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TIME-trend and forecasting of the economic impact of inflammatory bowel disease in Catalonia: a population-based analysis

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ABSTRACT

Introduction: Few studies have assessed the distribution and temporal trends of healthcare expenditures related to inflammatory bowel disease (IBD). The aims of the study were to analyze the expenditure trends for IBD patients in Catalonia from 2011 to 2024, to identify key cost drivers, and to forecast future costs through 2036.

Methods: All patients with a diagnosis of IBD included in the Catalan Health Surveillance System (CHSS) were eligible. CHSS compiles prospective data from public healthcare coverage of 8 million people in 2024. Healthcare utilization was analyzed, and expenditures were calculated using standard costs defined by the Catalan Department of Health. All expenditures were adjusted to 2024 euros using the Consumer Price Index to enable comparisons across years. Costs were estimated for IBD overall, Crohn's disease (CD) and ulcerative colitis (UC). An autoregressive integrated moving average model was used to forecast total costs up to 2036.

Results: IBD-related healthcare expenditure tripled from €67.4 M in 2011 to €201.6 M in 2024, while per-patient costs rose from €3,981 to €4,753. Biologic therapies were the main cost driver, especially in CD. Mean per-patient biologic costs decreased by 16.6% in CD but increased by 44.5% in UC. CD patients consistently incurred higher per capita costs. Forecasts indicate continued growth in total expenditure, reaching €319.0 M by 2036.

Conclusion: Overall, IBD-related healthcare expenditures in Catalonia markedly increased from 2011 to 2024, driven mainly by the increase in IBD prevalence. Per-patient cost moderately increased. Per-patient cost containment was observed in pharmaceutical costs, probably due to a strict policy favoring the use of biosimilars. These findings may be of help for designing future healthcare policies.

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Introduction

Inflammatory bowel disease (IBD) encompasses two chronic intestinal disorders: Crohn's disease (CD) and ulcerative colitis (UC)[1]. IBD affects millions of people worldwide and presents a variable clinical

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course, alternating periods of remission and flares[2,3]. Therapeutic approaches to IBD have changed over the last decades. At present, relatively expensive biological treatments such as anti-tumor necrosis factor (anti-TNF), anti-interleukin-23 and anti-integrin agents, and small molecules, including Janus kinase inhibitors and sphingosine-1 phosphate modulators, are the treatment of choice for many clinical situations, but they come with significant costs for healthcare expenditures[4,5]. These new drugs have positively influenced IBD management by increasing remission rates and reducing the need for hospitalization and surgery. However, there is still room for improvement in disease control and management: some series have reported annual hospitalization rates in the 5–20% range, and that 50% of IBD patients may require surgery within 10 years of diagnosis[6–9].

Previous data on cost distribution and evolution were heterogeneous. Park et al. quantified health care costs arising from care for IBD patients in the US between 2007 and 2016 and reported the annual cost to be over three times higher than that for matched non-IBD patients ($22,987 vs. $6,956)[10]. Overall costs of IBD care rose particularly after 2013, with hospitalization (40%), emergency room visits (18%) and pharmaceuticals (12%) being the major drivers[10]. Conversely, in Canada Targownik et al. followed IBD patients from 2005 to 2015, concluding that direct per-patient health costs attributable to IBD had more than doubled in 10 years (from $3,354 in 2005 to $7,801 in 2015), driven mostly by increasing expenditure on biological medications[11].

In the Netherlands, the COIN study found that healthcare costs for IBD in 2012 were mainly driven by pharmacological treatments. Anti-TNF therapy was the most important expense, while hospitalization and surgery accounted for only a small proportion of costs[12]. In addition, a cohort of patients newly diagnosed with IBD between 2010 and 2011 at the same institutions were followed for two years. The study concluded that although IBD-related costs remained stable during follow-up, the proportion of anti-TNF-related costs increased, whereas hospitalization costs decreased[13].

In 2011, the Catalan Health Service (CatSalut) created the Catalan Health Surveillance System (CHSS) database, a population-based health register covering the entire population of Catalonia, which in 2024 exceeded 8 million inhabitants (41,442 with IBD). Previous studies by our group using the CHSS database have reported a high prevalence and incidence of IBD[14]. A progressive decrease of hospitalization rates was observed for CD; this finding negatively correlated with the rates of biologic therapy use[15]. We also observed that the cost of care for IBD patients was more than three times higher than for the non-IBD population[16].

The aim of this study was to analyze the time trends in expenditures on patients with IBD in Catalonia between 2011 and 2024. Secondary objectives were to describe the main cost drivers for IBD patients and how they change over time, and to forecast expected expenditures on IBD in upcoming years.

Material and methods

Data source context

In Spain, a universal public healthcare system provides comprehensive medical coverage, including free access to specialist care and to publicly funded medications, with specific dispensing and co-payment conditions depending on the type of treatment. The system is decentralized, so budget management and organization are in the remit of the 17 regional governments in Spain.

The CHSS, created by the Catalan regional government in 2011, is a comprehensive healthcare information system that integrates data on healthcare utilization at the individual user level. The CHSS integrates information from all public healthcare providers in Catalonia (including primary health care (PHC), acute and intermediate care hospitals, outpatient clinics, mental health centers and emergency services) and uses automated validation systems and regular external audits to ensure consistency and accuracy[17–19]. Diagnoses are recorded following a Minimum Basic Data Set aligned with ICD-CM codes and encompass data on outpatient visits, hospital admissions, pharmaceutical prescriptions, mental health care, ambulatory rehabilitation, and other healthcare services, as well as invoicing information on services. The system provides a holistic and transversal view of health problems by consolidating data from

the entire public health system. At present, the CHSS holds population-based data covering over 8 million residents in Catalonia.

Data from private healthcare providers are not captured, however. As the Catalan Health System provides universal healthcare public coverage to all residents in Catalonia, most IBD patients are managed in the public system due to the high cost of treatment, and fully private patient care is deemed to be marginal[20].

Pharmaceutical expenditures are recorded on a per-patient basis and are trackable, and cover two main settings: outpatient drugs and hospital pharmacies[21]. Standard oral treatments prescribed by physicians to outpatients are generally dispensed through community pharmacies (e.g. mesalazine, oral steroids, azathioprine), according to a national co-payment system based on annual income and pensioner/employment status. Patients contribute between 10% and 60% of the retail price of these community-dispensed drugs, with monthly caps for pensioners. Certain groups (e.g. those with a permanent disability or on social welfare) are exempt from co-payments. On the other hand, most high-cost drugs, including all biologics for IBD (e.g. infliximab, adalimumab, vedolizumab, ustekinumab) and their biosimilars, are dispensed exclusively through hospital pharmacies and fully funded by the Public Health Service with no out-of-pocket expenses for patients[22]. See Supplementary Table 1 for detailed data.

In order to guarantee an evidence-based and efficient use of resources, policies for rational use of drugs are decided and implemented at the regional level, so therapeutic approaches and recommendations for best medication use are issued to guide the clinical practice of the different healthcare providers in the region. By this means public funding of hospitals is linked to compliance with therapeutic approach recommendations. Economic incentives for the rational use of drugs are in place and implemented through bonuses in annual contracts, conditioned to the fulfilment of prospectively agreed objectives. In Catalonia, incentives include rewards for switching from reference products to biosimilars[22].

With regard to IBD, treatment is typically expected to be stepped and progress from conventional therapy (5-ASA, steroids, immunosuppressants) to biologics if the treatment is not tolerated or the response is inadequate. In addition, biosimilar anti-TNF treatments are strongly recommended as first-line biologics, given their high efficacy, lower cost and increasing availability. If a biosimilar is available, its use is strongly advocated. Other IBD treatments can be used as second-line options, including IL-23 inhibitors, while newer, brand-name, and patent-protected therapies such as JAK inhibitors are generally reserved for third-line use[23,24].

Intensified biologic regimens are not easily trackable in the CHSS data, as the database does not capture treatment administration frequency or patient weight, both being required for dose calculation. Moreover, most expensive drugs, including biological treatments for IBD, are dispensed through hospital pharmacies and paid for by means of a monthly stipend per treated patient. This stipend varies between the different specialties, i.e. it is different for digestive or rheumatologic diseases - but is the same for each IBD patient treated with biologics. The calculation for the monthly stipend is based on an average cost per treatment resulting from an "ideal" scenario compliant with the recommendations and applied to the expected distribution of first-line, second-line and complex patients. By using stipends, the cost of intensification or new costly drugs is not directly funded by CatSalut, but relies on each hospital's management of its budget and case mix. This incentivizes local policies supporting the utilization of low-cost biosimilars and discourages the use of more expensive drugs unless they are strictly indicated[22].

All pharmaceutical data both for biologic and non-biologic drugs are recorded in the CHSS database and include the anatomical therapeutic chemical (ATC) codes, units dispensed, and the share of the cost covered by the public system versus patient co-payment. These data have been used in this study.

Study design and participants

A retrospective analysis of all IBD patients included in the CHSS was performed. Data were retrieved from 2011 to 2024. Patients were identified by their diagnosis as coded using the Clinical Modification codes of the International Classification of Diseases, 9th and 10th revisions (ICD-9-CM and ICD-10-CM

codes)[25] as detailed in Supplementary Table 2. A case was considered valid only if, in addition to an IBD diagnostic code, at least one prescription of an IBD-specific treatment was recorded.

Variables

The diagnosis of IBD was recorded as it appears in the CHSS database according to standard clinical practice, and coded according to ICD-CM codes. Variables associated with the utilization of healthcare services included data on PHC visits, hospitalization, IBD surgeries, emergency care episodes, outpatient visits, as well as over the counter (OTC) supplies and other services. Pharmaceutical expenditures were described separately for biologics, immunosuppressants, salicylates, steroids and other drugs, based on the ATC classification (see detailed data in Supplementary Table 3).

The calculation of the direct health expenditure was based on the standard costs of each service provided by the Department of Health of the Catalan government in 2024, applying the methodology previously reported by Vela et al.[20] each year. Expenditures were adjusted to 2024 euros using the consumer price index published by the Spanish National Statistics Institute (Instituto Nacional de Estadistica de España, INE)[26], thus allowing comparisons between different years. Expenditures were estimated for the overall IBD population and separately for the CD and UC populations and described by age and sex.

Indirect costs, including the duration of sick leave (related and unrelated to IBD), were estimated using the average labor cost per working day, as reported by the INE[26]. This cost includes various components such as gross salaries, employer social contributions, and direct social benefits. Therefore, while it provides a standardized reference value, it may not fully reflect the actual economic burden borne by public institutions during sick leave periods. For salaried employees in Spain and Catalonia, compensation during common sick leave is 60% of the contribution base from days 4 to 20 and 75% from day 21 onwards. These payments are jointly funded by the employer and the public social security system.

Out-of-pocket pharmaceutical expenditures (pharmaceutical costs paid directly by the patient, not reimbursed by the public healthcare system) were also estimated. The annual amount paid per citizen was adjusted using the annual Consumer Price Index (CPI), as published by the INE[26].

Statistical analysis

Incidence and prevalence rates were expressed per 100,000 persons. Annual expenditures per patient were calculated and expressed as the mean of expenditure per patient. Both total and per-patient expenditures were calculated globally for IBD, and for CD and UC separately. Per-patient yearly expenditures standardized by age and sex and income level were also calculated to correct for changes in the population structure.

Primary forecasting of IBD expenditure was based on the estimated costs per patient and total costs. Forecasting the prevalence of IBD using autoregressive integrated moving average (ARIMA) models have been previously validated[27]. A sensitivity analysis was done which approximated total costs by using per-person forecasts and prevalence forecasts[28]. Potential inflection points in the annual average cost per patient were assessed using segmented linear regression with a single possible breakpoint. Statistical significance of slope changes was assessed with the Davies test, and breakpoints were retained only when at least five years of data were available on either side of the estimated point. An autoregressive and moving average (ARIMA) model was used to forecast per patient costs with associated prediction intervals (PI)—if an inflection point was present then historical data for the forecasts would be based from that data point. Series stationarity was examined using the Dickey–Fuller test; when required, first-order differencing was applied. ARIMA terms were selected based on autocorrelation and partial autocorrelation functions, as well as information criteria (AIC, BIC). Model adequacy was further tested for white noise residuals using Bartlett's periodogram-based test and the Portmanteau test. When several models showed comparable fit, the most parsimonious was selected. Final models were then used, with the appropriate ARIMA model, to forecast total costs up to 2036.

The average annual percent change, with associated 95% confidence intervals (CI), were estimated by the regression of the natural log of costs (per person or total) on calendar year. Models were fitted using

Newey–West standard errors with a lag of one year to account for autocorrelation and heteroskedasticity.

The statistical analysis was carried out using the R statistical package version 4.4.0 and Stata 19.

Ethical issues

The study was conducted in accordance with the ethical principles for medical research involving human subjects of the Declaration of Helsinki[29] and Spain's Personal Data Protection Law (LOPD 03/2018): it was reviewed and approved by the local Ethics Committee of the Hospital Universitari Parc Taulí in Sabadell (CEIC 2024/5026). This study analyzed retrospective, anonymized and pooled data from the CHSS database. The CHSS database is pseudonymized, and the database extracted for the study did not contain any personally identifiable data, so that no person's identity can be retrieved or traced back to the original source in the database. As the population-based approach made informed consent unfeasible, the informed consent requirement was waived by the Ethics Committee. Results were presented in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and REporting of studies Conducted using Observational Routinely collected health Data (RECORD) guidelines[30]. See checklist in Supplementary Table 13.

Results

IBD prevalence in Catalonia

As described in previous articles by our group (14,30), from 2011 to 2024 there has been a marked increase in the prevalence of IBD in Catalonia, although the incidence has stabilized, reaching an incidence plateau in recent years[31]. This situation corresponds to a compounding prevalence stage according to the classification proposed by Kaplan et al.[32]. In 2024 the prevalence of IBD was 43,106 patients (rate of 538 per 100,000 inhabitants) and 23.1% were treated with biologic therapies (see Supplementary Table 4 for details).

Expenditures for IBD, CD and UC

The overall healthcare expenditure has increased every year (except in 2020 when there was a slight decrease), with costs tripling from 2011 to 2024 (from €67.4 M to €201.6 M) (Figure 1a). IBD per-patient expenditures also increased during this period, although the rate of increase was far slower, less than 20% (from €3,978 in 2011 to €4,793 in 2024) (Figure 1b). Data standardized by age, sex and income level were very similar to uncorrected data; see detailed data in Supplementary Figure 1.

Regarding type of IBD, the expenditure increased both for CD (from €35.2 M to €93.9 M), and for UC (from €32.1 M to €107.7 M) (Figures 2a and 2b). Per-patient expenditures were higher for CD than for UC; they remained stable during the study period, fluctuating from €5,636 per patient in 2011 to €5,881 per patient in 2024. Although the overall trend was stable, some year-to-year variation was observed, with a peak of €5,963 in 2013 and a dip to €5,184 in 2015 (Figure 2c). By contrast, costs for UC progressively increased from €3,008 per patient in 2011 to €4,128 in 2024 (Figure 2d).

Distribution of IBD, CD and UC expenditures

Biologic therapy was the most important cost item in IBD. The cost of biologics has increased from €25.6 M in 2011 to €62.8 M in 2024, representing a 145.3% increase (Table 1). However, the main cost drivers were different by disease subtype; for CD biologic therapy has remained the main expense; conversely, for UC, non-IBD drugs, hospitalization and biologic therapy were the main expense drivers and contributed similar shares of total costs (Supplementary Tables 5 and 6).

The total number of IBD patients treated with biological drugs increased from 1,748 in 2011 to 9,970 in 2024 (from 1,322 to 6,750 for CD and from 426 to 3,220 for UC). The rate of IBD patients receiving a

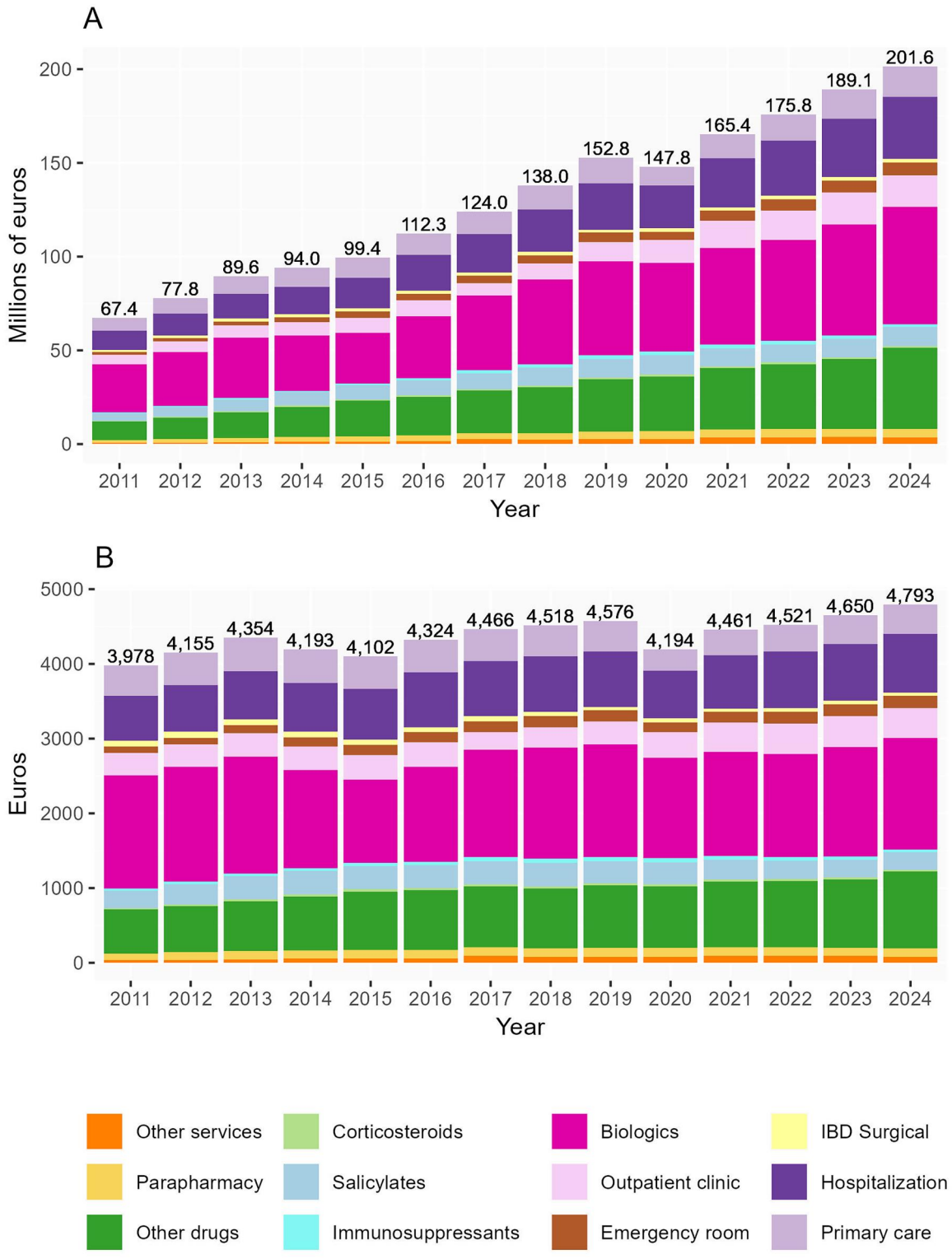

Figure 1. **1a.** Evolution of the main drivers of healthcare expenditure for IBD patients in Catalonia, 2011–2024. Expressed in M€ **1b.** Evolution of annual per capita healthcare expenditure for the population with IBD. Catalonia, 2011–2024.

biological drug increased from 10% to 23% (20% to 41% and 4% to 12% for CD and UC, respectively). See Supplementary Table 4 for details.

Average per-patient biologic therapy expenditures have fluctuated slightly over the years, showing opposite trends in UC and CD. In UC, the average per-patient cost of biologic therapies increased from €552.7 in 2011 to €798.9 in 2024 (+44.54%), whereas in CD, the average cost per patient decreased

Figure 2. **2a.** Evolution of total healthcare expenditure for the population with Crohn's Disease. Catalonia, 2011–2024. **2b.** Evolution of total healthcare expenditure for the population with Ulcerative Colitis. Catalonia, 2011–2024. **2c.** Evolution of annual per capita healthcare expenditure for the population with Crohn's Disease. Catalonia, 2011–2024. **2d.** Evolution of annual per capita healthcare expenditure for the population with Ulcerative Colitis. Catalonia, 2011–2024.

from €3,148.8 to €2,609.5 (−17.1%). Regarding hospital care, per-patient hospitalization expenditure increased for both (an increase of 20.2% for CD and 36.2% for UC) whereas per-patient surgery expenditure fell for both (−45.4% in CD and −35% in UC). See detailed data on per patient expenditure distribution in Table 2 and standardized data by age, sex and income level in Supplementary Table 7. For data on per patient expenditures for CD and UC separately, see Supplementary Tables 8 and 9, respectively.

Other per-patient items showed heterogeneous trends. While primary health care and outpatient non-biologic classical immunosuppressant treatment remained stable for both CD and UC, increases were observed in emergency room episodes, outpatient clinic visits, and non-IBD treatment costs. Some differences were noted between CD and UC; for example, while steroid and salicylate expenditures decreased for CD, they increased for UC.

Table 1. Evolution of the main drivers of healthcare expenditure in IBD patients in Catalonia, 2011–2024. Expressed in M€.

Year	PHC	Hospitalizations	IBD surgeries	Emergency care	Outpatient visits	Biologics	Immunosuppressants	Salicylates	Steroids	Other drugs	OTC supplies	Other services	TOTAL
2011	6.80	10.2	1.3	1.4	5.1	25.6	0.5	3.9	0.3	10	1.5	0.6	67.2
2012	8.20	11.7	1.5	1.6	5.6	28.8	0.6	5.1	0.5	11.5	1.9	0.7	77.7
2013	9.30	13.2	1.6	2.2	6.5	32.2	0.7	6.3	0.6	13.7	2.3	1	89.6
2014	10.00	14.6	1.6	2.8	7.1	29.5	0.7	7.1	0.7	16.1	2.5	1.3	94.0
2015	10.60	16.4	1.7	3.4	7.9	27.1	1.1	7.5	0.7	18.9	2.8	1.4	99.5
2016	11.30	19.1	1.7	3.4	8.5	33.2	1.1	7.9	0.7	20.7	3	1.5	112.1
2017	11.90	20.5	1.8	3.9	6.7	39.9	1.6	8.4	0.8	22.6	3.3	2.6	124.0
2018	12.80	22.6	1.9	4.5	8.3	45.4	1.8	9.6	0.9	24.3	3.5	2.4	138.0
2019	13.70	24.7	1.5	5.1	10.1	50.3	1.9	10	0.9	27.9	4	2.7	152.8
2020	9.90	22.6	2	4.4	12.1	47.4	2	10.3	1	29.1	4.2	2.8	147.8
2021	12.80	26.3	1.7	5.2	14.7	51.5	2	9.6	1	32.7	4.3	3.4	165.2
2022	13.90	29.4	1.9	6	15.8	53.8	1.8	9.5	1	34.6	4.5	3.6	175.8
2023	15.50	31	1.9	6.5	16.9	59.5	1.6	9.8	1	37.2	4.5	3.7	189.1
2024	16.40	33	1.9	6.7	16.9	62.8	1.5	10	0.9	43.2	4.7	3.5	201.5

Table 2. Evolution of annual per-patient healthcare expenditure distribution for the population with IBD in Catalonia, 2011–2024. Expressed in €.

Year	PHC	Hospitalizations	IBD surgeries	Emergency care	Outpatient visits	Biologics	Immunosuppressants	Salicylates	Steroids	Other drugs	OTC supplies	Other services	TOTAL
2011	402.8	604.8	77.2	83.5	302.8	1511.5	29.9	232.7	18	591.1	90.1	33.8	3978.2
2012	439.1	624.2	79.6	85.3	301.3	1540.1	32.1	272	25.3	614.6	103.7	37.8	4155.1
2013	452.1	641.7	79.7	108.1	316.2	1563.7	32.2	306	31.4	666.3	110.1	46.3	4353.8
2014	447.2	653.1	72.5	123.5	315.8	1314.2	32.7	316.8	30.9	718.1	110.4	57.5	4192.7
2015	437.3	675.9	70.8	138.8	325.1	1116.4	43.7	309.7	29.7	781.2	115.1	58.2	4101.9
2016	435.7	734.2	66.6	132.7	328.3	1277.5	43.9	303.2	28.5	798.5	116.1	59.1	4324.3
2017	428.6	738.2	65.4	142.2	241.3	1434.7	58.5	303.1	28.9	813.1	118.4	93.3	4465.7
2018	418.4	739.8	60.7	148.6	271.4	1486.6	58.4	314	28.5	797	115.3	79.1	4517.8
2019	410.7	740.3	45.7	152.5	303.7	1505.6	55.6	298.3	27.9	836.5	119.3	80	4576.1
2020	281.6	641.2	55.9	124.2	344.3	1344.6	57.4	292.3	27.8	824.9	119.1	80.4	4193.7
2021	345.8	710.8	46.5	139.6	397.2	1390.6	52.8	259.9	26.6	881.1	117.3	92.5	4460.7
2022	357.8	755.2	50	154.9	405.6	1384.6	45.4	244.7	26.5	888.7	114.9	93.2	4521.5
2023	380.9	762.8	47.3	159.5	414.6	1462.3	40	241.3	24.3	913.9	111.7	91.1	4649.7
2024	390.9	785	45.9	159.8	401.3	1492.6	35.1	237.8	22.5	1027.2	112.9	82.4	4793.4

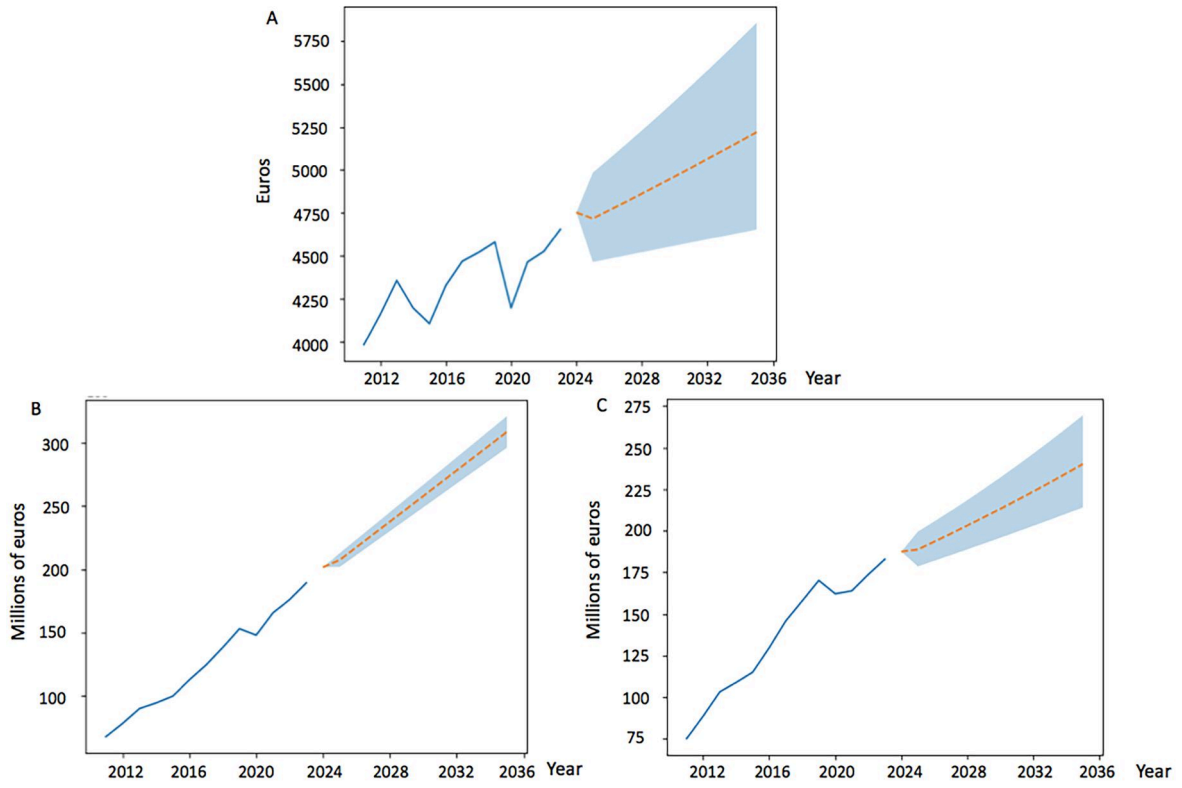

Figure 3. **3a.** Forecasted per person expenditures. **3b.** Forecasted total expenditures. **3c.** Forecasted expenditures per patient using forecasted prevalence.

Expenditures by sex and age

Male patients had higher expenditures than female patients; in 2011, spending for the average male patient with IBD was €4,058 compared with €3,899 for the average female patient (net difference of €159). The gap increased from 2011 to 2024, where for each man the cost was €4,986 and for each woman the cost was €4,605 (net difference of €381). See Supplementary Figure 2.

When analyzed by age group, the highest expenditures were for patients under 18 years, mainly attributable to biological treatments. For older adult patients, costs increased progressively over time, with hospitalization and non-IBD treatments being the main contributors to these costs. In middle-aged patients, expenditures remained barely stable, led by biological therapies (see Supplementary Figure 3).

Approach to some indirect costs of IBD, CD and UC

From 2011 to 2024, overall per-patient losses for all-cause sick leave increased in IBD patients, from a total of €1,367.70 in 2011 to €2,044.20 in 2024 with a peak of €2,127.70 in 2020 during the SARS-CoV-2 pandemic. However, the overall losses per patient for IBD-related sick leave decreased over the study period from €480.10 per IBD patient in 2011 to €402.30 per IBD patient in 2024. (see Supplementary Table 10).

When comparing diseases, expenditures for CD patients are higher for sick leave per patient than for UC patients (see Supplementary Table 11). No substantial differences were observed between sexes.

Regarding out-of-pocket expenditures, patients spent increasingly higher amounts between 2011 and 2020; thereafter, expenditures decreased. By 2024 patients were paying a mean of €60.60 annually.

Forecast of IBD expenditures

The projected annual average cost to the healthcare system per person is expected to reach €4,886 (95% CI: 4,550; 5,223) by 2029 and €5,196 (95% CI: 4,678; 5,715) by 2036. The average annual percent

change (AAPC) during the historical period (2011–2024) was estimated to significantly increase at 1.02% (95% CI: 0.68; 1.36) per year. Forecasted AAPC from 2025–2036 demonstrates a similar significant increase at 0.90% (95% CI: 0.40; 1.33) (Figure 3a).

Total costs were projected to increase from €247.9 M (95% CI: 239.7; €256.2 M) in 2029 to €319.0 M (95% CI: 305.8; €332.3 M) by 2036. The historical AAPC from 2011 to 2024 was 8.48% (95% CI: 7.71; 9.26). Forecasts suggest a deceleration in growth, with forecasted AAPC of 3.98% (95% CI: 3.83, 4.11) from 2025–2036 (Figure 3b).

In the sensitivity analysis, when accounting for both per-person costs and projected costs (using forecasted prevalence)[28], total costs are expected to rise from €207.0 (95% CI: 192.8; €221.3 M) in 2029 to €242.3 M (95% CI: 218.1; €266.5 M) in 2036. The historical AAPC for the period 2011–2024 was 6.81% (95% CI: 5.24; 8.40), while the forecasted AAPCs was 2.31% (95% CI: 1.80; 2.74) for 2025–2036 (Figure 3c). Detailed data are shown in Supplementary Table 12.

Discussion

Our study shows an increase in healthcare expenditures for IBD in Catalonia over the years, with costs tripling from 2011 to 2024 (from €67.4 M to €201.6 M). This upward trend is mainly attributable to the growing prevalence of IBD. Since expenditures were adjusted to constant 2024 euros, this increase cannot be interpreted as a consequence of general inflation. We also forecast an annual 3.98% cost increase to a maximum cost of €319.0 M in 2036.

Per-patient costs for IBD also increased, though more moderately: from €3,978 in 2011 to €4,793 in 2024, representing an increase of around 20%. The minimal per-patient increase in cost contrasts with the marked increases described in other settings. For example, Click et al. in United States described an increase from $3,421 to $8,643, an increase of around 150% in IBD-related expenditures between 1998 and 2015[33]. Cost containment in our study seems to be related mainly to a strict prescription policy favoring the prescription of biosimilar drugs that led to a considerable decrease in the cost per biologic-treated patient during the study period (see below).

When analyzing CD and UC separately, we observed that expenditures for CD were higher overall and per patient. This observation is consistent with findings by Targownik et al. (10) who reported that more CD patients require expensive biological treatments, suggesting that this higher cost is due to higher disease complexity. Also, costs for UC seem to be increasing more markedly due to a higher percentage increase in the use of biologics. This finding was also observed in previous population-based studies[10]. Specifically, in the study of van Linschoten et al. expenditures on anti-TNF agents and other targeted therapies rose by 274% in CD and 638% in UC, with the proportion of treated patients increasing from 5% to 26% in CD and from 1% to 10% in UC[32].

A shift in the distribution of healthcare resources over time has been reported worldwide, switching from hospitalization-driven expenditures to pharmaceutical treatments, particularly biologics[33,34]. It is striking that while there was an increase in per-patient biologic therapy expenditures for UC, in CD they decreased (+44.54% *vs.* −17.1%). This difference is probably driven by a different percentage of increase in the number of patients receiving biologic therapy, which approximately doubled for CD patients and tripled in UC, associated with a marked decrease in the cost of biologic treatments related to the widespread use of biosimilar drugs. In fact, previous studies suggest that biosimilars may reduce costs by 30–75%[35,36]. Additionally, the cost of biosimilars has also decreased markedly worldwide[37,38].

Regarding other expenses, the cost of hospitalizations increased and surgical expenditures decreased. However, as previously reported in two population-based time trend studies by our group, in Catalonia the number of hospitalizations and surgical procedures for IBD has progressively declined over the last decade[15,31]. This suggests that the increase in hospitalization expenditure is mainly explained by higher unitary cost per hospitalization and for hospitalizations due to non-IBD reasons, explained to a great extent by the progressive aging and increased prevalence of comorbidities observed in the IBD population[16].

Our study also reveals sex-related differences, with male patients incurring higher costs than females. This may reflect differences in disease severity and treatment choices. Some studies suggest there is lower use of immunosuppressants in females[39]. Moreover, there appears to be a more cautious approach to prescribing new or more aggressive therapies to women of childbearing age[40]. Age is

another major cost driver, with both pediatric and elderly patients showing higher expenditures. This aligns with previous studies[41], likely due to intensive care needs in children and increased comorbidity, complications, and healthcare use of the elderly.

Indirect costs in IBD are mainly driven by productivity losses, including both absenteeism and presenteeism. Previous studies in Europe have estimated the indirect costs of IBD as amounting to up to €7,915 for absenteeism and €14,524 for presenteeism[42]. In Spain, reported data about annual indirect costs for UC amount to €399.30 per patient[39], with higher costs strongly correlated with disease activity[42,43].

The rising cost of IBD demonstrated in Catalonia, and consistent with patterns observed globally[44], will place increasing strain on healthcare systems striving to deliver accessible and equitable care over time[45]. Our forecasting models, which outline the projected future economic burden, provide an important opportunity for societies to proactively prepare[46]. This includes innovating models of care delivery, optimizing the use of cost-saving biosimilars, and re-imagining workforce structures through the integration of IBD-trained nurses within IBD-clinics[46]. In parallel, the research community should prioritize implementation of preventive health strategies, such as environmental health interventions and promoting healthy dietary patterns like the Mediterranean diet, to help reduce the incidence of IBD at the population level[47]. By emphasizing these efforts today, we may better position healthcare systems to mitigate and manage the rising costs of IBD in the years ahead[45].

This study has several limitations that should be acknowledged. First, the CHSS database only includes patients within the public healthcare system, potentially excluding some individuals with milder disease who may not have been recorded. However, the public system covers more than 80% of the Catalonian population and given the chronic nature of IBD and the high cost of biologic treatments, private insurance policies rarely cover these medications. As a result, nearly all biologic drug dispensing occurs within the public system, minimizing the potential selection bias. Second, some healthcare services, such as nursing homes, and nutrition services (one of the cornerstones of pediatric IBD management), are not funded by the public system and were not included. Calculating indirect costs comes with some limitations. The use of the average labor cost per day may overestimate or misrepresent the actual economic loss associated with sick leave, as it includes components not directly related to public expenditure, such as private employer contributions and social security benefits. Besides, for self-employed workers the compensation system is more complex than for those employed by third parties, and may involve temporary cessation of economic activity, which is not captured in our estimates[26]. Additionally, the financial data used in this study were adjusted to 2024 cost levels, which may introduce discrepancies when comparing with previous reports. Finally, this study did not include a contemporaneous non-IBD comparator group, as it was designed to describe time trends, cost drivers and forecasts within the IBD population. In addition, our data did not allow a comparative cost-effectiveness analysis of individual therapeutic strategies, treatment sequences, treatment-related adverse events, or emerging approaches such as microbiota-based therapies.

The findings of this study highlight the growing economic burden of IBD in Catalonia. In previous studies, we observed that the healthcare cost of IBD was approximately 3.4 times higher than the healthcare cost in the non-IBD population[16]. Expenditures for IBD are expected to increase year over year; when analyzing costs per person, the estimated increase appears to be linear and stable. However, the increase in prevalence is not linear, when we cross our economic data with the prevalence forecasted for Catalonia in the study by Coward S et al.[28], the expected IBD expenditures show a more flattened trend. It is important to note that these data are theoretical, and several relevant factors (new biosimilars may contribute to cost reductions, while the new therapies could lead to increases in costs) could not be considered in the analysis.

In conclusion, inflation-adjusted healthcare expenditures for IBD have significantly increased in Catalonia between 2011 and 2024, mainly because of the growing prevalent IBD population, whereas per-patient costs increased more moderately. CD patients consistently incurred higher expenses than UC patients. Pharmaceutical costs for biologics are the largest expenditure driver. However, the growth over time of pharmaceutical costs seem to be noticeably lower than those reported in previous reports. Hence, our findings support that appropriate prescription strategies can help manage IBD-related expenditures while maintaining access to advanced therapies for selected patients. These findings and the forecasted analysis highlight the rising economic burden of IBD and underline the need for cost-effective management strategies to optimize resource allocation.

Transparency

Declaration of funding

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Declaration of financial/other relationships

EBM has served as a speaker and consultant for Janssen and Chiesi, Kern, Takeda, Lilly and Alfasigma.

AV has served as a speaker and consultant from for MSD and Abbvie.

LM has served as a speaker and consultant from for MSD, Abbvie, Janssen, Takeda, Pfizer and Tillots.

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BGS, EV, LPL, CP, PP, AP, SL and MJRL have no conflicts of interest to declare.

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Authors' contributions

EB, BGS, EV and XC designed the study, and wrote the manuscript. EV also analyzed data. EB and SC, designed and performed the forecasting analysis.

EB, BGS, XC, EV, SL, LM, LL, CP, AP, PP, MJRL, AV, SC and GGK reviewed the text and provided important intellectual content.

All authors definitively approved the submitted version.

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Data availability statement

For ethical/privacy reasons the full dataset cannot be shared publicly because they come from a population registry supervised by the Catalan Health Surveillance System and can only be accessed from CatSalut. The data will be shared on reasonable request made to the corresponding author.

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