



## **A Systematic Review on the Methods Developed to Detect COVID-19 Patients**

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### **Abstract**

A review has been presented in this paper on “Methods developed to detect COVID-19 patient” and Bibliometric survey presented based on the methods developed to detect COVID-19 patients. The first case of Corona virus disease recorded in China in the month of December 2019. Within few days, it spreads all over the world. Most of the researchers still working on methodologies to detect patients who are suffering from this disease using X- ray images and CT images by collecting data from various hospital and standard data sets. To review the papers published on the COVID-19, a search is made using key ‘COVID-19’ in Scopus database and found 167,008 documents published in the years 2020 and 2021. To review the performance of the methods/ Techniques developed, the Scopus database is used for collecting the papers. The number of documents published to detect COVID-19 patients are 1802 and Bibliometric analysis is conducted on these documents. Out of these documents, paper published on detecting COVID-19 patients using X-ray images having minimum number of citations 11 are used to compare the performance of the method. The statistical analysis and Network analysis is also carried out using VOSviewer1.6.16 software. The Source for all tables and figures is [www.scopus.com](http://www.scopus.com). The data is assessed on 14<sup>th</sup> July, 2021.

**Keywords:** COVID-19, Isolation, Pandemic, Network Analysis, Statistical Analysis

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### **Introduction**

In Wuhan, a series of pneumonia cases of unknown cause emerged in December 2019[1]. The disease which is spread swiftly in chain and more than 210 countries in the late December 2019 and early of 2020 is named as Coronavirus disease 2019 (COVID-19). The COVID-19 patients do not have common symptoms.

Some may have fever; some have cough and others do not have fever. Some patients even do not have abnormal radiology finding [2]. Chinese scientists are able to isolate a novel coronavirus, severe acute respiratory syndrome coronavirus 2 by Jan 7, 2020 [3-6]. 2019-nCoV is different from both MERS-CoV and SARS-CoV. A new family member (7th member) infected humans [7].

The characterization and identification of new coronavirus is reported in [8]. In United States, the details of identification of first patients and diagnosis details are described in [9]. In February 2020, community transmission was detected in the state of Washington [10]. Antibody responses are presented in [11]. Various methods were developed to identify the patients like symptoms, medical images (CT, X-ray, etc.) [12-18].

Zhou, S et al., presented a report based on CT images and clinical data [19]. Mehta V et Al., presented malignant diagnosis [20]. Guidance for detecting disease provided to radiologists by Simpson S et al., using CT images. Various variable used for analysis are presented in [22-23]. The experimental results are compared with laboratory results.

Using the advancement in AI, various semi-automated and fully automated methods were developed. The automatic method implemented using darknet model has the classification accuracy 98.08% for binary and 87.02% for multi-class cases [24]. 96.78% accuracy is obtained using Transfer Learning based Neural Networks [25]. COVID-net ( a deep neural network) has achieves 93.3% accuracy [26]. CovidGAN ( based on Auxiliary Classifier Generative Adversarial Network) produces synthetic images using these images CNN accuracy increased from 85 % to 95% [27]. SqueezeNet (light network design with Bayesian optimization additive) has an accuracy performance of 98.3% and 100% for the single recognition of COVID-19 [5]. nCOVnet has accuracy 97.62% [28].

COVID-19 detection using Explainable Deep Learning obtained an accuracy of 97% [29]. CovXNet(A deep convolutional neural network), obtained an accuracy of 97.4% for COVID/Normal, 96.9% for COVID/Viral pneumonia by utilizing depth wise convolution with varying dilation rates for efficiently extracting diversified features [30]. CNN-LSTM (combined CNN and long short-term memory) deep network has an accuracy of 99.4% [31]. ResNet50+ SVM achieved 95.33 % accuracy [32]. The algorithm based on DNN and CNN has the accuracy 93.2% [33]. DCNN-based system achieved 97.81% accuracy in complex multiway classification [34].

DL based algorithm proposed in [35] can identify COVID-19 in less than two seconds with an accuracy of 95.61%, and the algorithms proposed in [36],[37] achieved 98.93% and 94.80% accuracy. Pre-trained ConvNet encoder (to capture image feature) based system achieved an accuracy of 95.6 %. Majority vote-based classifier achieved 98.02% accuracy [38]. COVID-CheXNet system has obtained accuracy rate of 99.99% [39]. 95% accuracy is obtained DL and CNN based algorithm proposed in [40]. Stacked deep convolution network InstaCovNet-19 has achieved 99.08% accuracy [41]. CNN with the combination of machine learning algorithms achieved 98.5% accuracy [42], [43]. DCNN proposed by El-Rashidy et al., and Jain, R., have an accuracy of 97.95%, 97.97% respectively [44],[45]. COVID-DeepNet has an accuracy rate of 99.93% [46].

## **Materials and methods**

### **Search strategy**

The review was carried out by searching Scopus electronics database for all year. The search conducted on 14<sup>th</sup> July 2021 using the key term “detection of COVID-19 patients”.

### **Documents selection**

The documents obtained as a result from the data base are carefully examined. The documents which are highly correlated with the term “detection of COVID-19 patients” and its applications are selected for review.

### **Document Analysis**

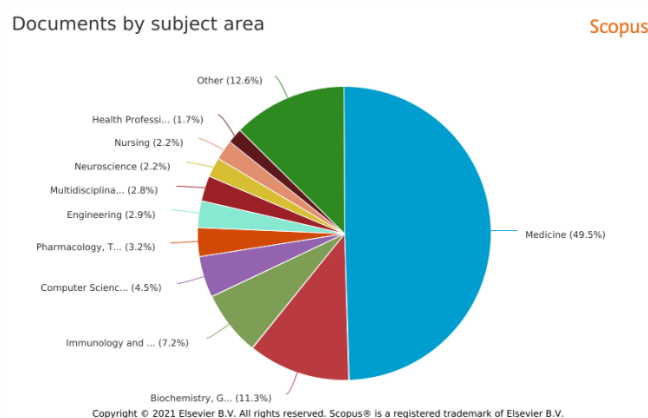
The documents are analyzed based on identification COVID\_19 patients using symptoms, medical reports and parameter considered by analysts. The results obtained by the authors in various application are also studied.

The statistical analysis and Network analysis is also carried out using VOSviewer1.6.16 software. It provides a very effective way to analyze the co-authorship, co-occurrences, citations and bibliometric couplings etc.

## Results and discussion

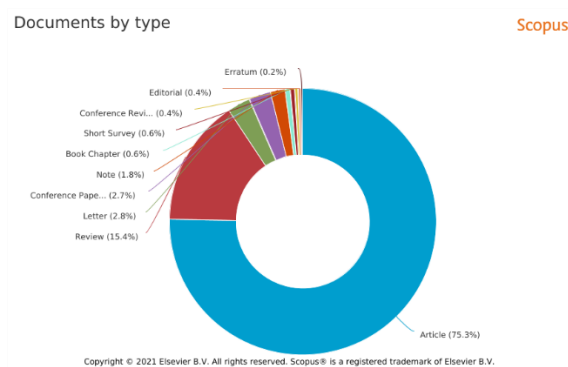
### Statistical Analysis

In the year 2020, 914 documents were published which is the highest number of followed by 2021. In the year 2021, there are 888 documents published still there is scope for publishing a greater number of documents. Great research is going on in this area. Plos One has published 41 documents during the period of study which is highest under the category of sources. This is followed by Journal Of Medical Virology with 26 documents. Next to it is Frontiers In Medicine with 31 documents. Figure 1 shows the documents by subject area. Highest percentage of documents published in the 'medicine' area equal to 49.5% and followed by Biochemistry with 11.3%.



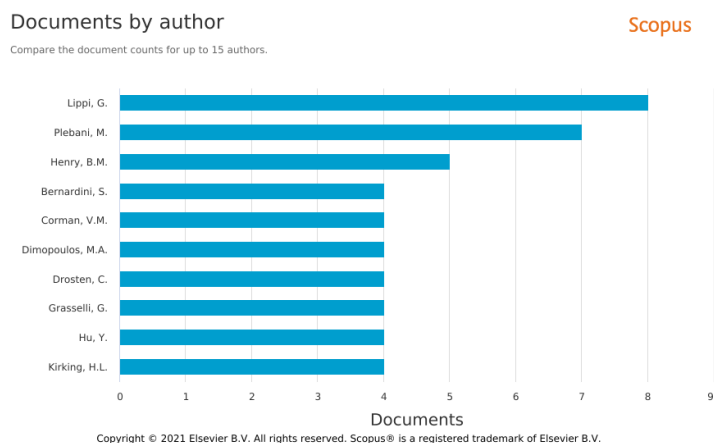
**Figure 1** Documents by Subject Area

Figure 2 Shows the distribution based on type of documents. Majority of the published documents are articles followed by review documents. There are 75.3% Articles and 15.4% review documents



**Figure 2** Distribution based on type of document

US has published 439, which is the highest number of documents followed by China and Italy. China has published 296 documents and Italy has published 214 documents during 2020-2021. Figure 3 shows documents by author. Lippi G., has published 8 documents in this area which is highest and followed by Plebani, M., with 7 documents.



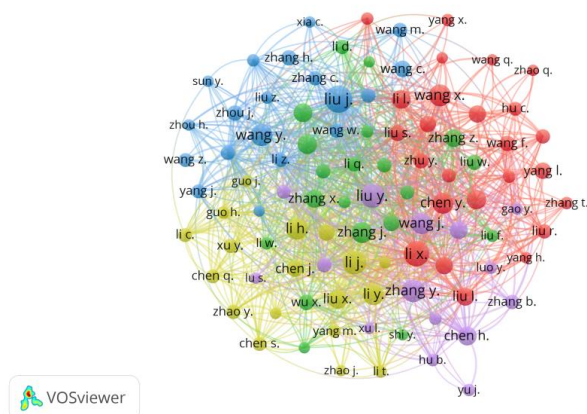
**Figure 3** Documents by author

Huazhong University of Science and Technology has published 54 number of documents which is highest followed by Tongji Medical College with 53 documents. NNSF of China has sponsored 87 documents which is highest in the category of funding agencies. Next to it is National Institutes of 85 documents.

### Network Analysis

#### Co-authorship in terms of Authors

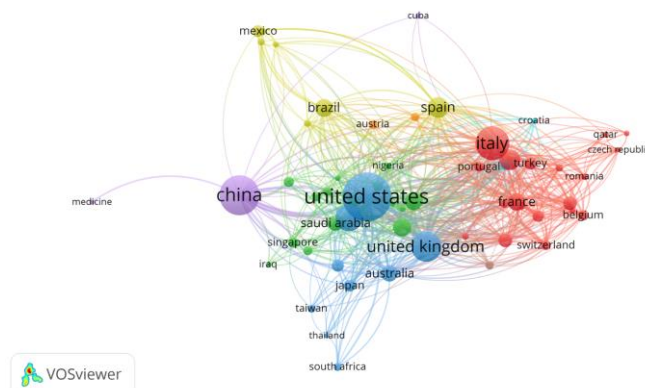
The documents with more than 30 authors are ignored. To analyze the network analysis of Co authorship, number of documents published by an author is 5 or more considered. 100 authors out of 11832 authors, met the criteria. Liu y has total link strength of 100 which is the highest in the co-authorship analysis with 21 documents. Li j has 99 links with 489 citations for 27 documents. Figure 4 shows Network analysis.



**Figure 4** Co-author relationship with each other

#### Network analysis for Co-authorship in terms of Country

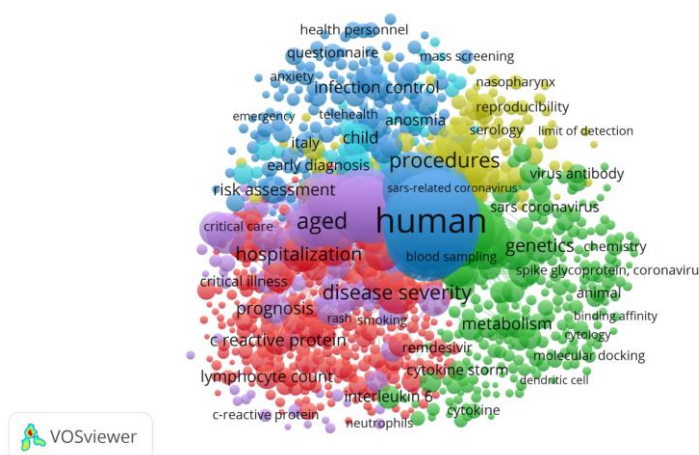
Totally there are 206 countries identified which are publishing documents on the said topic. Out of 206 countries, 58 countries met the minimum threshold value 5 documents per country. US is found to have the highest citations of 13001, and the link strength of 278 as shown in table 8. This is followed by United Kingdom with link strength of 209. Figure 5 shows the network of co-authorship in terms of country.



**Figure 5** Co-authorship in terms of Country

#### Co-occurrence analysis in terms of all keywords

Out of 12255 keywords, 1725 keywords met the threshold value 5. The keyword “human” is having 41658 link strengths with 1372 times occurrence in various documents as shown in figure 6. The keyword “coronavirus disease 2019” having 35980 link strengths with 1065 times occurrence in various documents.

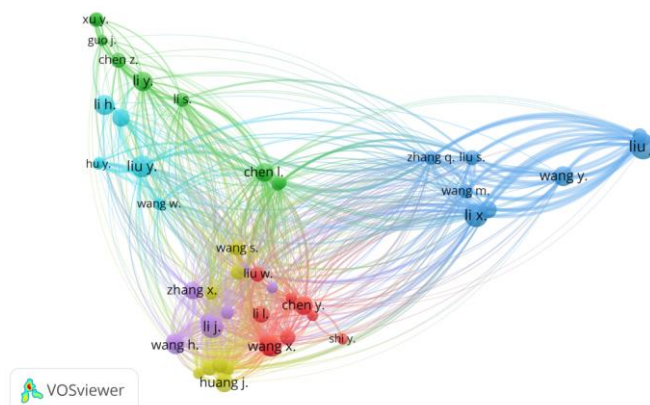


**Figure 6** Co-occurrence Analysis in Terms of All Keywords

#### Co-occurrence analysis in terms of Author keywords

Out of 3695 keywords by the authors, 161 keywords met the threshold value 5 per author. “COVID-19” keyword occurrence is 1007 times with 1659 link strength as shown in table 10. This is followed by the keyword ‘sars-cov-2’ with 444 occurrences and link strength of 881. Figure 7 shows the occurrence analysis in terms of author keywords.





**Figure 9** Bibliographic coupling by Authors

## Conclusions

The methods developed to detect COVID-19 patients using X-ray images are used for performance analysis. The papers considered on this topic contains methods based on Neural Networks and these methods efficiency more than 95%. No method has obtained 100% accuracy for detection COVID-19 patients but obtained 99% and more. Bibliometric survey has been carried out on Identification of COVID-19 Patient without specifying year range. There are 1802 documents found on the topic of Identification of COVID-19 Patient. The analysis shows that 1802 documents are published in the years 2020 and 2021. Extensive network analysis and Bibliographic coupling in terms of Documents and Authors is also carried out.

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