Responses to Reviewer Comments:

Reviewer 1:

The author had revealed that the attending difference for hospital service in IBD patients. The results from this study may contribute to improve accessibility to hospital in IBD care, however, they are specific to UK and cannot be applied to other countries. Moreover, the specific solutions are not clearly mentioned. Though this study is retrospective observational study using large national patient data set, analysis by severity will be supportive at actual situations.

We thank the reviewer for considering our paper and for their considered comments. We note the comment regarding the specificity of results to the English National Health System.

Although these findings are from the UK, we think that these results are likely to be replicated in many other modern healthcare systems around the world where care is centralised between hospitals. It is common to many healthcare systems that patients with IBD may attend different hospitals not only for outpatient appointments, but also for emergency care. Often, their gastroenterology 'home provider' may not be aware of these attendances and may have difficulty obtaining the notes from these encounters. This is where we feel this paper is useful as it has shown that these attendances to other hospitals may be more common than previously thought. We think that this may impact on IBD patient care. We also feel that the methodology and findings from this study are novel and can provide an approach that may be used by researchers in other countries around the world.

To clarify these comments in the paper we have made some changes and included the following statement in the discussion "Centralisation of care between hospitals is increasingly common in healthcare systems around the world and these findings may be replicated in other systems internationally.". We have also added reference

to a recent article referring to the prevalence of fragmented care for among IBD patients in the US (Cohen-Mekelburg S, Rosenblatt R, Gold S, Shen N, Fortune B, Waljee AK, et al. Fragmented Care is Prevalent among Inflammatory Bowel Disease Readmissions and is Associated with Worse Outcomes. Am. J. Gastroenterol.2018;)

Reviewer 2:

1. The most distinctive feature of this study is that the status of patients with IBD depends largely on the UK medical system. In other countries, if a patient develops eye or skin disease, the doctor of gastroenterology will decide whether to treat the patient as a GP or refer it to a specialist. And when referring to a specialist, the gastroenterologist will state the letter of reference responsibly. Therefore, this analytical result seems to be difficult to apply to other countries.

We thank the reviewer for their review of the article and considered comments. We understand that there are differences in systems around the world in the way IBD patients are managed and referred to other hospitals and that these findings may not be transferrable to all of these systems. There are however, also several large healthcare systems that share similarities with the NHS in England and many of the findings are still important to consider in these systems. Both the methodology and findings are novel and could be repeated in other systems. We have made some amendments to the paper to clarify the transferability of results to other countries including the following sentence in the discussion: "Centralisation of care between hospitals is increasingly common in healthcare systems around the world and these findings may be replicated in other systems internationally."

2. "All of the 20 providers with lowest proportion of IBD patients attending that provider of healthcare were located in major metropolitan centers." "Younger patients had a significantly lower proportion of care events with their 'home provider'." These results apply to all patients with intractable diseases, not

particularly the characteristics of IBD patients. The author should discuss the IBD specific problem a little more.

In response to this comment we have made some changes to the paper. Acknowleging that other intractable diseases may share the same problems we have added the following sentence to the discussion: "The approaches used to identify hospitals and specialties that share the care of patents could be applied to other chronic and complex disease processes to better delineate provider care networks across systems." Specific to IBD we have made some changes and additions to the article highlights section noting "Inflammatory bowel disease (IBD) is a chronic, inflammatory disorder characterised by both intestinal and extra-intestinal pathology. Patients may receive both emergency and elective care from several providers, often in different hospital settings. Poorly managed transitions of care between providers can lead to inefficiencies in care and patient safety issues."

Reviewer 3:

Without any doubt, this retrospective observational study at a national level represents a very interesting paper, analysing frequency and location of accident and emergency, inpatient and outpatient encounters for IBD patients within NHS England, with the aim of emphasising the proportion of people transitioning from the 'home provider'. The title, abstract and the whole structure of the manuscript are well chosen and written. Results were also focused on presenting "regional differences in 'home provider' attendance", "type of specialty services accessed by IBD patients" and "age-related differences in patient events", which are very important. Discussion paragraph is nicely written, including "strengths and weaknesses of study". Figures are illustrative. The style required by the WJG was followed. Definitely, a very good paper, which required a lot of work.

We thank the reviewer for considering our article and providing a supportive review.

Some minor comments:

1. In the Abstract, it is mentioned: "Adult patients with a diagnosis of IBD following admission to hospital were followed over a 2-year period to determine the proportion of care accessed at the SAME hospital providing their outpatient IBD care, defined as their 'home provider'". Since the next sentence presents the "Secondary outcomes measures", the reader can assume that the previous sentence refers to the "primary outcome". However, in the "Material and Methods" – it is written "The primary outcome measure was the proportion of adult IBD patients in England that access services from providers OTHER than their 'home provider'. Please clarify and correct.

We thank the reviewer for raising this issue which has been clarified in the text. In the materials and methods section the primary outcome measure now reads: "The primary outcome measure was the proportion of encounters that adult IBD patients in England have with their identified 'home provider'. This is now consistent with the abstract and rest of the paper.

2. In the "Introduction", The authors wrote "Inflammatory bowel disease (IBD) comprises the chronic relapsing inflammatory disorders Crohn's disease (CD) and ulcerative colitis (UC)[1]." Does it mean that patients with IBD-U were not included in this study? They account for 10-15% of all IBD cases. From "Material and Methods" it seems they were included (according to the code). Please clarify and correct, with inclusion of IBD-U, if that is the case.

To clarify that our definition of IBD included IBD-U we have amended this line of the introduction to read "Inflammatory bowel disease (IBD) includes the chronic relapsing inflammatory disorders Crohn's disease (CD) and ulcerative colitis (UC)[1]."

3. For the sentence "Furthermore, many IBD patients require care for extra-intestinal manifestations of disease[9][10][11]" – please insert the ECCO Consensus reference:

"Marcus Harbord Vito Annese Stephan R. Vavricka Matthieu Allez Manuel Barreiro-de Acosta Kirsten Muri Boberg Johan Burisch Martine De Vos Anne-Marie De Vries Andrew D. Dick Pascal Juillerat Tom H. Karlsen Ioannis Koutroubakis Peter L. Lakatos Tim Orchard Pavol Papay Tim Raine Max Reinshagen Diamant Thaci Herbert Tilg Franck Carbonnel for the European Crohn's and Colitis Organisation [ECCO]. The First European Evidence-based Consensus on Extra-intestinal Manifestations in Inflammatory Bowel Disease. Journal of Crohn's and Colitis, Volume 10, Issue 3, 1 March 2016, Pages 239–254, https://doi.org/10.1093/ecco-jcc/jjv213"

This reference has been added to the manuscript as suggested.

4. The authors wrote: "1,466,155 of 1,760,156 (83.3%) IBD patient encounters were with the 'home provider'". However, the authors concluded that "Transitions of care between secondary care settings are common for patients with IBD." Why? Please explain. In the Discussion, the same result is commented and admitted as a majority: "A majority of patients accessed accident and emergency, inpatient and outpatient care through the same 'home provider' that they attended for gastroenterology outpatient care."

Although statistically the majority (total 83.3%) of encounters were with the 'home provider', we felt that the number of encounters with other providers was still more common than might be expected. For example, more than one in four (26.7%) accident and emergency encounters for IBD patients was at another hospital. Although the term 'common' is subjective, we felt that the use of this term was appropriate in this setting. To clarify this in the paper and emphasise the above finding we have made some additions to the discussion and the 'research highlights' sections. The following statements have been added to the discussion "A substantial proportion of patients, however, accessed care from different hospital providers, particularly when using accident and emergency services (26.7% of accident and emergency encounters)." "More than one in four (26.7%) accident and emergency encounters were with a different hospital to the patient's gastroenterology 'home

provider'. This is more than the proportion of non-'home provider' events for inpatient (12.2%) and outpatient (16.9%) services." To the research highlights section we have added "The proportion of encounters with hospitals other than the usual gastroenterology 'home provider' for 95,055 IBD patients was up to 26.7% for accident and emergency encounters, followed by 16.9% for outpatient and 12.2% for inpatient encounters. Patients living in cities and younger patients were less likely to attend their 'home provider' for hospital services. The most commonly attended outpatient specialty services were gastroenterology, general surgery and ophthalmology."

Reviewer 4:

In this retrospective study, Warren et al demonstrated that inflammatory bowel disease (IBD) patients tend to "migrate" towards different hospitals and centers of care in England (phenomenon of "transition" according to the definition of the Authors).

The authors thank the reviewer for their considered responses and recommendations that have been addressed below:

Main comments:

1. In the last paragraph of the Results section, it would be interesting to investigate whether patients with extra-intestinal manifestations may show a more enhanced fragmentation of care than those with IBD alone.

This is relevant observation and suggestion, however the administrative data that we used for this research does not specifically inform us as to whether or not each patient definitively had extra-intestinal manifestations or not. We can only infer the possibility of this from the type of outpatient encounters that the patient had (for example rheumatology or ophthalmology services) which is included in our current

analysis. Further work to look specifically at patients with definitive extra-intestinal manifestations would require an expanded or different dataset.

2. Figure 2 distinguished between low and high providers. Did Authors choose a cut-off to define these categories?

This figure refers to the distribution of 20 highest and 20 lowest providers per proportion of encounters with home provider. These were selected from 144 possible providers. The cut off for these providers was simply the 20 providers with the highest proportion of 'home provider' encounters and the 20 providers with the lowest proportion of 'home provider' encounters from these 144. 20 of each group was an arbitrary number that we felt most clearly demonstrated the rural/urban distribution of patients. To clarify this point in the figure legend we have amended it to read "Distribution of 20 highest and 20 lowest providers per proportion of encounters with home provider (from 144 included providers)".

3. In table 1, it is important to report the range of home provider proportions.

Table 1 has been amended as suggested.

4. It would be interesting to know whether care dispersion may depend on the mean number of patients followed per care center: please discuss.

This is a fair suggestion however was not included in our research protocol and analysis so was not reported in this particular paper. In response to this suggestion we have added/amended the following comments to our discussion: "More in-depth analysis of the networks studied in this paper may offer further insights into patient sharing within the NHS and further guide interventions. Additional analyses of other hospital-level factors such as hospital size, IBD patient numbers and IBD service availability may provide additional insights in future work."

5. Care fragmentation may lead to worse IBD clinical outcome (as recently demonstrated in Cohen-Mekelburg S et al, Am J Gastroenterol 2018 in press), however this point was not discussed enough in the appropriate section.

We thank the reviewer for identifying this important reference which relates to and supports the value of our findings. In response to this, we have made some amendments/additions to the paper including adding the following statement to the introduction "Fragmented inpatient care has been shown to be associated with a higher likelihood of in-hospital mortality, colonoscopy and longer readmission length of stay" with a reference to this paper. We have also added the following to the discussion "This is an important finding that is congruent with previous research on the prevalence of fragmentation in IBD care[16] and underscores the need for effective systems to manage transitions of care and sharing of patient information between settings".

6. Care fragmentation was higher in Greater London than in peripheral centers. This issue was not commented in the Discussion paragraph.

We thank the reviewer for this observation and suggestion and have made some further changes that we feel strengthen the paper. In the discussion section we have amended/added the following: "All of the 20 providers with the lowest proportion of IBD patients attending that same provider for healthcare were located in major metropolitan centres including London, Manchester, Birmingham and Liverpool. In these areas, the proportion of encounters with the usual gastroenterology 'home provider' was as low as 1 in 3 (37%) for accident and emergency encounters and only half of inpatient (57.2%) or outpatient (55.7%) encounters. Reasons for this may include increased service centralisation in these regions or ease of access to alternative providers for urgent or non-IBD related care. Regardless, this is an important finding as it indicates that within metropolitan centres, there is a more

dynamic ecosystem of care and increased need to ensure adequate exchange of health information."

Reviewer 5:

In this observational study the authors highlight that in the UK IBD patients turn to multiple providers on several levels, which does not necessarily affect their treatment in the most favorable direction. Their results speak for themselves, their conclusions are moderate. Possible methodological errors are interpreted with due care. I suggest to accept the manuscrpt for publication.

We thank the reviewer for their consideration of the article and supportive comments.