Global Trends in Cancer Nanotechnology

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This study presents a new way to investigate comprehensive trends in cancer nanotechnology research in different countries, institutions, and journals providing critical insights to prevention, diagnosis, and therapy. This paper applies the qualitative method of bibliometric analysis on cancer nanotechnology using the PubMed database during the years 2000-2021. Inspired by hybrid medical models and content-based and bibliometric features for machine learning models, our results show cancer nanotechnology studies have expanded exponentially since 2010. The highest production of articles in cancer nanotechnology is mainly from US institutions, with several countries notably the USA, China, UK, India, and Iran as concentrated focal points as centers of cancer nanotechnology research, especially in the last five years. The analysis shows the greatest overlap between nanotechnology and DNA, RNA, iron oxide or mesoporous silica, breast cancer, and cancer diagnosis and cancer treatment. Moreover, more than 50% of information related to the keywords, authors, institutions, journals, and countries are considerably investigated in the form of publications from the top 100 journals. This study has the potentials to provide past and current lines of research that can unmask comprehensive trends in cancer nanotechnology, key research topics, or pmost productive countries and authors in the field.

Cancer | Nanotechnology | Nanomaterials | Bibliometric Measures | Machine Learning Models | Visualizing Networks

1. Introduction

Nanomaterials are perhaps the most important scientific advancement in the last decade and have revolutionized many segments of society and technology including computers and electronics, engineering, military applications, and many others. There is no more important application benefitting human health than nanomedicine, indeed cancer nanotechnology seeks to apply nanoparticles and nanoconstructs to improve cancer detection, diagnosis, imaging, and therapy while reducing toxicity associated with traditional cancer therapy [1][2]. A great deal of information in this important new cancer nanotechnology emerging sub-discipline has been published. Thus, to inform the field and provide guidance to researchers, clinical practitioners, and nanotechnologists, it is important to take stock of where the field stands today, in order to see the opportunities and challenges for the future.

Numerous topics related to the applications of cancer nanotechnology were studied, from cancer detection and diagnosis to tumor imaging, drug delivery, and cancer therapy, and mainly concerned with the development in nanotechnology for the future of clinical cancer care. Our aim in this study was to collate and organize this wealth of information to investigate global directions and trends of cancer nanotechnology research from appropriate

datasets of accredited literature, independent hubs, and scholarly research sources. We accumulated all data on cancer nanotechnology from the PubMed database during 2000-2021 [3]. This analysis shows what direction the field has previously been and currently trending and how the field has changed by exploring the most notable countries, common keywords, authors, institutions, and journals.

Great advancements in cancer nanotechnology have come in drug delivery, development of new materials, and a basic understanding of nanoparticles pharmacokinetics, biodistribution, biological and clinical activity [4][5][6][7]. One major direction being “monitoring, repair, and improvement of human biologic systems”[8] . The link of cancer nanotechnology into clinical practice requires careful clinical, ethical, and societal consideration and a multidisciplinary approach. Advances in combination therapies based on transdisciplinary approaches have been made possible by interconnecting technology developers, physicists, chemists, and data scientists collaborating with clinicians and biologists to identify and devote effort to principal complications and enigmas clinical translation of cancer care and treatment [9][10][11][12][13][14][15][16]. Multiple studies have shown that cancer nanotechnology has significant potential to improve current standards of care[17][18][19][20][21][22][23] . In addition, a variety of nanomaterials were under investigation and development with the applications related to cancer nanotechnology, including biodegradable controlled-release polymers and polymeric nanoparticles, the dendrimer-mediated formation of multicomponent nanomaterials (*e.g.,* receptor-targeted/peptide-conjugated dendrimer-encapsulated nanoparticles), lipid-based microparticles, organometallic complexes, and carbon- and silicon-based nanostructural materials [[20][21][22][23]. Biological performance of materials, biocompatibility, safety and toxicology of engineered nanomaterials, size distribution and size-dependent diffusion, surface chemistry, and their properties in biologic systems are also considered in the selection of specific nanomaterials for applications in cancer nanotechnology. On the other hand, Rueda G, et al. investigated the nanotechnology field using bibliometrics and social network analysis in 1992-2006 [24]. They examined the inter-relationships among lead authors and co-authors, authors with the highest number of publications, and countries making the highest contribution to nanotechnology.

2. Results

Figure 3 a-c represents the snapshot of heatmaps of the countries’ publications in the area of cancer nanotechnology from PubMed Core Collection in 2021 for the entire dataset (considered all 48629 documents), the sample contains the top 100 journals and the top 50 journals. In 2020, the USA and China were the most productive country in terms of publications in the field of cancer nanotechnology and, within the past decade period of 2010-2021, the number of publications spreads in most countries in Europe, South Asia, and East Asia (Figure 3a). The same analysis was equally performed for the top 100 and 50 journals. Figure 3b indicates the sample of the top 100 journals averagely cover the publication of most of the destinations in the world in 2020, while a sample of the top 50 journals only covers the countries like China, the UK, and some parts of the USA and Europe. This leads to the idea of high quality/high impact publications in sub-samples that contain the top 100 journals, significantly impact the cancer nanotechnology field, and also cover an average of 50% of publications. Figure 3d is the Geomap of the country’s publications, which visualizes the map of each country, with colors and values assigned.[25][26][27][28][29][30][31][32][33][34][35]

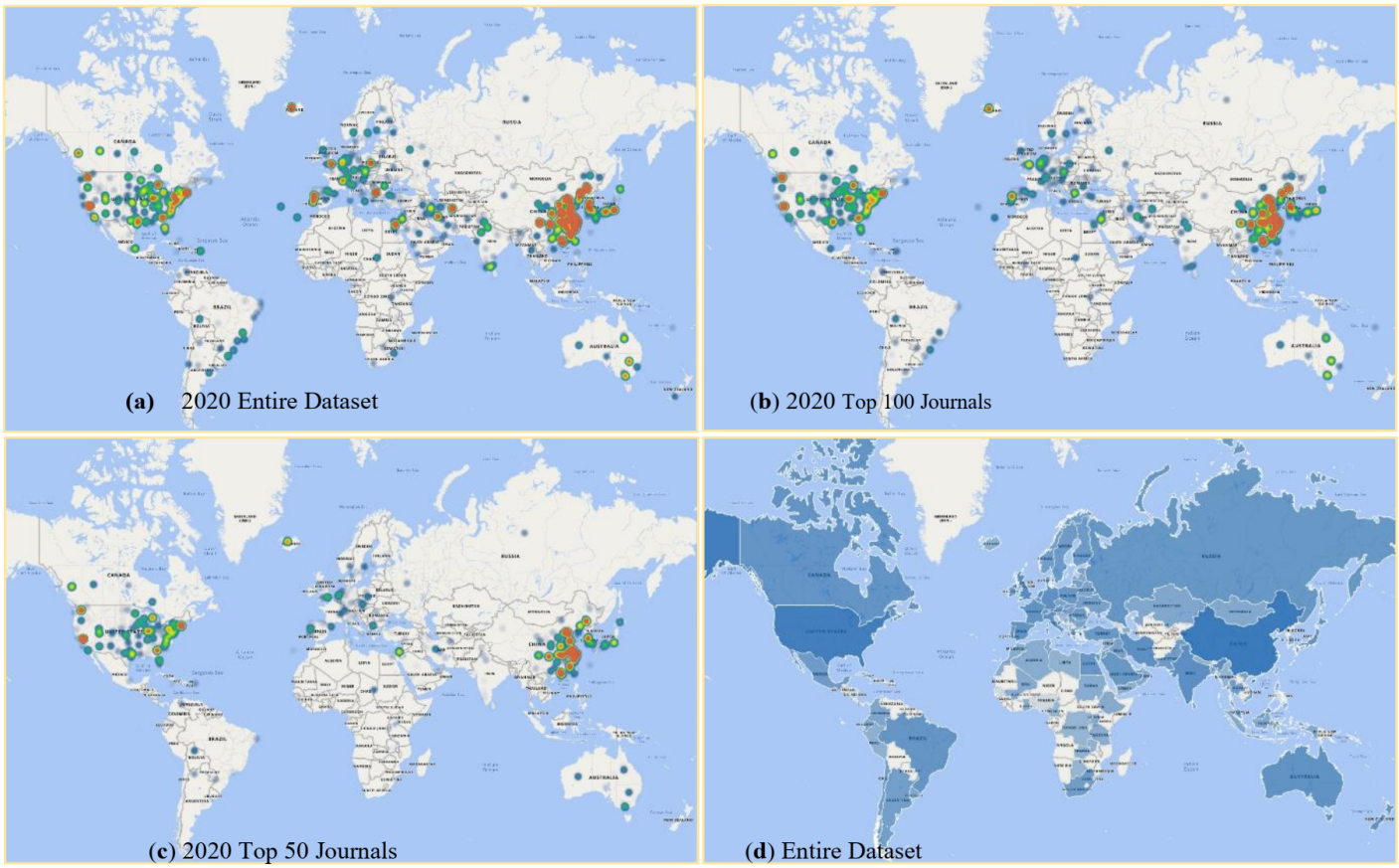

Figure 3. Heatmap and Geomap of the number of publications in the area of cancer nanotechnology in (a) the entire dataset, (b) the top 100 journals, (c) the top 50 journals, (d) per country for the entire dataset.

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