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Changing nationwide trends in endoscopic, medical and surgical admissions for inflammatory bowel disease: 2003–2013

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ABSTRACT

Background and study aims In the last decade, there have been major advances in inflammatory bowel disease (IBD) management but their impact on hospital admissions requires evaluation. We aim to investigate nationwide trends in IBD surgical/medical elective and emergency admissions, including endoscopy and cytokine inhibitor infusions, between 2003 and 2013.

Patients and methods We used Hospital Episode Statistics and population data from the UK Office for National Statistics.

Results Age-sex standardised admission rates increased from 76.5 to 202.9/100 000 (p<0.001) and from 69.5 to 149.5/100 000 (p<0.001) for Crohn's disease (CD) and ulcerative colitis (UC) between 2003–2004 and 2012–2013, respectively. Mean length of stay (days) fell significantly for elective (from 2.6 to 0.7 and from 2.0 to 0.7 for CD and UC, respectively) and emergency admissions (from 9.2 to 6.8 and from 10.8 to 7.6 for CD and UC, respectively). Elective lower gastrointestinal (GI) endoscopy rates decreased from 6.3% to 3.7% (p<0.001) and from 18.4% to 17.6% (p=0.002) for CD and UC, respectively. Elective major abdominal surgery rates decreased from 2.8% to 1.0% (p<0.001) and from 4.9 to 2.4 (p=0.010) for CD and UC, respectively, with emergency rates also decreasing significantly for CD. Between 2006-2007 and 2012-2013, elective admission rates for cytokine-inhibitor infusions increased from 11.1 to 57.2/100 000 and from 1.4 to 12.1/100 000 for CD and UC, respectively.

Conclusions Rising IBD hospital admission rates in the past decade have been driven by an increase in the incidence and prevalence of IBD. Lower GI endoscopy and surgery rates have fallen, while cytokine inhibitor infusion rates have risen. There has been a concurrent shift from emergency care to shorter elective hospital stays. These trends indicate a move towards more elective medical management and may reflect improvements in disease control.

Summary box

What is already known about this subject?

- Over the period 1989–1990 to 1999–2000, hospital admission rates for inflammatory bowel disease (IBD) increased by 14% and 6% for Crohn's disease (CD) and ulcerative colitis (UC), respectively.
- Over the past decade, treatment of IBD has evolved significantly most notably with the introduction of cytokine inhibitor therapy.

What are the new findings?

- During the period 2003–2004 to 2012–2013, admission rates increased for CD and UC whilst mean length of stay fell significantly for elective and emergency admissions.
- Elective lower-gastrointestinal endoscopy rates decreased for both CD and UC as a proportion of all IBD admissions.
- Elective major abdominal surgery rates for CD and UC decreased as a proportion of all IBD admissions.
- Between 2006–2007 and 2012–2013, elective admission rates for cytokine inhibitor infusions increased for CD and UC.

How might it impact on clinical practice in the foreseeable future?

- Analysing trends in hospital admission rates and management approaches for IBD over time allows us to understand the potential impact of new therapies in improving the quality of care and enables more effective evidence-based health service planning.

INTRODUCTION

Inflammatory bowel disease (IBD) comprising Crohn's disease (CD) and ulcerative colitis (UC) may cause significant morbidity and mortality. In the UK, around 0.25 million people are affected with a prevalence of approximately 400 per 100 000 population. The European incidence of IBD has roughly doubled in the past three decades coupled with an ageing population, in common with many chronic conditions, is contributing to a rising prevalence placing a substantial economic and clinical burden on health services.[1–5] IBD diagnosis and management requires input from multidisciplinary

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teams including specialist gastrointestinal physicians and surgeons. Patient care is usually overseen by specialists in outpatient clinics but some patients may require hospital admission for assessment, medical treatment of flares and surgery. There is evidence to suggest a reduction in rates of surgery in recent decades which could be seen as a long-term outcome of the 'treat-to-target' approach of the modern era. Estimates of the risk of surgery vary but around 50% of patients with CD and 15% of patients with UC will undergo surgery within 10 years of diagnosis.[6] Endoscopy is often required diagnostically for disease mapping as well as for chronic disease monitoring for severity assessment, cancer surveillance, therapeutic interventions such as stricture dilatation and to assess mucosal healing in response to therapy.[7 8] Additionally, the European Crohn's and Colitis Organisation guidelines suggest that endoscopic evaluation is required for any admission with acute severe UC.[8] The goal of care is to improve quality of life by inducing and maintaining remission and importantly prevent complications of the disease that can necessitate surgical intervention. Hence, emergency admissions to hospital for surgery may serve as a surrogate of disease severity, whereas elective activity is likely to reflect proactive surveillance and evidence of early intervention to prevent emergency admissions.

We have previously found that hospital admission rates for IBD had increased over the previous decade 1989–1990 to 1999–2000 by 14% and 6% for CD and UC, respectively.[9] Over the past decade, treatment of IBD has evolved significantly most notably with the introduction of antitumour necrosis factor (TNF) therapy. The regulatory authority responsible for the introduction of new drugs in England, the National Institute for Health and Care Excellence (NICE), approved episodic treatment with infliximab in 2002 and the use of maintenance cytokine inhibitor therapy including infliximab for CD in 2010.[10 11] In addition, NICE released guidance for induction of remission in acute severe UC and maintenance cytokine inhibitor therapy including infliximab in 2015.[12 13] In the last decade, there has also been wider and earlier use of thiopurines in IBD.[14–18] Other developments which may also have impacted on admission rates include the greater involvement of IBD nurse specialists[19] as well as greater patient autonomy with the adoption of self-managed action plans.[20 21]

We hypothesised that these advances in medical therapies and care provision may have resulted in a shift from emergency to elective admissions and day case activity. As the importance of mucosal healing as a therapeutic target has emerged, we also anticipated a parallel increase in lower GI endoscopy.[22 23] We also anticipate that the number of admissions for cytokine inhibitor infusions will have increased and that with improved medical treatment that surgery rates would have decreased. In this study, we therefore aimed to investigate nationwide trends in lower GI endoscopic, surgical and medical (including cytokine inhibitor infusions) admissions, both elective and emergency, for IBD between 2003–2004 and 2012–2013.

METHODS

The hospital admissions data were obtained from Hospital Episode Statistics (HES) for the financial years 2003–2004 to 2012–2013. HES is a national administrative database containing patient-level records of all admissions to National Health Service (NHS) hospitals in England. Each record corresponds to a finished consultant episode, during which a patient is under the care of a particular consultant. We aggregated these episodes into hospital spells (which equate to a hospital admission), covering a patient's total length of stay in a hospital, using the patient identifier, provider code, admission date and discharge date.[24] Data were provided by the NHS Health and Social Care Information Centre (now NHS Digital).[25]

HES contains 20 fields per record for diagnostic codes that are defined in the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10).[26] We extracted data where an ICD-10 code for IBD (K50 and K51) was listed as either a primary or secondary diagnosis. Where an IBD coded was listed as a secondary diagnosis, the clinical steering group (comprising AA, CA and RP) reviewed the entire list of coded primary diagnoses (n=4847) and, by a consensus process, only diagnoses deemed related to IBD were included for further analysis. A full list of the diagnoses chosen by the clinical steering group, selected when the diagnosis was chosen by two or more group members, is shown in the online supplementary appendix. The clinical steering group comprised practising clinicians with a subspecialty interest in IBD.

Hospital admission rates

We first calculated crude hospital admission rates by dividing the number of admissions by mid-year population estimates for England obtained from the Office for National Statistics[27] and all rates are expressed as admissions per 100 000 population. We used the mid-year population estimate for the calendar year overlapping the majority (9 months) of the financial year. All rates were age and sex standardised: direct standardisation was carried out to determine age-sex standardised rates which were calculated by applying the rates of each age-sex group (0–14, 15–24, 25–39, 40–59 and 60 years and over; male and female) to the 2003 population in England. Lengths of stay in hospital were examined using mean spell duration from the HES data. Admissions were additionally categorised into those which were elective or emergency.

Endoscopy, surgery and infusions

We examined the hospital age-sex standardised admissions that involved a lower endoscopic procedure. We considered the codes G14–G19, G42–G47, G54, G55, G64, G65, G79, G80, H20–H28 and H68–H70 as lower endoscopic procedures.

We calculated the age-sex standardised inpatient hospital admission rates, both emergency and elective, for CD or UC that involved a surgical procedure (see above regarding selection procedure). CD surgery was subcategorised as either major (intestinal) abdominal

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surgery or perianal surgery. HES records operation codes according to the OPCS Classification of Interventions and Procedures (OPCS-4).[28] G58–59, G63, G69–75, G78, H04–13 were considered as a major abdominal surgery for CD. H33, H41, H46, H47–49, H55–56 were considered as perianal surgery for CD. H04–H11 were considered as surgical procedures for UC.

We also examined admissions for therapeutic infusion. We considered codes X28.1, X28.2, X28.8, X28.9, X29.2, X29.3, X29.8, X29.9 and X92.1 to identify infusions of a therapeutic substance including administration of anti-cytokine treatment codes for which a specific code was introduced in 2006-2007.

Statistical analysis

We used negative binomial regression to test for an association between hospital admission rates and financial year, adjusting for age and sex group. Linear regression adjusting for age and sex was used for the analyses of changes in mean lengths of stay. The analysis was conducted in Stata V.14.0.

Ethical considerations

Imperial College London has permission to use HES data for research from the NHS Health and Social Care Information Centre (now NHS Digital).

RESULTS

Hospital admission rates

Age-specific hospital admission rates

For all age groups, there was an increase in hospital admission rates (including both elective and emergency admissions) during the study period from 2003-2004 to 2012-2013 (table 1). CD admission rates increased almost threefold from 76.5 to 202.9/100 000 and doubled for UC from 69.5 to 149.5/100 000 population. The rate of increase in admission rates was greatest in the group aged 15–24 years for CD rising from 77.3 to 239.0/100 000 and in the group aged 25–39 years for UC from 61.2 to 147.1/100 000.

CD admission rates were highest in the group aged 25–39 years for most of the study period except for 2003–2004 and 2009–2010 when admission rates were highest in patients aged 60 and above. UC admission rates were consistently highest in patients aged 60 and above throughout the study period.

Mean length of stay

The mean length of stay for CD and UC admissions, for both elective and emergency admissions, has fallen from 2003–2004 to 2012–2013. The relative reduction in length of stay for elective admissions was greater than for emergency admissions reflecting the increase in day case activity. Length of stay for elective admissions fell from 2.6 to 0.7 days for CD and from 2.0 to 0.7 days for UC. Length of stay for emergency admissions fell from 9.2 to 6.8 days for CD and from 10.8 to 7.6 days for UC. The proportion of elective admissions with a length of stay of less than 1 day increased from 68.9% to 89.2% (p<0.001) and from 78.5% to 88.1% (p<0.001) for CD and UC, respectively. The proportion of emergency admissions with length of stay of less than 1 day increased from 10.1% to 13.9% (p<0.001) and from 8.4% to 10.9% (p<0.001) for CD and UC, respectively.

Elective and emergency admissions

During the study period, hospital admission rates increased significantly for CD and UC for both emergency

Table 1 Age-sex standardised and age-specific hospital admission rates* for Crohn's disease (CD) and ulcerative colitis (UC)

	Year										
Age (years)	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	P values trend
CD											
0–14	17.2	19.2	21.9	23.1	25.3	30.1	55.1	31.2	36.2	40.3	<0.001
15–24	77.3	85.0	103.4	115.8	127.7	155.0	177.2	191.9	214.1	239.0	<0.001
25–39	93.7	101.5	126.0	146.9	161.9	176.8	176.2	227.4	241.1	258.5	<0.001
40–59	88.5	98.0	113.4	127.3	145.0	163.4	177.6	204.1	217.5	236.0	<0.001
60+	95.2	99.9	113.3	125.7	136.7	152.8	189.9	202.1	213.4	223.7	<0.001
Overall CD	76.5	83.1	98.1	110.7	122.8	138.7	157.4	175.6	188.2	202.9	<0.001
UC											
0–14	8.0	8.1	9.6	9.9	11.1	12.7	20.0	14.2	15.3	15.8	<0.001
15–24	41.9	41.4	50.1	54.6	57.7	62.8	79.2	78.1	85.7	98.8	<0.001
25–39	61.2	66.4	75.7	84.9	93.8	104.0	98.8	127.3	132.1	147.1	<0.001
40–59	90.9	92.0	104.2	112.0	122.7	134.6	134.9	160.3	167.1	178.3	<0.001
60+	122.0	130.0	148.2	164.0	179.3	199.9	225.6	238.7	249.0	265.9	<0.001
Overall UC	69.5	72.5	82.9	90.9	99.4	110.0	117.6	132.1	138.1	149.5	<0.001

*Rates per 100 000 population were calculated by dividing the number of admissions by mid-year population estimates for England obtained from the Office for National Statistics.

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Table 2 Age-sex standardised elective and emergency hospital admission rates* for Crohn's disease (CD) and ulcerative colitis (UC) 2003/2004–2012/2013 and surgical admission as a proportion of all inflammatory bowel disease admissions

	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	P values trend
CD											
Emergency (total)	36.9	39.8	44.6	46.2	48.2	52.4	58	62.4	62.7	65.2	<0.001
Medical	34.5	37.4	42	43.9	45.8	49.9	55.4	59.8	60.1	62.6	<0.001
Surgical	2.4	2.4	2.6	2.3	2.4	2.5	2.6	2.6	2.6	2.6	0.006
% Surgical	6.5	6	5.8	5	5	4.8	4.5	4.2	4.1	4	0.001
Elective (total)	39.6	43.3	53.5	64.5	74.6	86.3	99.4	113.2	125.5	137.7	<0.001
Medical	34.8	38.5	48.5	59.4	69.2	80.6	93.6	107.2	119.2	131.5	<0.001
Surgical	4.8	4.8	5	5.1	5.4	5.7	5.8	6	6.3	6.2	<0.001
% Surgical	12.1	11.1	9.3	7.9	7.2	6.6	5.8	5.3	5	4.5	<0.001
UC											
Emergency (total)	26.0	28.4	32.1	33	35.1	38.3	41.4	45.8	45.7	49.6	<0.001
Medical	24.8	27.1	30.8	31.8	33.9	37	40.2	44.5	44.4	48.5	<0.001
Surgical	1.2	1.3	1.3	1.2	1.2	1.3	1.2	1.3	1.3	1.1	0.146
% Surgical	4.6	4.6	4	3.6	3.4	3.4	2.9	2.8	2.8	2.2	<0.001
Elective (total)	43.5	44.1	50.8	57.9	64.3	71.7	76.2	86.3	92.4	99.9	<0.001
Medical	40.1	40.8	47.2	54.7	60.8	68	72.5	82.4	88.6	96.3	<0.001
Surgical	3.4	3.3	3.6	3.2	3.5	3.7	3.7	3.9	3.8	3.6	0.01
% Surgical	7.8	7.5	7.1	5.4	5.2	5.2	5.1	4.5	4.1	3.6	<0.001

*Rates per 100 000 population were calculated by dividing the number of admissions by mid-year population estimates for England obtained from the Office for National Statistics.

and elective admissions (table 2). The increase in elective hospital admission rates was proportionally greater for CD admissions compared with UC.

Elective admission rates for CD increased from 39.6 to 137.7/100 000 (p<0.001). During the same period, elective admission rates for UC also rose significantly from 43.5 to 99.9/100 000 (p<0.001). Emergency admission rates for CD increased from 36.9 to 65.2/100 000 (p<0.001) during the period from 2003–2004 to 2012–2013. During the same period, emergency admission rates for UC also rose significantly from 26.0 to 49.6/100 000 (p<0.001). The percentage of surgical admissions, as a proportion of all IBD admissions, fell for all admission types (elective and emergency) and for both CD and UC during the study period. The percentage of surgical emergency admissions fell from 6.5% to 4.0% for CD (p=0.001) and from 4.6% to 2.2% for UC (p<0.001). The percentage of surgical elective admissions fell from 12.1% to 4.5% for CD (p<0.001) and from 7.8% to 3.6% for UC (p<0.001).

Endoscopy, surgery and infusions

As a proportion of IBD admissions, elective endoscopy rates have fallen for CD and UC from 6.3% to 3.7% (p<0.001) and 18.4% to 17.6% (p=0.002), respectively (table 3). Emergency endoscopy rates have also fallen for UC from 43.9% to 38.6% (p<0.001) but did not reach statistical significance for CD from 4.1% to 1.9% (p=0.754).

CD surgery rates, as a proportion of IBD admissions, for both major abdominal and perianal surgery decreased significantly during the study period (table 4). CD emergency perianal surgery and major surgery reduced from 0.4% to 0.2% (p=0.001) and 4.5% to 2% (p<0.001), respectively. CD elective perianal surgery and major surgery reduced from 1.8% to 1.1% (p<0.001) and 2.8% to 1.0% (p<0.001), respectively. UC surgery rates fell significantly for elective admissions from 4.9% to 2.4% (p=0.010) but not significantly for emergency admissions from 1.8% to 0.8% (p=0.146).

Infusion rates for both CD and UC increased during the study period regardless of admission type (table 5). The proportion of planned infusions was much greater than for emergency infusions for both conditions. Elective admissions for cytokine inhibitor infusions increased between 2006–2007 (following the introduction of a specific code) and 2012–2013 from 11.1 to 57.2/100 000 (p<0.001) and from 1.4 to 12.1/100 000 (p<0.001) for CD and UC, respectively. Emergency admissions for cytokine inhibitor infusions increased from 0.5 to 1.9/100

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Table 3 Percentage proportion of lower gastrointestinal endoscopy procedures during emergency and elective inflammatory bowel disease admissions

	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	P values for trend
Crohn's disease											
Emergency	4.1	3.9	3.3	2.8	2.8	2.5	2.3	2.2	1.9	1.9	0.754
Elective	6.3	6.2	5.7	5.1	4.8	4.6	4.4	4.0	3.8	3.7	<0.001
Ulcerative colitis											
Emergency	43.9	42.7	41.7	43.3	42.7	43.3	41.4	40.0	39.7	38.6	<0.001
Elective	18.4	16.8	16.5	17.4	17.3	17.9	17.3	17.3	17.7	17.6	0.002

Percentage for Crohn's disease or ulcerative colitis admissions—p value from linear regression.

000 (p<0.001) and from 0.1 to 1.0/100 000 (p<0.001) for CD and UC, respectively.

DISCUSSION

Main findings

Total IBD hospital admission rates have more than doubled from 2003–2004 to 2012–2013 driven by substantial rises in elective admissions particularly for lower GI endoscopy and cytokine inhibitor infusions. While medical admissions have risen steeply, surgical admissions have plateaued with a significant reduction in the rate of emergency and elective surgery for CD and a reduction in the rate of elective surgery for UC over the decade despite an increasing incidence and severity of disease phenotype in European populations.[4 5 29] Mean length of stay has decreased for both elective and emergency admissions. These trends suggest a shift from reactive emergency management of IBD towards more planned day case based activity. There has also been a reduction in elective lower GI endoscopy for CD and UC as a proportion of all IBD admissions over the last decade. Emergency endoscopy rates fell significantly for UC but not CD over the study period. The rise in cytokine inhibitor infusions (infliximab) reflects the emergence and increasing use of these agents over the period initially for CD and more recently for UC. These findings reveal important changes in the approach to the management of IBD over the past decade with a shift to shorter, elective, day case medical admissions.

Findings in relation to other studies

Hospital admission rates for IBD have largely been reported to be rising in Europe and North America for some years but are not consistent.[30–34] All these studies predate our findings which analysed a period during which there has been significant changes in the availability of newer medications. We found overall IBD admissions more than doubled in the decade between 2003–2004 and 2012–2013. This is striking compared with previous studies that found much smaller increases in admission in the nineties.[9] Overall, with the advent of national screening measures, lower GI endoscopy rates

Table 4 Percentage proportion of surgical procedures during emergency and elective inflammatory bowel disease admissions

	Year										
	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	P value for trend
Crohn's disease											
Perianal surgery											
Emergency	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.001
Elective	1.8	1.7	1.6	1.4	1.4	1.4	1.3	1.2	1.2	1.1	<0.001
Major surgery											
Emergency	4.5	4.1	3.6	3.2	3.0	2.8	2.4	2.2	2.2	2.0	<0.001
Elective	2.8	2.5	2.3	1.8	1.7	1.5	1.4	1.2	1.1	1.0	<0.001
Ulcerative colitis											
Surgery											
Emergency	1.8	1.8	1.5	1.4	1.2	1.2	1.0	0.9	0.9	0.8	0.146
Elective	4.9	4.6	4.4	3.5	3.5	3.3	3.1	2.9	2.7	2.4	0.010

Percentage for Crohn's disease or ulcerative colitis admissions—p value from linear regression.

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Table 5 Elective and emergency hospital admissions* with any infusion or cytokine inhibitor infusion for Crohn's disease and ulcerative colitis

		Year							
	Mode of admission	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	P value for trend
Crohn's disease									
Cytokine inhibitor infusions	Emergency	0.5	0.8	1.3	1.4	1.4	1.5	1.9	<0.001
	Elective	11.1	19.5	26.7	33.5	40.3	46.1	57.2	<0.001
Ulcerative Colitis									
Cytokine inhibitor infusions	Emergency	0.1	0.2	0.3	0.3	0.5	0.6	1.0	<0.001
	Elective	1.4	3.5	4.2	5.2	7.3	9.2	12.1	<0.001

*Rates per 100 000 population were calculated by dividing the number of admissions by mid-year population estimates for England obtained from the Office for National Statistics.

have previously been reported to be rising with an indication that this is associated with reduction in mortality at the population level.[35 36] Regarding lower GI endoscopy rates for patients with IBD, there is a lack of published literature. We found a significant fall in the proportion of lower GI endoscopy rates for both emergency and elective UC admissions and for elective CD admissions over the 10-year period. This may reflect improved disease control as a result of medical advancements with a reduction in disease flares requiring endoscopic evaluation. These findings suggest that the overall increase in demand for endoscopic services over recent years is a result of the increasing incidence and prevalence of IBD.

In the USA, there have been three analyses using the National inpatient sample (NIS), in many ways comparable to HES, with all these studies indicating a rise in admissions.[32–34] Most recently, non-surgical admission rates increased by 68% and 52% for CD and UC, respectively, between 2004 and 2007.[32] However, a study from Northern California, from the health maintenance organisation Kaiser Permanente, which has arguably similar constraints on healthcare provision to the NHS, found a 33% and 29% decrease in hospital admission rates for CD and UC, respectively, between 1998 and 2005 but importantly the study did not include day case activity.[31]. An Irish study, of both day cases and inpatients, also reported an overall rise in national IBD admission rates between 1996 and 2001.[31] The rises are consistent with a general trend of rising hospital admissions in developed countries,[37] among an ageing population with increasingly complex multimorbidity. Superimposed on this trend is rising incidence of IBD including a proportionally greater rise in children and young people with IBD among whom the condition has a more severe phenotype.[2 4 5 38] An additional explanation for rises in admissions may be improved ascertainment over the study period. Finally, the rises may reflect changing clinical practice, in particular, the advent of biologic drugs that may have driven the shift to shorter more frequent elective day case activity.

We examined surgery rates between 2003-2004 and 2012-2013, as a proportion of all IBD admissions and found a significant reduction in CD surgery rates, both perianal and major surgery, for emergency and elective admissions. UC elective surgery rates also fell significantly but there was no significant reduction in emergency surgery. An analysis of rates of surgery in the USA between 1998 and 2012 showed a similar decrease in admissions for CD-related and UC-related bowel surgery of 4.9% and 3.3% with the greater proportion related to a reduction in emergency surgery.[32 39]

The proportion of day case activity rose and there was an overall reduction in inpatient length of stay suggesting patients now have more frequent but shorter hospital spells. In keeping with our findings, day case admissions have also risen substantially in Ireland.[31] This may, in part, reflect the greater use of day case admissions for anticytokine infusions in recent years. The greater rise in elective admission rates compared with emergency admissions may also reflect a more general shift in chronic disease management in the UK national health service and elsewhere directed towards better disease control through outpatient care and planned elective procedures replacing emergency activity.[40–42] We found length of stay for IBD emergency admissions fell from 9.2 to 6.8 days and 10.8 to 7.6 days for CD and UC during the study period depending on the admission type. In the USA, over the same time period, average length of stay for patients with either UC or CD has also fallen by a similar magnitude.[32 34]

The observed trends in our study and others are reflected in a meta-analysis of studies from Europe, North America and Asia that found a significant drop in IBD-related surgery over the past five decades.[6] A national Danish population-based cohort also report a decreasing requirement for IBD surgery over the past 30 years.[43] A more recent analysis from 2002 to 2010 in Canada also showed an overall reduction in surgical resection rates with elective operations being more commonly performed than emergency surgery.[44] Studies show the increasing and earlier use of thiopurines and

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maintenance cytokine inhibitor therapy is associated with a reduced need for surgery in CD.[16 45] We postulate that as biological therapies become increasingly established, we will see further evidence of a fall in rates of surgery in IBD in the future.[14–16 46–49]

We found an increase in the use of infusions largely related to anticytokine infusions (infliximab) in England during the study period. Our study is the first nationwide study to characterise temporal trends in infliximab use. The rising trend reflects the increasing use of infliximab in the latter half of the study period although maintenance therapy for CD was not finally approved for use in the UK until towards the end of the study period.[11] The use of cytokine inhibitor agents as a maintenance treatment in the management of UC was not approved until after the end of the study period in 2015.[13] However, the use of infliximab, as a second-line option, for the induction of remission in acute severe colitis was approved in the UK in 2008.[12] This difference in the availability of anti-TNFs for the treatment of UC compared with CD is reflected in the much smaller number of cytokine inhibitor infusions for UC. Our findings mirror the interim UK biologics audit, a study reporting data derived from the majority of the nation's IBD units, indicated a relatively modest uptake of cytokine inhibitor use in 2010 but temporal trends were not reported.[50 51]

Accumulating evidence suggests that long-term cytokine inhibitor treatment may significantly reduce the need for surgery in CD,[45 52 53] although the evidence in UC is possibly less compelling.[54 55] Data from Canada, Hungary and the UK show that surgical rates were already falling before biological therapy came into widespread use.[14 15 46 47] We and others have reported data supporting an important role for thiopurines in reducing the long-term need for surgery.[16]

Study strengths and limitations

HES maintains a comprehensive data set of all admissions to NHS hospitals in England and has previously been used in the field of IBD research.[56 57] Our national study includes all hospitals in England, and its size and representativeness mean that it overcomes potential biases of previous regional referral centre cohort studies.[56] However, in common with other observational studies using large administrative databases, the quality of the coding of diagnoses and surgery relies on data entry performed locally at hospital level with the potential for misclassification. The precision and depth of coding may have changed over the decade of study and might, at least in part, account for the observed rise in admissions.[58] Furthermore, some procedures may not have been coded with the relevant accompanying IBD code. We have attempted to improve the ascertainment of IBD-related admissions by including IBD admissions coded as either primary or secondary diagnoses and, in the case of the latter, admissions were only included where the primary diagnosis was considered relevant to IBD by a clinical steering group. Unfortunately, HES does not provide data for adalimumab which is a self-administered subcutaneous injection that does not require admission. Finally, we did not detail trends in specific surgical procedures but we have distinguished major abdominal (intestinal) surgery from perianal surgery in CD which is arguably the most clinically relevant categorisation. HES is an administrative dataset so causal relations between trends in admissions and changes in IBD management cannot be drawn merely observed associations.

Implications and future research

Our findings, indicating a shift towards more planned and shorter elective inpatient care is a considerable improvement for patients who previously required long hospital admissions. The general fall in endoscopy and surgery rates coupled with a rise in cytokine inhibitor use may suggest improved disease control. The shift from emergency to elective activity with shorter length of stay will have reduced costs substantially. That being said, cost savings are likely offset by the increasing expense of biologics as underscored by the Dutch IBD healthcare cost analysis COIN study as well as the rising incidence and prevalence of IBD.[59] Further health economic studies, particularly with regard to avoidable emergency care, would be enlightening.

Our findings address a gap in information identified by the quality agenda set by the published UK IBD standards[60 61] and provide valuable information for future health service planning. The fact that surgery rates are falling despite the rising incidence and prevalence of this chronic disorder suggests that there have been improvements in the quality of care and efficacy of treatment provided to patients with IBD but further work is needed to elucidate this further. It is probable that recent advances in the management of IBD including the substantial increase in the use of thiopurines and cytokine inhibitor therapy may have impacted on long-term outcomes in this condition and with it a reduction in long-stay admissions. Further, IBD time trends analysis in the forthcoming decade will shed further light on the impact of these agents.

CONCLUSION

Rising IBD hospital admission rates in the past decade have been driven by an increase in the incidence and prevalence of IBD. Lower GI endoscopy and surgery rates have fallen as a proportion of all IBD admissions, while cytokine inhibitor infusion rates have risen. There has been a concurrent shift from emergency care to much shorter elective hospital stays. These trends indicate a move towards more elective medical management and may reflect improvements in disease control.

Contributors AM conceived the idea and designed the analysis with AA, AAL, TC and RP. AA, RP and CA were members of the clinical steering group. AA wrote the first draft of the article and managed its revisions. AAL acquired the HES data and conducted the data analysis in Stata. All authors, including SS, contributed to the interpretation of the data and revision of the article for important intellectual

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content. All authors approved the final version of the article, including the authorship list.

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