

A Bibliometric Analysis and Visualisation of Research Trends in Nano diagnostic

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Abstract

Material engineering and or Nanotechnology had revolutionized the Nano diagnostic segment by improving the quality of images, detection, and by offering help in treatments. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Nano diagnostic”. All published articles related to “Nano diagnostic” from “Scopus”, were analyzed using the VOS viewer to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “Nano diagnostic” and also to find out the trends related to the same. The most active journal in this research domain was the International Journal of NanoMedicine. The most active country was the United States of America. The leading organizations engaged in the research regarding Nano diagnostics were the Harvard University of USA and Shivaji University of India. The most active authors who had made valuable contributions related to Nano diagnostics were Li Z, and Wang L.

Keywords: Nanomedicine, Nano diagnostics, Material engineering, Bibliometric analysis, VOS viewer,

INTRODUCTION

The concept of Nanotechnology had started in 1970, a Nanomedicine is a relatively new branch of science [1]. Nanotechnology had been a breakthrough in material engineering and it opened Nanotechnology into the pharmaceutical and medical sectors. Nanomedicine has been defined as the monitoring, repair, construction, and control of human biological systems at the molecular level using engineered Nanodevices and nanostructures [2]. The major applications of Nanomedicines are in detection, diagnostics, monitoring, and therapeutics [3][4]. The application of Nanotechnology for screening, diagnosis, and treatment is collectively known as “Nanomedicine”. Nanomedicines are more personalized in nature and a blend of refined concepts of molecular medicine, integrating genomics and proteomics. Generally, the application of Nanomedicine can be classified into three categories of analytical/diagnostic tools, drug delivery, and regenerative medicine [2][5][6].

The application of Nanobiotechnology in molecular diagnosis is called Nano diagnostics [7]. Nano diagnostics is an important application of Nanotechnology and material engineering [8]–[13] in medical diagnostics [14], [15]. Infra-red imaging technology and an external high-frequency alternating magnetic field can be used to detect and treat cancer at early stages [16]. Similarly, Nano diagnostics can be applied to spot cancer biomarkers

[7][17]; Nano diagnostics can be used for early detection and treatment of HER-2-positive cancers [18][18]. Nano diagnostics had been successful for detecting infectious pathogens in water [19]; for detecting rice pathogenic fungus (*Pyriculariaoryzae*), causing rice blast [20]; rapid and specific detection of highly dangerous infections [21][22] detection of avian influenza virus [23]. Nanotechnology offers impressive results in developing diagnostic equipment for the detection of Hepatitis B virus [24]. High-quality imaging is possible by using Nanoparticulate contrast systems which offers better stability and yields [25]. Cost-effective and high-quality diagnostic tools can be developed for the detection of dengue infection using Nano-sized materials including liposomes, nanowires, and Nanopores, coupled to conventional fluorescence and many more[26].

This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Nanomedicines. This article is arranged into four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and discussion. The fourth section deals with the conclusion. The following research objectives and research questions were framed for conducting bibliometric analysis systematically.

1.1 Research Objectives

- a) To consolidate the literature regarding Nano diagnostics
- b) To find out the trends related to research in Nano diagnostics

1.2 Research Questions

- a) Who are the active researchers working on Nano diagnostics?
- b) Which are the main organizations and countries working on Nano diagnostics?
- c) Which are the main journals related to Nano diagnostics?

RESEARCH METHODOLOGY

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE(Nano diagnostic)on 17/01/2021. All the tables in this paper were created by using Microsoft Excel and VOS Viewer. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation.This paper had been inspired by bibliometric analysis in its presentation style, analysis, and methodology from the works [27]–[33].

RESULTS AND DISCUSSION

1.1 Results

This first round of search produced an outcome of 111 documents, in four languages, out of which 109 documents were in English. The classification of document categories is shown in Figure 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters “Article” and “English” the second round search produced an outcome of 41 English articles (both open access and others) and had been used to conduct bibliometric analysis and visualization using

VOS Viewer. The English research articles in this domain since 2004 had been shown in Figure 2.

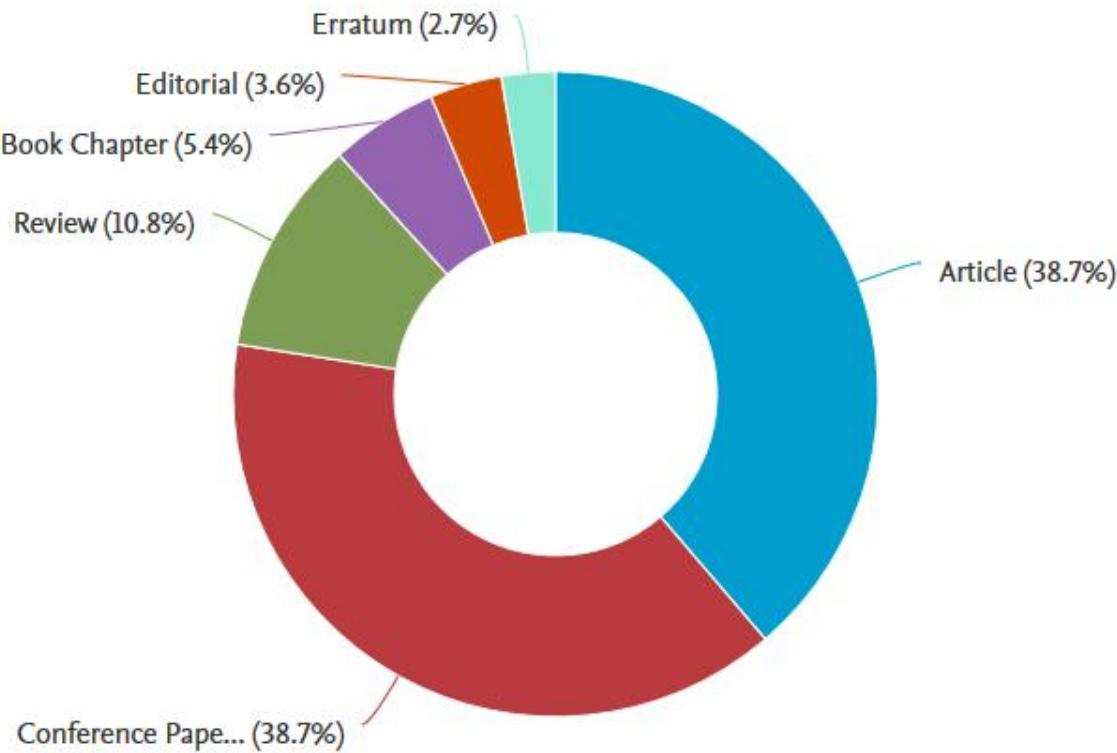


Figure 1: Classification of the documents on “Nano diagnostics”, Source: www.scopus.com

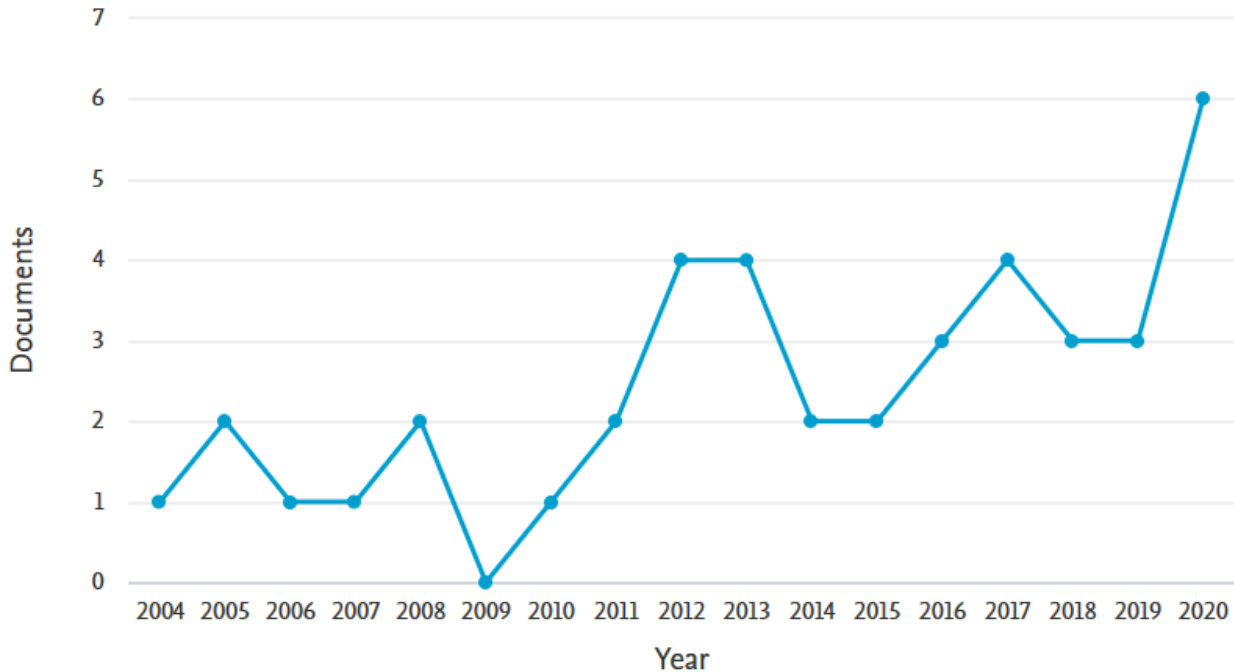


Figure 2: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in figure 3. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as two and the minimum number of citations of authors as one. This combination plotted the

map offive authors, in two clusters. The overlay visualization map of co-authorship analysis plotted in Figure 3, points out the major researchers with their strong co-authorship linkages and clusters involved.

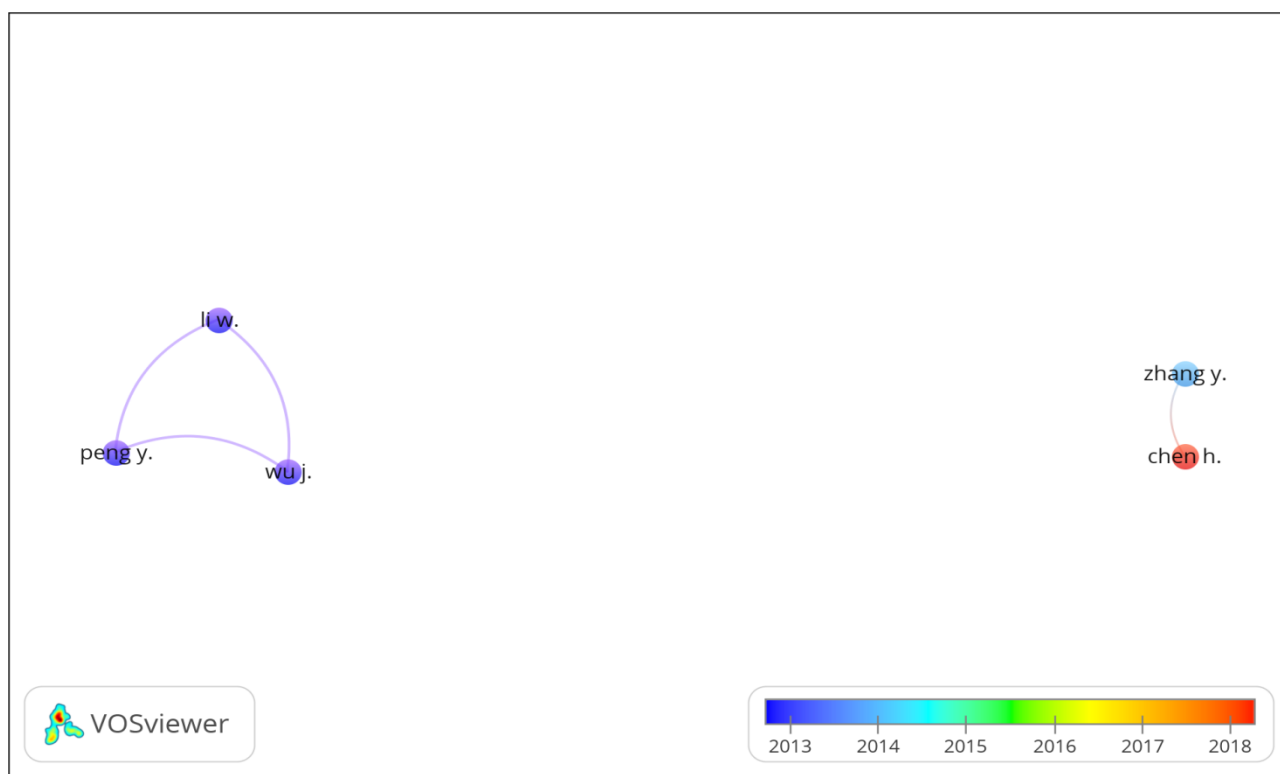


Figure 3: Co-authorship analysis on basis of authors

The citation analysis of top authors had been shown in table 1, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of an author as one and the minimum citations of an author as one.

Table 1: Highlights of most active authors

Description	Authors	Documents	Citations	Average citations per documents	Link strength
Authors with the highest publication	Chen H.	2	44	22	7
	Li W.	2	16	8	8
	Peng Y.	2	16	8	8
	Wu J.	2	16	8	8
	Zhang Y.	2	24	12	5
Authors with the highest citations	Li Z.	1	146	146	1
	Wang Z.L.	1	146	146	1
Authors with the highest co-authorship links	Akam E.A.	1	3	3	11
	Caravan P.	1	3	3	11
	El Fakhri G.	1	3	3	11

	Gholami Y.H.	1	3	3	11
	Josephson L.	1	3	3	11
	Kolnick A.	1	3	3	11
	Kuncic Z.	1	3	3	11
	MaschmeyerR.	1	3	3	11
	NormandinM.D.	1	3	3	11
	Pan X.-Z.	1	3	3	11
	WilksM.Q.	1	3	3	11
	Yuan H.	1	3	3	11

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 4. This combination plotted the map of 4 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

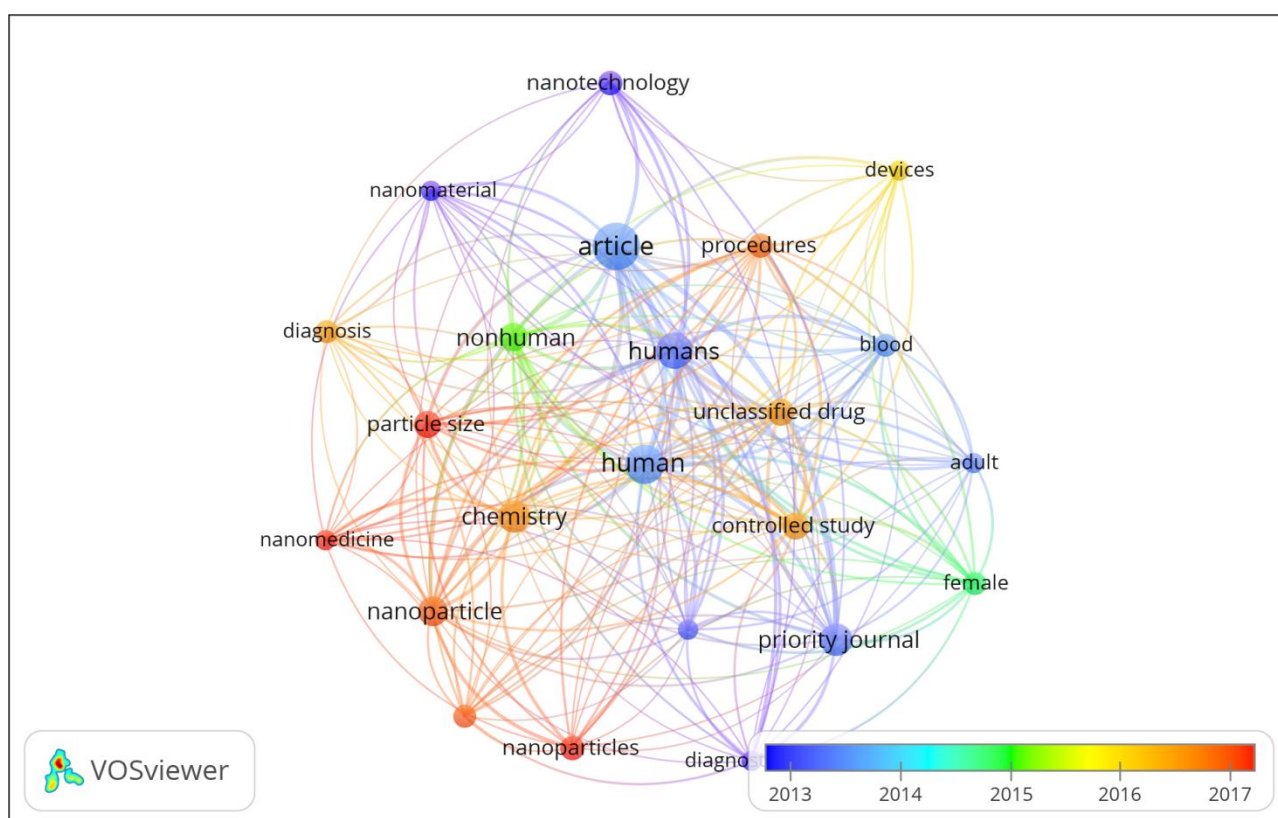


Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on “Nano diagnostics” had been found out by the volume of publications and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. The leading organization in the research regarding “Nano diagnostics”, is highlighted in table 2 (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Harvard University	United States of America	2	33	16.5
Shivaji University	India	2	57	28.5

Co-authorship analysis of the countries engaged in the research on “Nano diagnostics” had been shown in Figure 5. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as three and the minimum number of citations of authors as one. This combination plotted the map of five countries, two clusters. The overlay visualization map of co-authorship analysis plotted in Figure 5, points out the main countries with their strong co-authorship linkages and clusters involved.

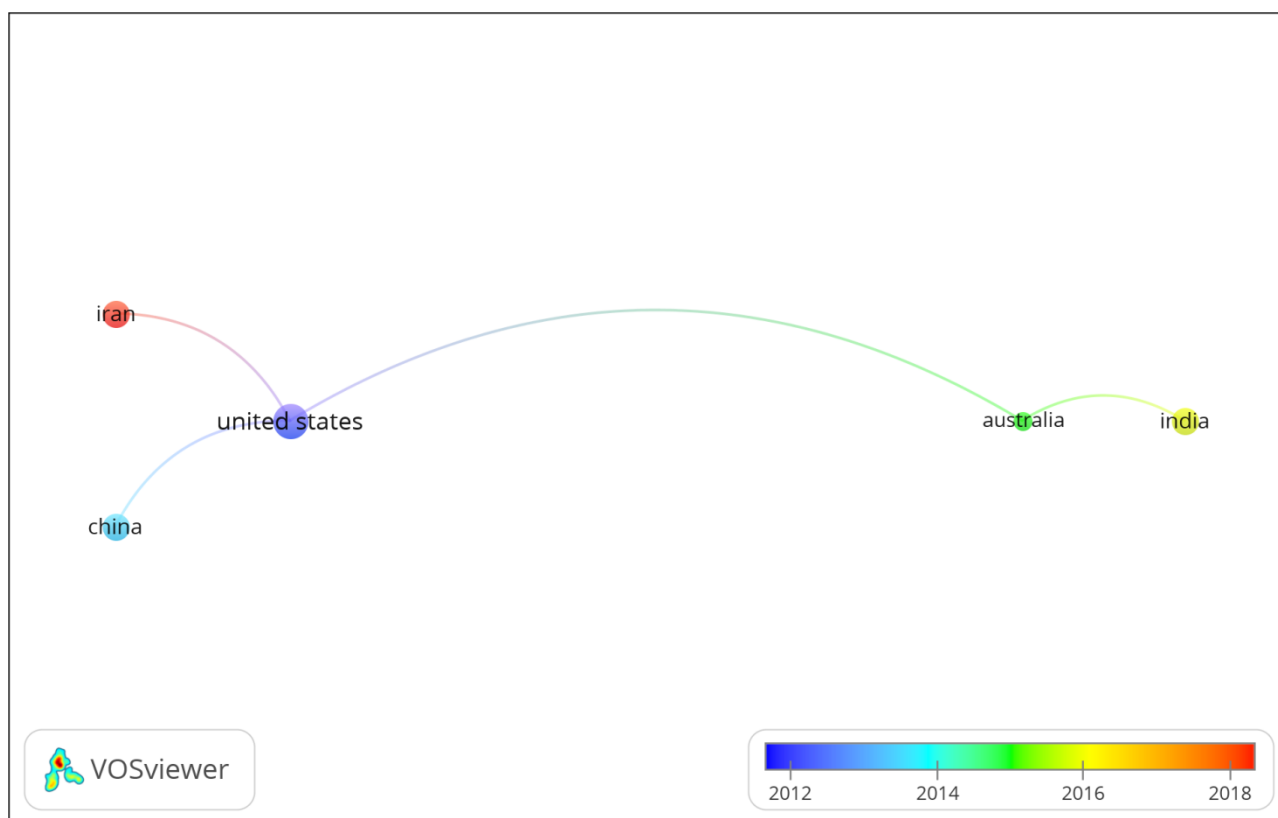


Figure 5: Co-authorship analysis on basis of countries

The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of a country as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

Description	Country	Documents	Citations	Link strength
The country with the highest publication, citations, and co-authorship links	United States of America	10	279	5

The most active country in this research domain was the United States of America, with the highest number of publications, and citations.

Link analysis and citation analysis were used to identify the most active journal in this research domain. We have taken the parameters of the minimum number of documents of a journal as one and the minimum number of citations of a journal as one for the link analysis and citation analysis. Highlights of the most active and relevant journals related to “Nano diagnostics” are shown in table 4. Table 4 shows the journal activity of this research domain through parameters of publication volume, citations, and co-authorship linkages.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents	Link strength
Journal with the highest publications, and co-authorship links	International Journal of NanoMedicine	2	3	1.5	0

From the above discussion regarding the bibliometric patterns in the research regarding Nano diagnostics, this research had observed a gradual increase in research interest regarding Nano diagnostics from the starting of the millennium and the momentum is going on positively. This points out the relevance and potential of this research domain (Refer to Figure 2). The most active authors in this research domain Li Z, and Wang L with the highest publication, citation, and co-authorship links respectively (Refer to table 1). The overlay analysis of top countries researching pacemaker battery indicates that the United States of America was the leading countries relating to the highest number of publications, citations, and co-authorship links (Refer to figure 5). The top journal of this research domain was identified as the International Journal of NanoMedicine. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding the battery of pacemakers.

CONCLUSION

Nano diagnostics was an interesting research domain and the most active journal related to this research domain was the International Journal of NanoMedicine. The most active country was the

United States of America. The leading organizations engaged in the research regarding Nano diagnostics were the Harvard University of USA and Shivaji University of India. The most active authors who had made valuable contributions related to pacemaker batteries were Li Z, and Wang L. This research domain offers a new avenue for researchers and future research can be on innovations.

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