Visualizing and Analyzing the Intellectual structure of IBS Disease based on Co-word and Co-authorship Network Analysis

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ABSTRACT: Background: *Irritable bowel syndrome is a functional gastrointestinal disorder characterized by changes inbowel habits and abdominal pain without any organic cause. The process of disseminating knowledge among the science and specialized fields of knowledge is one of the major issues affecting the optimal development of knowledge in each field. Moreover, the understanding of the Infrastructure is necessary and influential to form specialized knowledge.*

Aims: *This study aims to analyze the articles regarding IBS disease based on the concepts of co-occurrence network analysis and centrality indicators published in Clarivate Analytics WoS1 during 1983-2017.*

Methods: *This is a descriptive study, using Scientometric techniques. Its statistical population contains all clinical trials related to IBS disease in Clarivate Analytics WoS during1983-2017.*

Results: *The scientific research on IBS disease starts in 2014. Based on the scientific map of countries, IBS disease hasbeen active in some countries including Australia, Scotland, Austria, Poland, Ireland, Hungary, and England. USA and China have also been active in research on this disease from 2015. The top authors in IBS field in Clarivate Analytics WoS during 1989- 2017 are Siemren, Mayer, Camillier, Tornblom and Santos.*

Conclusions: *The analysis of IBS disease also showed that based on co-word analysis there are 11 clusters. Among those clusters, 1 is the largest and related to diarrhea-predominant IBS (IBS-D). Other clusters are IBS- related stress, disruption of intestinal flora, bacteria, secretion of endocrine cells, infection with Blastocystis, gastrointestinal disorders under the effects of brain damage, genetic effects, melatonin, and the role of probiotics which play an important role in the emergence of various types of IBS.*

1. Background

Irritable bowel syndrome is a functional gastrointestinal disorder (1) characterized by changes in defecation and abdominal pain without any other organic cause. There is no clear diagnostic index for it, so all the definitions of the disease are based on clinical manifestations (2). This disorder causes a significant drop in the life quality of the patient and has significant social, economic and psychological consequences (3). It is also the most common cause of referral to gastroenterologists so that it consists of 20 to 50 percent of referral patients (4). It's noteworthy that it would be a disorder that occurs in all ages. The first symptoms appear before 45- year-old ages (2). Studies show that the incidence of this disease is higher in women and varies from country to country. Meanwhile, its prevalence in the global population is estimated at around 11% (5).

The process of disseminating knowledge among the sciences and specialized fields of knowledge is one of the issues that must be addressed to optimized development of knowledge in each field, understand the infrastructure of the formation of a specialized knowledge domain, the influential individuals in the formation of knowledge, the peak and descent process of a thematic domain, and ultimately an attempt to use the past experiences for future development (6). In other words, the study of the process (history) of the formation of knowledge leads to the rational development of that science and the attention to the ignored and forgotten points of that science. In other words, the study of how the dissemination of knowledge forms between the scientific network is the answer to this question that why a science develops while a science and a field of science is not taken into account (7).

In the process of disseminating knowledge through the network Co-occurrence of word and co-authorship is an effective way of illustrating the structure of science, which is used to provide an image of the conceptual and intellectual frameworks of an area of research that is associated with the increasing production of science. In this study, the IBS illness is considered which we investigate this issue by drawing, analyzing and study the cause of this disease, in accordance with the analysis of the published research in this area.

2. Aims

The purpose of the present study is to map the intellectual structure of the IBS disease to investigate the level of the causes and types of this disease, the research method will be co-author and co-word network analysis and the centrality measures also will be calculated with the use of scientometric indicators in Clarivate Analytics WoS during 1983-2017.

Research Questions

1. Based on the co-word network analysis, the extracted clusters belong to which topics in IBS disease during 1983-2017?

2. Based on country co-word network analysis, which countries have been working on IBS disease during 1983-2017.

3. Based on the co-author network analysis, who are the top authors in IBS disease in Clarivate Analytics WoS during 1983-2017.

4. What is the position of collaborative authors based on the centrality measures of co-author network analysis in IBS disease articles in Clarivate Analytics WoS during 1983 to 2017?

3. Research Methods

This research is a descriptive study using Scietometric approach. In this research, scientometric techniques including co-word network analysis, co-authorship network analysis and centrality measures have been used. The research population of this study contains all articles on IBS disease in the Clarivate Analytics WoS from 1983 to 2017. Data were collected from the data source using the following search strategy:

TITLE: (IBS) OR TITLE: (functional dyspepsia) OR TITLE: Irritable bowel syndrome.

For this research, data were collected in a plain text format, using above search strategy. Extracted data contained 4886 articles in selected database during 1983-2017. Finally, data were analyzed using VOSviewer, UCINet and Netdraw its complementary package.

4. Findings of the Research

By analyzing data, using Co-word network analysis in IBS disease, 11 clusters have been extracted. The largest cluster (cluster #1 in red colour), is related to diarrhea-predominant irritable bowel syndrome (D-IBS). Cluster # 2 which is in green colour, belongs to stress in IBS disease. Cluster #3 in yellow colour, indicating is derived from disruption of the natural flora in the intestine in ISB disease. Cluster #4 that is shown in pink colour, is about the role of microbes in the development of IBS disease. Cluster #5 referred to a type of IBS disease which is in purple colour. This kind of IBS is derived from the disorder of secretions of endocrine and enteroendocrine cells. Cluster #6 associated with constipation-predominant irritable bowel syndrome (IBS-C) is in pale blue. Cluster #7 which displaying the association between Blastocystis and IBS disease is in blue. Cluster #8 could be a sort of IBS disease derived from bowel dysfunctions under the influence of the brain secretions is yellowish amber. Cluster #9 indicating IBS disease which is affected by genetics and polymorphism and other psychiatric disorders is an olive green colour. Cluster #10 in pale pink is a kind of IBS disease associated with melatonin and the role of probiotics. The cluster #11 had been considered no matter due to low-value communication; however no specific type of IBS disease has been seen in this cluster.

Figure 1. The co-word network analysis of IBS disease

2. Based on country co-word network analysis, which countries have been working on IBS disease during 1983-2017?

In 2014, the first IBS-based studies were appearing and published in Clarivate Analytics WoS databases. As can be seen in the Fig 2 the pioneer countries in this area were Austria, Scotland, Poland, Ireland, Hungary and England which have been activated in this field during 2014 to 2015. While, in 2015, USA and China have provided the most research articles in this year.

However, the countries of USA, England, Germany, Belgium, and Sweden were the most active countries in this research. In late 2015, countries like Belgium, and Sweden also contributed to the scientific production in IBS disease (Figure 2).
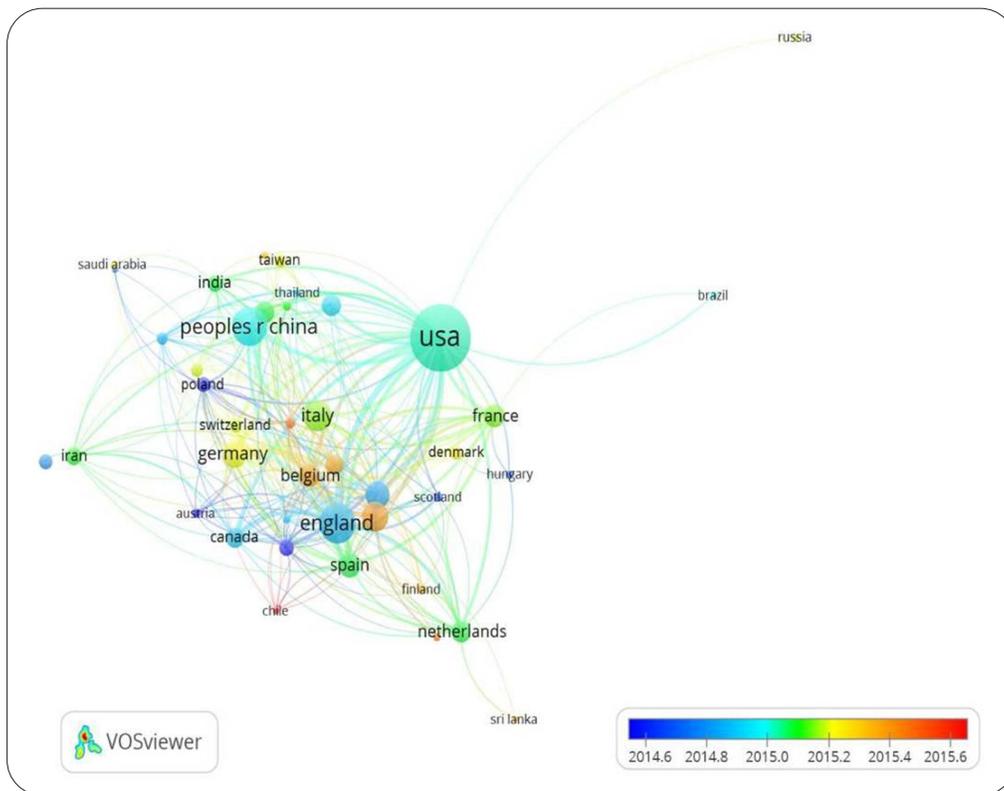

Figure 2. Collaborative countries in IBS disease during 1983-2017

3. Based on the co-author network analysis, who are the top authors in IBS disease in Clarivate Analytics WoS during 1983-2017?

The dispersion of authors in this area was high. Authors like Siemren, Mayer, Camillier, Tornblom and Santos have been the most active authors in this study. Similarly, authors like Simren, Mayer, Toroblom, Pimentel, Chang, have been the most prolific and top authors based on the number of articles in this research see Figure 3.

4. How is the position of collaborative authors based on the centrality measures of co-author network analysis in IBS disease articles in Clarivate Analytics WoS during 1983 to 2017?

As can be seen in Table 1, some centrality measures such as Degree, Closeness and betweens are calculated and reported. Collaborative authors in Table 1 are ranked from high to low based on Degree measure.

Co-authorship network of IBS disease was analyzed based on various measures. One of the most useful and most common measures is centrality. The centrality measure is referring to the specific nodes' positions within the network. The highest degree index that represents the most prominent individuals in this subject area included the authors Talley, Tack, Mayer, Simren and Chang respectively. Among these authors, Talley NJ has the highest degree and proximity. According to their proximity index Talley NJ, Mayer EA, Tack J, Chey WD and Tack JF ranked the highest.

5. Discussion and Conclusion

The results of this study showed that the research trend in IBS disease was accelerated from 2014 onwards, and Australia,
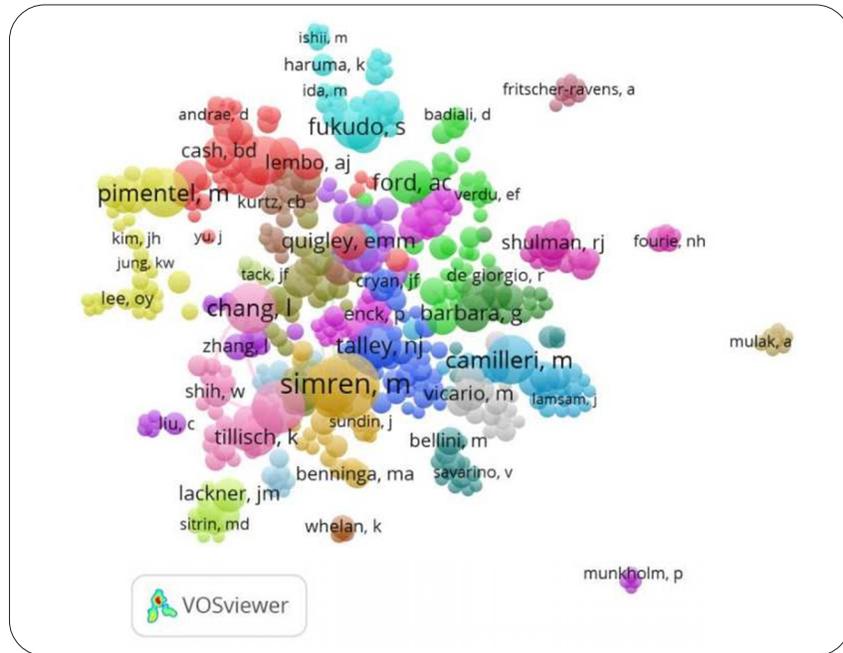
Figure 3. Collaborative authors in co-authorship network analysis of IBS disease

Row	Authors	Degree	BetaCent	Closeness	Eigenvector	Betweens
1	talley, nj	843	307616.906	2631	0	73127.25
2	mayer, ea	656	11542.583	2730	0	38700.789
3	tack, j	623	67551.094	2675	0	46794.551
4	simren, m	521	19371.049	2853	0	21850.807
5	chang, l	462	7421.259	1997	0	15119.95
6	van oudenhove, l	454	27064.514	2976	0	9968.153
7	whitehead, we	401	7555.22	2837	0	24687.957
8	naliboff, bd	351	5900.519	3110	0	4416.042
9	zinsmeister, ar	343	72869.328	3036	0	5656.708
10	chey, wd	329	8554.591	2808	0	26680.684
11	holtmann, g	326	82319.016	3077	0	13738.853
12	vos, r	314	20007.301	3115	0	1229.437
13	palsson, os	303	5395.998	3104	0	2372.017
14	locke, gr	291	62248.035	2931	0	8350.431
15	tack, jf	276	10627.747	2776	0	37451.094
16	pimentel, m	237	2210.253	3102	0	12659.385
17	drossman, da	232	2590	2942	0	18101.369
18	tillisch, k	228	2863.789	3200	0	2055.711
19	demyttenaere, k	217	12131.154	3230	0	228.553
20	camilleri, m	212	23010.754	2820	0	19074.951

Table 1. Centrality measures of collaborative authors in IBS disease in Clarivate Analytics WoS during 1983-2017

Scottland, Poland, Ireland, Hungary and England were active in this area in 2014 and on the other hand, in the late 2014 to 2015, countries like USA and people's R China had published scientific production in this area of this subject. Authors such as Siemren, Mayer, Camillier, Tornblom and Santos have the most involved in the publication of articles, as well as Simren, Mayer, Toroblom, Pimentel and Chang which have the most articles in the IBS disease area.

Based on the centrality indicators: Talley, Tack, Mayer, Simren and Chang, raked the highest respectively have the highest degree. Talley has been the most widely used author for measuring centrality of people in social networks, the measurement of the rank centrality and middle.

In the proximity index, Tack JF, Talley NJ, Mayer EA, Tack J and Chey WD have the most relevance to published articles. Generally, these people who have high centrality metrics, have the most impact on the published literature on IBS disease. According to the research results, the following issues in IBS disease were analyzed and can classify the cases mentioned in IBS disease as follows:

Items which were driven from cluster 1 indicate the role of inflammation and inflammatory process in IBS disease especially diarrhea-predominant irritable bowel syndrome (IBS-D). It is also mentioned that Calprotectin played a role in this disease, and in general, IBS-D is associated with inflammatory factors and It also reveals the role of cytokines, interleukin 10 (IL-10), nitric oxide, serotonin transporter, and mast cells in connection with IBS-D. It states that there is a significant relationship between IBS-D, inflammation and the cytokine role with bowel permeability.

The items in this cluster indicate that IBS-D is associated with visceral hypersensitivity, visceral hyperalgesia, and visceral pain, and also we can see a combination of visceral hypersensitivity and visceral hyperalgesia, which confirmed the text Harrison's book. The book says visceral hypersensitivity creates visceral hyperalgesia over time.

Another result is that IBS-D is associated with Crohn and ulcerative colitis, which this link either is related to accompaniment with this two diseases or suggests a similarity in pathology, it means that the cause of IBS-D, Crohn and ulcerative colitis, is inflammation and Influence of inflammatory factors. Also, we observed a significant correlation between IBS-D and colonoscopy according to this cluster items. Then this may indicate in the type, the physicians are more inclined to perform the colonoscopy or the symptoms of illness and evidences are in such a way which leads to colonoscopy.

Cluster 2 refers to the association of mental states, stress, and depression with IBS. This cluster shows the effects of stress and depression on the autonomic nervous system and ultimately their role on IBS disease, and it seems to be the same type of biopsychosocial model. This type of IBS has more relationship to Children (maybe more common in children) and shows that the functional abdominal pains are exist in this type of IBS disease. In addition there is a significant relationship between this type and Heart rate variability. Common treatments used in this type include cognitive behavioral therapy and Hypnotherapy and in their treatment, diet and physical activity have been emphasized.

Cluster 3 points to the role of the intestinal flora in the IBS disease. This cluster refers to the role of dysbiosis and Small Intestine Bacterial Overgrowth (SIBO) in IBS. It also shows that in this type, there are the clinical symptoms of fibromyalgia and migraine.It means that it is indicating the association between fibromyalgia and migraine in IBS with dysbiosis. In these cases, the diagnostic approach can be Lactulose breath test. These patients are usually lactose intolerant. On the other hands, there is a significant relationship between this type and functional bowel diseases. According to this cluster, Eluxadoline and Rifaximin are more applicable in the treatment of this type. In addition, the probiotics can be helpful alongside these drugs.

Cluster 4 refers to the role of carbohydrates and fodmaps in IBS disease, and it mentioned that there is a significant correlation between carbohydrates (especially gluten and disaccharides), fermentation, food allergies, food intolerance, and gastrointestinal symptoms with intestinal microbes. In this cluster the food effect and the role of the intestinal flora was considered and emphasized the low fodmap diet in their treatment. The origin of this type is mostly colon.

Cluster 5 refers to a type of IBS disease in which occurs due to disruption of endocrine and enteroendocrine cells secretion (such as serotonin and somatostatin). In this type, the biomarkers and chromogranin A, food and Microbiota roles were mentioned. In addition, in this IBS disease type, there is low-grade inflammation and the treatment is basically based on psychotherapy.

Cluster 6 is constipation-predominant irritable bowel syndrome IBS disease). In this type, based on the provided information, Abdominal Discomfort, Abdominal pain, Bloating, Chronic constipation, Functional constipation are predominant symptoms. Moreover, Linaclotide, Lubiprostone, and Peppermint oil could be considered as the most effective drugs.

Cluster 7 reports the association between Blastocystis infection and irritable bowel syndrome. This type is associated with celiac disease. The apparent symptoms are Dyspepsia, Functional Dyspepsia, Gastroesophageal reflux, and the most recommended treatment is using the Gluten-free diet.

Cluster 8 items indicate that the disruption in 5-hydroxytryptamine secretion and Brain-gut axis disorder cause functional bowel disorders and it will affect the life quality of patients, in particular, patients with IBS-D and Pi-IBS. In other hands, visceral sensitivity in these cases is observable.

Cluster 9 items are expressing two controversies: one is genetic and polymorphism and another one are psychological distress and Somatization. There is also genetic and psychiatric disorders comorbidity in some IBS cases. Both of these cause disease and also demonstrations of this kind have Somatization aspect.

Cluster 10 reveals the relationship between intestinal function with melatonin and probiotics as well as pain.

Cluster 11 contains 3 items of Diarrhea, Fmri, and Moxibustion. It's noteworthy that no relationship between them has been seen.

6. Result

In general, the result of this analysis showed that we can have another category for IBS disease. We could choose more special treatment for a variety of IBS disease based on common symptoms and more likely mechanisms by collecting the items that have the most links together and all conducted based on clinical studies in a real environment and may have better results. For example, as shown in cluster 3 for IBS disease with fibromyalgia and migraine symptoms, the best diagnosis can be the IBS disease results from the disruption of the natural intestinal flora. Based on the results, the best diagnostic test for these is Lactulose breath test. According to the components of analysis, we would take the best treatment response from the prescription of drugs like Eluxadoline and Rifaximin.

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