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Rapid Communication

Translational Knowledge Map of Covid-19

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ABSTRACT

A translational knowledge map of COVID-19, based on the analysis of scientific papers and networks citation concurrence of terms and keywords of the terms: covid-19, 2019-ncov and sars-cov-2 in leading databases (MEDLINE, web of Science and Scopus), was constructed. Some fields of the research on covid-19 are connected together, differing in structure, content and evolution.

INTRODUCTION

COVID-19 epidemic is an emergent infectious disease caused by respiratory syndrome coronavirus 2 and has been named SARS-CoV-2 (formerly 2019-nCoV) and COVID-19 disease [1-8]. Coronaviruses were first described in 1965 [1] by Tyrell and Bynoe, who cultured the viruses from patients with what was thought common colds symptoms [2,3]. The term "Coronavirus," which described the characteristic microscopic morphology of these viruses, was officially coined in 1968 [3]. SARS CoV-2 belongs to the B-lineage of beta-coronaviruses and is closely related to the SARS-CoV virus. Currently, the suspicion of infection with 2019-nCoV requires two elements as indicators of the case: presence of fever and symptoms of respiratory disease. SARS-CoV-2 apparently managed to make its transition from animals to humans at the seafood market in Wuhan, China [4,5]. Wuhan, is the same place where one of the largest biosafety level 4 (BSL-4) Asia´s laboratories is located, where European, Canadian and American experts collaborate. The initial clinical sign of COVID-19-related disease that allowed detection was pneumonia. Observations so far suggest an incubation average period of five days.

The literature on the medical, virology and epidemiology aspects of the COVID-19 emergency are beginning to abound, revealing important pieces of data towards the understanding and possible solutions of this global problem [4-8]. However, very scarce studies are yet available on the analysis of the conceptual mapping of coronaviruses, in terms of the relationships among all the data produced in the last 25 years in this area. Accordingly, this present investigation shows an analysis of the published documents of COVID-19 in reliable sources, including Medline, Web of Science and Scopus, and the results of the mentioned bases were integrated into a comprehensive bibliometric analysis, including not only basic and applied research, but also how this knowledge begins to involve intellectual property.

METHODOLOGY

The software package Mendeley, a recognized references manager, was employed to collect 547 items of different databases such as Medline, Web of Science and Scopus. To map the knowledge translation of COVID-19, we used the statistical indicator R and graphics, networks and histograms through the software package "Bibliometrix". This methodology has proven very insightful to the knowledge structure of complex diseases cases such as cancer [9] and ebola [10]. Figure 1 shows schematically the analytical methodology we have employed [9,10].

Data was extracted from different scientific and medical databases to analyze the different and relevant concepts that revolve around COVID-19, including 2019-nCoV and SARS-CoV-2. Then, a data framework from different articles was created, along with a structure of the involved knowledge that allows understanding the relationships among the different variables. Thus, results from the different Medline, Web of Science and Scopus databases can be appreciated unified and not separated from each other, as there is the case of the few studies available, which present relevant data, although disconnected and somehow incoherent. Therefore, to estimate the relative risk of transmission of COVID-19, we considered the most relevant scientific databases to estimate the risk of using a single analysis.

RESULTS AND DISCUSSION

We analyzed 547 articles from the information contained in different scientific databases, based on the key terms, so the statistical applications determine the behavior of the variables, as summarized in Table 1.

To create a conceptual structure of COVID-19 one requires not only to properly identify the relevant concepts involved, but also their time and geographical evolution. This allows identifying

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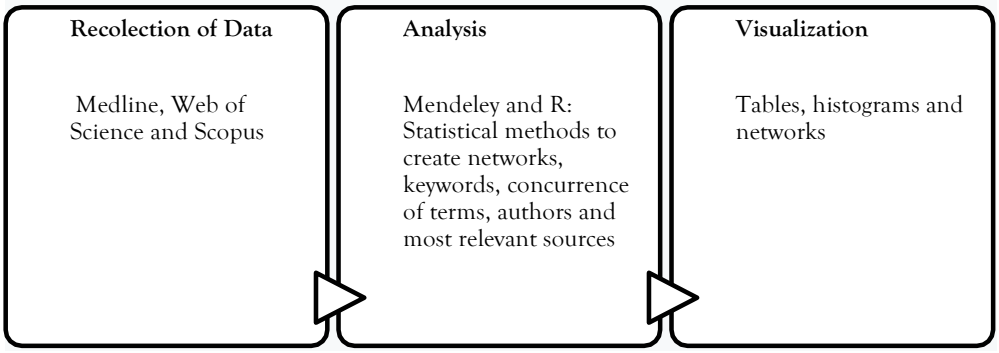

Figure 1: Block diagram of the analysis.

Table 1: Contents of the Data Bases

Description	Results
Documents	547
Sources	184
Keywords	160
Period	2003 - 2020
Authors	2198
Author Appearances	3315
Authors of single-authored documents	70
Authors of multi-authored documents	2128
Single-authored documents	121
Documents per Author	0.249
Authors per Document	4.02
Co-Authors per Documents	6.06
Collaboration Index	5

that 2020 has been the year with the highest number of scientific articles, as shown in Table 2. This would be an obvious result, given the current worldwide concern on this disease. However, the time evolution of the knowledge related to associated keywords reveals interesting facts.

The origin of the references is very important, to identify the interest and influence of various geographical locations, as well as the disciplines which were first attracted to this phenomenon, as observed in Table 1, which provides a first clue that, despite representing an area of scientific interest and public health danger, coronavirus has been basically a set of isolated efforts, localized in few authors and institutions who focused on this subject, with a relatively low Collaboration Index. Certainly, there are few single-auto red papers, but the great percentage corresponded to teams working consistently in the area for nearly 20 years. The most relevant and most cited sources are summarized in Table 3.

Figure 2 allows to better visualize the time evolution of the knowledge generated around coronavirus. Interestingly, and despite that the first reports, published in top journals, date back to the 1960´s [1-3], only in the very recent past a clear increase in the production of knowledge can be appreciated, coinciding with the first claim of novelty in 2014, which has resulted in a patent granted in 2018 [11].

It is also interesting to analyze the most relevant authors in what now is known as COVID-19, not only by names, but also from their professional associations. Thence, we find Y. Wang with 21 publications, X. Li with 17 posts, W. Wang with 15 articles, Y. Yang with 15 papers, among others, as shown in Figure 3.

Then, the constructed database was filtered by keyword layers: Abstracts, Titles and Author's keywords, as shown in Figures 4, 5 and 6. Notice that, despite that China was officially the origin of COVID-19, in the keyword layers the term "China" is not among the most relevant ones, except when comes to authors. "Coronavirus", "Patients" and "Humans" are the leading terms in the literature. The term "COVID" is also among the most important indicators. Table 4 shows the occurrence of the keywords.

Figure 7 shows the concurrence network of the set of articles analyzed. When Centrality is analyzed, Table 5, the term "Humans" is the most important one, followed by "China" and "Coronavirus infections", with the rest of the nodes having very little contribution. This allows quantifying the influence of those particular nodes within the network of knowledge formed by all the articles and patents.

As it could be expected, COVID-19 involves a wide variety of terms, concepts, references, citations and actions which, at first thought, could seem impossibly to classify or organize in a coherent way, given the multidisciplinary character of the problem. However, as it can be appreciated in Figure 8, it is possible to structure all the information available into few conceptual clusters, which can be, in turn, summarized by basically 3 concepts, namely "China", "Coronavirus" and "Disease outbreak". This has been consistent in the last 17 years, which allows to understand why it not should be surprising that a "Coronavirus

Finally, if we redraw that data of Figure 9 into a conceptual map, Figure 10, which corresponds to the actual Conceptual Map of COVID-19, which allows identifying the modularity of the

Table 2: Yearly scientific production.

Year	Articles
2003	2
2004	1
2006	1
2011	1
2019	1
2020	522

Table 3: Most relevant bibliographic sources.

Source	Articles
Lancet (london england)	34
Journal of medical virology	32
Chinese journal of tuberculosis and respiratory diseases	18
BMJ (clinical research ed.)	16
Radiology	16
Journal of clinical medicine	15
The new england journal of medicine	13
Travel medicine and infectious disease	13
Euro surveillance : bulletin europeen sur les maladies transmissibles	12
The lancet. infectious diseases	12
Intensive care medicine	10
The journal of infection	10

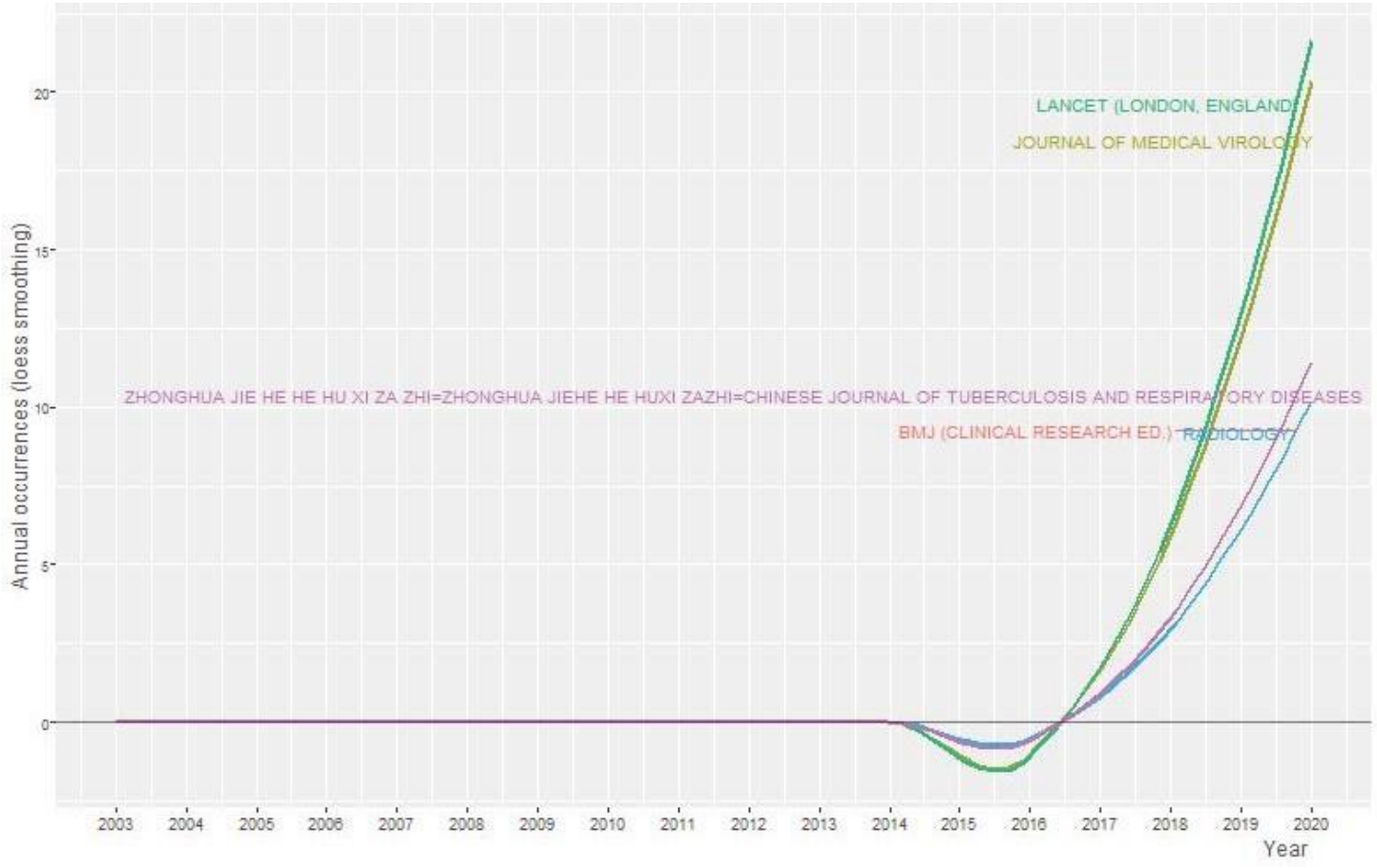

Figure 2: Time evolution of sources.

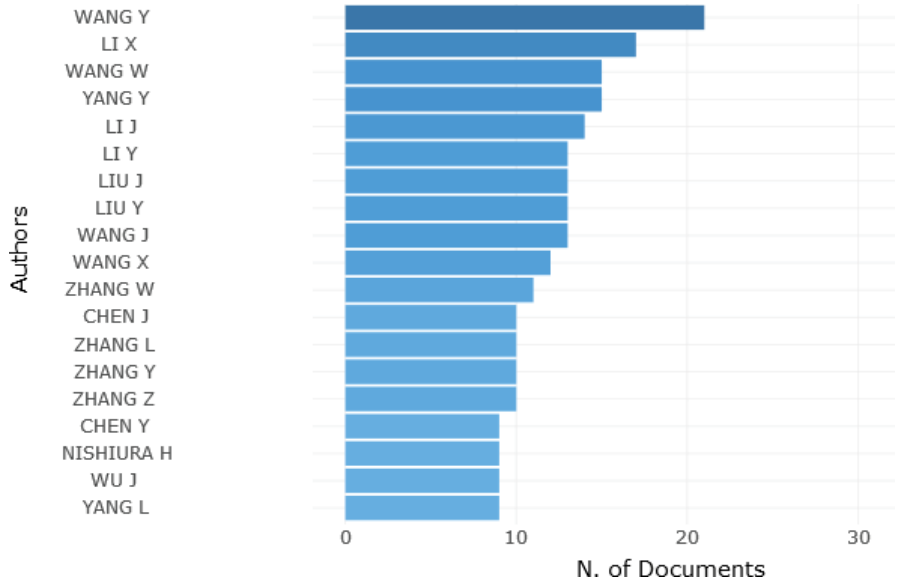

Figure 3: Production by main authors.

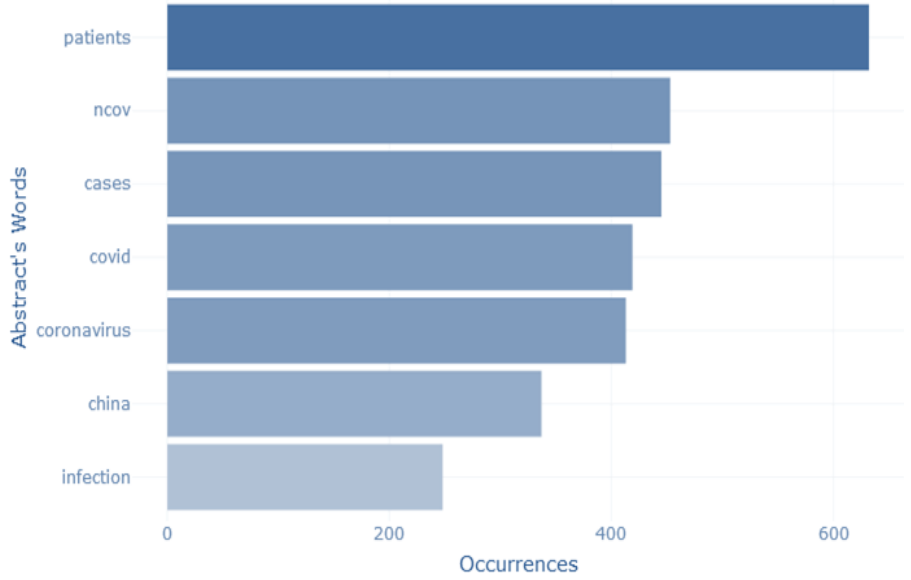

Figure 4: Layer Abstracts.

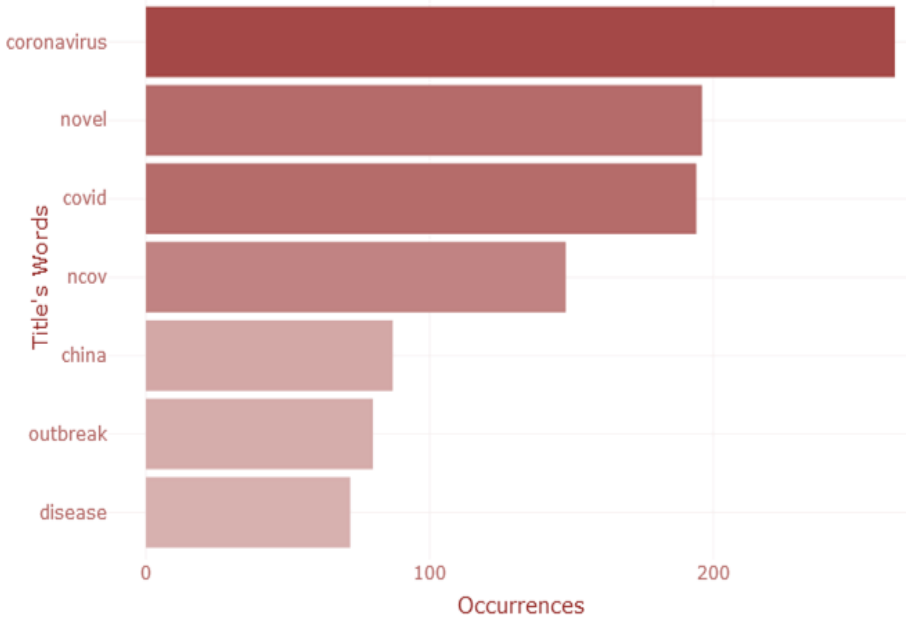

Figure 5: Layer Titles.

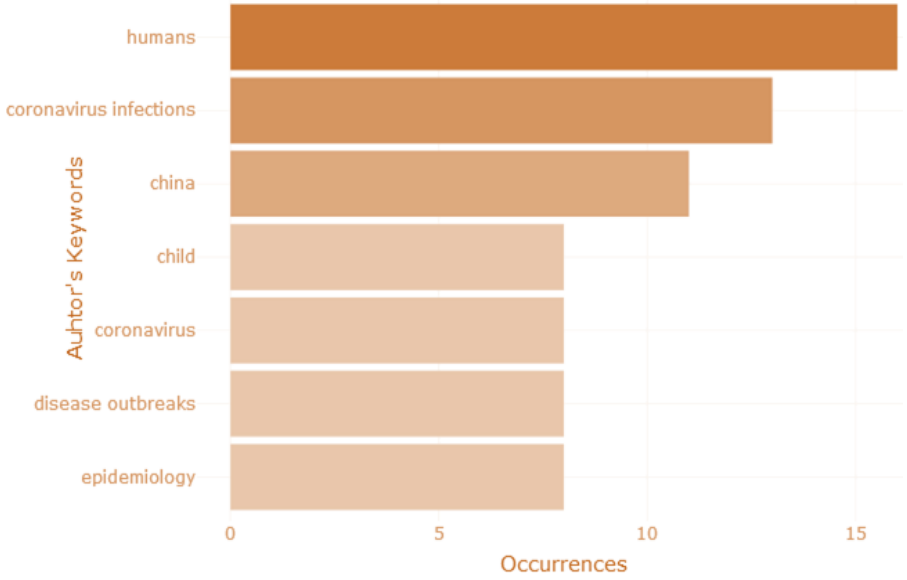

Figure 6: Layer Author's keywords.

Table 4: Ocurrence of keywords.

Words	Occurrences
Patients	632
Outbreak	80
Novel	196
Ncov	601
Infection	248
Humans	16
epidemiology	8
disease outbreaks	8
Disease	72
Covid	613
coronavirus infections	13
coronavirus	677
coronavirus	8
china	435
cases	445
TOTAL	4,052

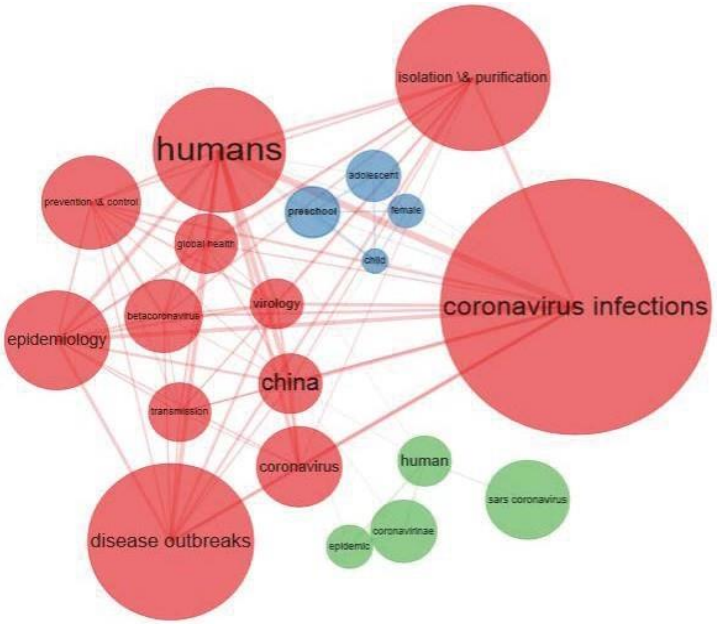

Figure 7: Concurrence network of articles.

Table 5: Centrality of terms.

Term	Centrality
Humans	47.7859514864345
China	38.2912056482265
Human	19.4310344827586
coronavirus infections	17.6666184907487
Child	0.98803659394792
Epidemiology	0.51042434528946
isolation & purification	0.35951366609041
Virology	0.35951366609041
Betacoronavirus	0.19368131868131
prevention & control	0.19368131868131
disease outbreaks	0.15254237288135
Transmission	0.06779661016949

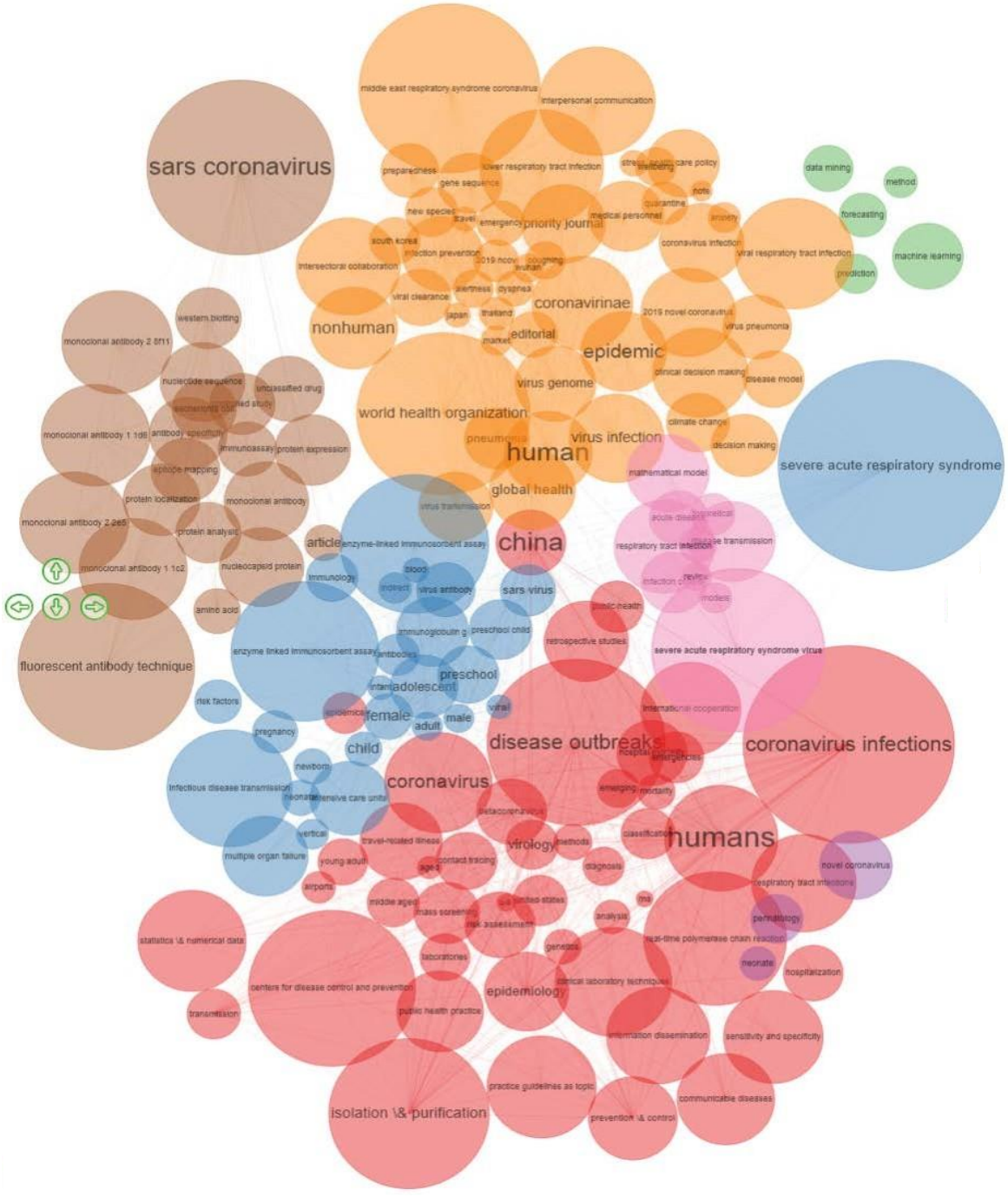

Figure 8: Conceptual structure of COVID-19.

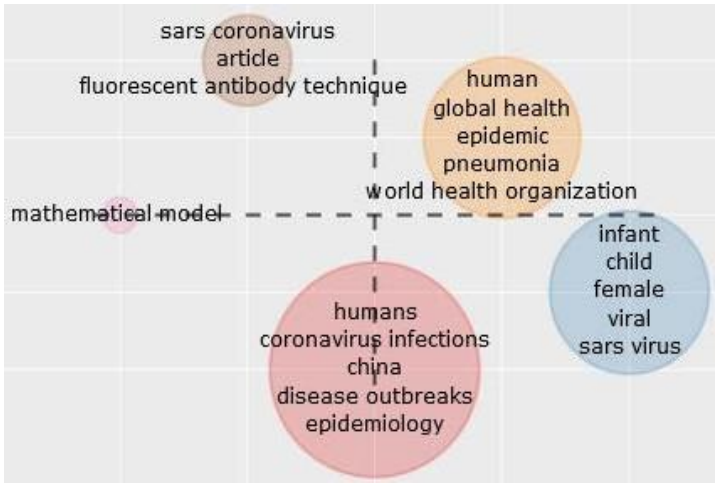

Figure 9: Conceptual Map of COVID-19.

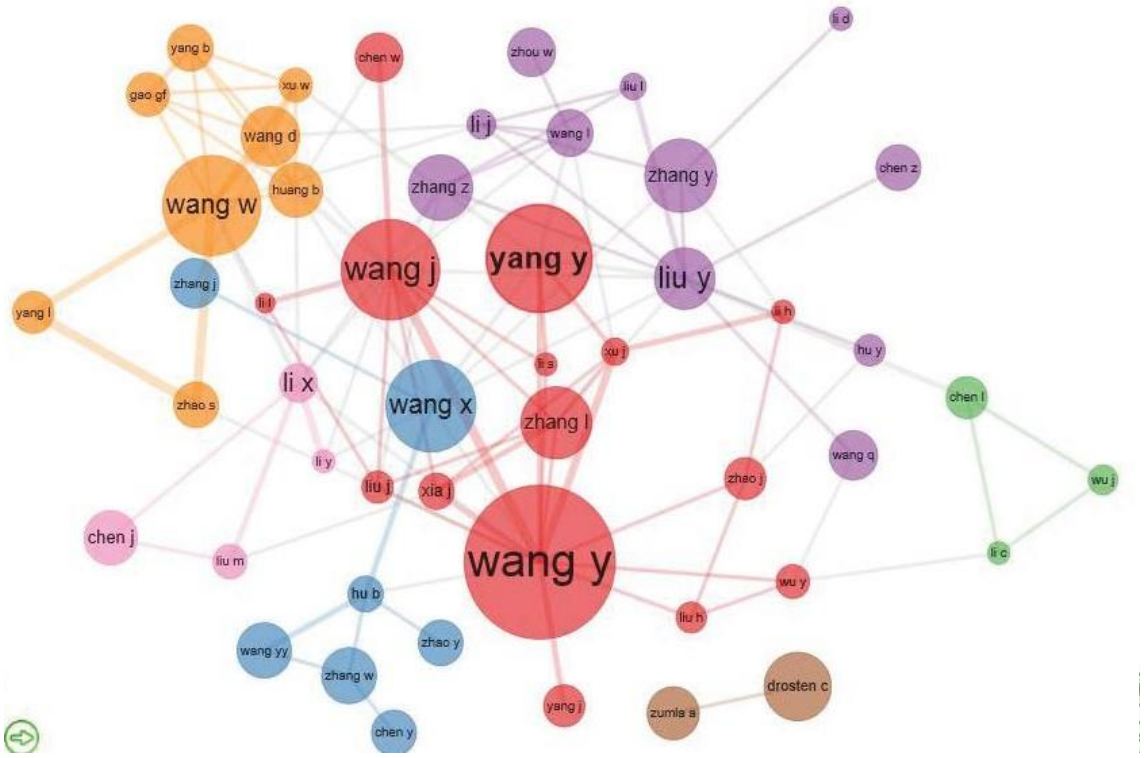

Figure 10: Collaboration of the authors.

nodes that represent the entire database built from the scientific information available.

A knowledge cluster is centered at the origin (SARS coronavirus), while the other focus on the causes (epidemic) symptoms-free (infant and child), creation of scenarios (mathematical models) and on the fibal consequences (coronavirus infections). A translation process of the knowledge in research through a set of items that link the infection by covid-19 with pneumonia via high degree of infection and transmission in humans was found.

CONCLUDING REMARKS

A translational knowledge map of COVID-19 was constructed from the available literature data on articles, reports and patents, aiming to provide a relevant vision of the current stage and an overview of the knowledge structure of COVID-19. Furthermore, this methodology has the potential to become a useful assessment tool for monitoring the evolution of knowledge on various emerging disease such as COVID-19. Finally, it should be mentioned that, despite that the fundamental scientific fact is that COVID-19 outbreak began affecting China, and therefore these terms are at the center of the conceptual structure, there exist less visible nodes identified by terms such as: "war", "biotechnology", "fear", "economic" and "economy", which appear related to patents.

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