS, Zinsmeister AR, Tremaine WJ, et al. (2006) Update on the incidence and prevalence of Crohn's disease and ulcerative colitis in Olmsted County, Minnesota, 1940-2000. *Inflamm Bowel Dis* 13: 254-261.
6. Ingle SB, Loftus EV, Tremaine WJ (2007) Increasing incidence and prevalence of inflammatory bowel disease in Olmsted County, Minnesota, during 2001-2004. *Gastroenterology* 132: 37-38.
7. Lucendo AJ, Hervías D, Roncero Ó, Lorente R, Bouhmidí A, et al. (2014) Epidemiology and temporal trends (2000-2012) of inflammatory bowel disease in adult patients in a central region of Spain. *Eur J Gastroenterol Hepatol* 26: 1399-1407.

8. Gismera CS, Aladrén BS (2008) Inflammatory bowel diseases: a disease (s) of modern times? Is incidence Still increasing? *World J Gastroenterol* 14: 5491-5498.
9. López-Serrano P, Pérez-Calle JL, Carrera-Alonso E, Pérez-Fernández T, Rodríguez-Caravaca G, et al. (2009) Epidemiologic study on the current incidence of inflammatory bowel disease in Madrid. *Rev Esp Enferm Dig* 101: 768-772.
10. Arin Letamendia A, Borda Celaya F, Burusco Paternain MJ, Prieto Martínez C, Martínez Echeverría A, et al. (2008) [High incidence rates of inflammatory bowel disease in Navarra (Spain). Results of a prospective, population-based study]. *Gastroenterol Hepatol* 31: 111-116.
11. Bernklev T, Jahnsen J, Aadland E, Sauar J, Schulz T, et al. (2004) Health-related quality of life in patients with inflammatory bowel disease five years after the initial diagnosis. *Scand J Gastroenterol* 39: 365-373.
12. Langholz E, Munkholm P, Davidsen M, Binder V (1994) Course of ulcerative colitis: analysis of changes in disease activity over years. *Gastroenterology* 107: 3-11.
13. Persson PG, Bernell O, Leijonmarck CE, Farahmand BY, Hellers G, et al. (1996) Survival and cause-specific mortality in inflammatory bowel disease: a population-based cohort study. *Gastroenterology* 110: 1339-1345.
14. Palli D, Trallori G, Saieva C, O Tarantino, E Edili, et al. (1998) General and cancer specific mortality of a population based cohort of patients with inflammatory bowel disease: the Florence Study. *Gut* 42: 175-179.
15. Winther KV, Jess T, Langholz E, Munkholm P, Binder V, et al. (2003) Survival and cause-specific mortality in ulcerative colitis: follow-up of a population-based cohort in Copenhagen County. *Gastroenterology* 125: 1576-1582.
16. Feagan BG, Sandborn WJ, Lazar A, Thakkar RB, Huang B, et al. (2014) Adalimumab therapy is associated with reduced risk of hospitalization in patients with ulcerative colitis. *Gastroenterology* 146: 110-118.
17. Lopez A, Ford AC, Colombel JF, Reinisch W, Sandborn WJ, et al. (2015) Efficacy of tumour necrosis factor antagonists on remission, colectomy and hospitalisations in ulcerative colitis: Meta-analysis of placebo-controlled trials. *Dig Liver Dis* 47: 356-364.
18. Costa J, Magro F, Caldeira D, Alarcão J, Sousa R, et al. (2013) Infliximab reduces hospitalizations and surgery interventions in patients with inflammatory bowel disease: a systematic review and meta-analysis. *Inflamm Bowel Dis* 19: 2098-2110.
19. Rubenstein JH, Chong RY, Cohen RD (2002) Infliximab decreases resource use among patients with Crohn's disease. *J Clin Gastroenterol* 35: 151-156
20. Lichtenstein GR, Yan S, Bala M, Hanauer S (2004) Remission in patients with Crohn's disease is associated with improvement in employment and quality of life and a decrease in hospitalizations and surgeries. *Am J Gastroenterol* 99: 91-96.
21. Jewell DP, Satsangi J, Lobo A, Probert C, Forbes A, et al. (2005) Infliximab use in Crohn's disease: impact on health care resources in the UK. *Eur J Gastroenterol Hepatol* 17: 1047-1052.
22. Taxonera C, Rodrigo L, Casellas F, Calvet X, Gómez-Camacho F, et al. (2009) Infliximab maintenance therapy is associated with decreases in direct resource use in patients with luminal or fistulizing Crohn's disease. *J Clin Gastroenterol* 43: 950-956.
23. Saro C, da la Coba C, Casado MA, Morales JM, Otero B (2007) Resource use in patients with Crohn's disease treated with infliximab. *Aliment Pharmacol Ther* 26: 1313-1323.
24. Bernstein CN, Nabalamba A (2006) Hospitalization, surgery, and readmission rates of IBD in Canada: a population-based study. *Am J Gastroenterol* 101: 110-118.
25. Ministerio de Sanidad (2015) Servicios Sociales e Igualdad. Sistema de Información Sanitaria. Registro de Actividad de Atención Especializada. RAE-CMBD Spain; Ministerio de Sanidad y Consumo (2016) Análisis y desarrollo de los GDR en el Sistema Nacional de Salud. Agustín Rivero Spain.
26. Schreyögg J, Stargardt T, Tiemann O, Busse R (2006) Methods to determine reimbursement rates for diagnosis related groups (DRG): a comparison of nine European countries. *Health Care Manag Sci* 9: 215-223.
27. Pajares JM, Gisbert JP (2001) Epidemiology of inflammatory bowel disease in Spain. A systematic review. *Rev Esp Enferm Dig* 93: 9-20.
28. Nguyen GC, Tuskey A, Dassopoulos T, Harris ML, Brant SR (2007) Rising hospitalization rates for inflammatory bowel disease in the United States between 1998 and 2004. *Inflamm Bowel Dis* 13: 1529-1535.
29. Button LA, Roberts SE, Goldacre MJ, Akbari A, Rodgers SE, et al (2010) Hospitalized prevalence and 5-year mortality for IBD: record linkage study. *World J Gastroenterol* 16: 431-438.
30. Nabalamba A, Seko C, Bernstein CN (2004) Inflammatory bowel disease-hospitalization. *Health reports* 15: 25.
31. Ananthakrishnan AN, McGinley EL, Binion DG (2009) Inflammatory bowel disease in the elderly is associated with worse outcomes: a national study of hospitalizations. *Inflamm Bowel Dis* 15: 182-189.
32. Höie O, Schouten LJ, Wolters FL, Solberg IC, Riis L (2007) Ulcerative colitis: no rise in mortality in a European-wide population based cohort 10 years after diagnosis. *Gut* 56: 497-503.
33. Larson DW, Pemberton JH. (2004) Current concepts and controversies in surgery for IBD. *Gastroenterology* 126: 1611-1619.
34. Farrokhvar F, McHugh K, Irvine EJ (2002) Self-reported awareness and use of the International Classification of Diseases coding of inflammatory bowel disease services by Ontario physicians. *Can J Gastroenterol* 16: 519-526.
35. Bernstein CN, Blanchard JF, Rawsthorne P, Wajda A (1999) Epidemiology of Crohn's disease and ulcerative colitis in a central Canadian province: a population-based study. *Am J Epidemiol* 149: 916-924.
36. Walter S, Beltrán-Sánchez H, Regidor E, Gomez-Martin C, Del-Barrio JL, et al. (2016) No evidence of morbidity compression in Spain: a time series study based on national hospitalization records. *Int J Public Health* 61: 729-738.
37. Gil-Prieto R, Pascual-García R, San-Roman-Montero J, Martínez-Martin P, Castrodeza-Sanz J, et al. (2016) Measuring the Burden of Hospitalization in Patients with Parkinson's Disease in Spain. *PLoS One* 11: 0151563.
38. Gil-Prieto R, Gonzalez-Escalada A, Marín-García P, Gallardo-Pino C, Gilde-Miguel A (2015) Respiratory Syncytial Virus Bronchiolitis in Children up to 5 Years of Age in Spain: Epidemiology and Comorbidities: An Observational Study. *Medicine (Baltimore)* 94: 831.