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Scientific Profiles in the field of Biomarkers (2000-2010)

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Abstract

Biological marker is a term used in many scientific fields and was introduced as a measurable element or a clinical indicator in the abnormal biological processes, pathological condition, or pharmacological intervention. Science Citation Index Expanded (SCI-E) from database of Web of Science (WoS) was used to extract all publication indexed as a topic of "*Biomarkers*" during a period of eleven years through 2000-2010. Extracting of data was restricted to the tag of topics (TS = Biomarkers) from advanced search menu. A total number of 37397 records were extracted on 5 May 2013 and went under analysis. In this study the papers originated jointly by multiple authors from different countries were defined as ones for each country. The study showed that the number of publication in the field of biomarkers showed an increase through the period of study. The number of publication in 2010 was greater than 10 times in 2000. More than 98% of publication was in English. The majority of publication (68%) was in the form journal article. Harvard University, sharing 1,128 papers in the field, was the most prolific university among institutes. The USA contributing 33% of world's profile in the field was the most productive country. Based on the Bradford's scattering law, the journal of "*Cancer Epidemiology Biomarkers Prevention*" publishing 3.12% of world's publication was the most prolific journal among core journals. Analysis of data concluded that oncology was the most interesting subject area of scientists in the field of Biomarkers through the last decade.

Keywords: Biological Markers, Biomarkers, Scientometrics

Introduction

In the early 1960s, American biologist Marshall Nirenberg provided a brilliant experiment

in biochemistry that led to a molecular revolution. The revolution in molecular science has introduced biomarkers as an important subject in medical science (Goo, 2010). The biomarker definition has been changed by new developments in the diagnostic technology over time. Perhaps the traditional definition of biomarkers was used only for the proteins which were measurable in the body fluids; but the progress in the imaging techniques and other diagnostic methods, also has introduced certain conditions such as the structural changes in the human body or brain electroencephalography (EEG) as the biomarker of certain diseases (Beveren and Hoogendijk, 2011; Garea, Griese, and Imhof., 2007; Goo, 2010). According to the biomarkers definitions working group a biomarker is "a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention" (Biomarkers-Definitions-Working-Group, 2001). Therefore, the scientific definition of biomarkers was expanded to include not only the proteins and their fragments, but also metabolites, carbohydrate biomarkers, and genomic biomarkers (RNA and DNA) (Gormally Caboux, Vineis, and Hainaut, 2007; Kraus et al., 2011; Suspiro and Prista, 2011). Today, the importance of biomarkers as measurable indicators in the normal and pathological processes has led to using these objects in different fields of medical sciences, i.e. diagnostic, responses to drug therapy, side effects of therapy, and prediction of disease (Kraus et al., 2011; Mayeux, 2004; Suspiro and Prista, 2011; Vainio, 2001). Since the biomarkers of a disease are detectable even in the first stages of a pathological condition, these elements attract a lot of interest in the diagnostic processes of specific diseases, in particular, cancer, and the number of publications in this field is growing fast (Au, 2007; Cazzola and Novelli, 2010; Cummings, 2011; Eason and Halloran, 2002; Ganti and Weiss, 2011; Schaaij-Visser, Brakenhoff, Leemans, Heck, and Slijper, 2010). Although the diagnostic processes by the biomarkers are very interesting and useful, two main aspects of progress should have been obtained in this area. First, the progress in the analytical procedures and accuracy of analytical equipments are an important subject for biomarker tracing. Second, the vast researches should be performed to discover specific biomarkers for specific conditions (Garea et al., 2007; He and Yu, 2012; Lobdell and Mendola, 2005; Mayeux, 2004; Wehrens, Franceschi, Vrhovsek, and Mattivi, 2011). Therefore, the publications of a country in this field could be considered as an index for the overall progress of that country in this subject (Biglu, 2008). This study investigated all publication indexed under the topic of Biomarkers in SCI-E and visualized the scientific activity of leading countries in the field through 2000-2010.

Method

Science Citation Index expanded (SCI-E) from database of web of science was used to extract all publication indexed as a topic of "*Biomarkers*" during a period of eleven years through 2000-2010. We restricted extracting of data to the tag of topics (TS = Biomarkers) from

advanced search menu. This led to retrieving all documents indexed as a topic of Biomarkers in SCI-E. A total number of 37397 records on 5 May 2013 were extracted and analyzed. Science Citation Index Expanded (SCI-E) is a citation database that covers more than 8000 journals in JCR Science Edition and more than 2600 journals in JCR Social Sciences, across 150 disciplines, from 1900 to the present. This database allows researchers to access the bibliographic information of publication and to identify which later articles have cited any particular earlier article, or cited the articles of any particular author, or determine which articles have been cited most frequently. In this study the papers originated jointly by multiple authors from different countries were defined as ones for each country. For example if a paper had three authors from three different countries, we counted one paper for each of them. Regarding to calculating the number of published papers during the period of study each paper counted as one regardless to the number of contributor countries/institutions. Therefore, the occurrence of countries/institutions is greater than the total number of published papers.

Findings

Analysis of data obtained from database of Science Citation Index- Expanded (SCI-E) throughout a period of eleven years indicated that the number of publication in the field of Biomarkers has increased steady through the period of study. (Fig. 1)

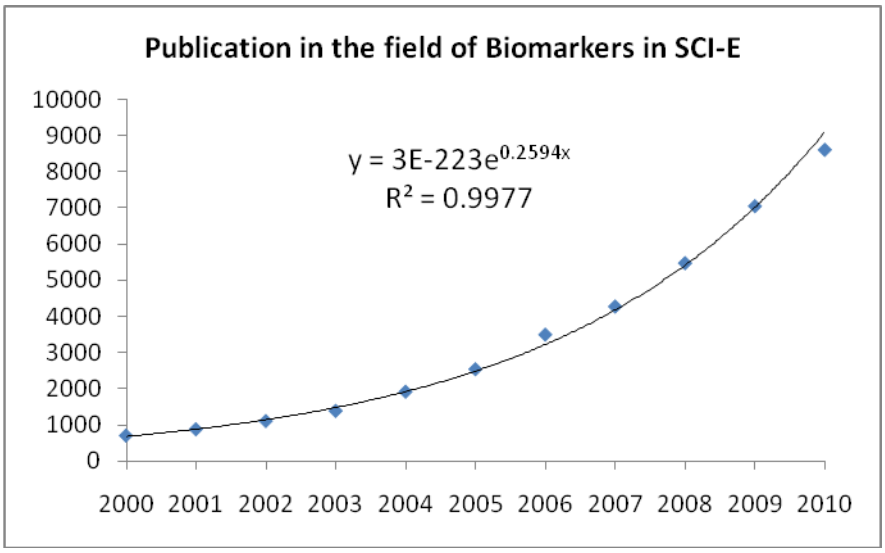

Figure 1. Number of publication in the field of Biomarkers in SCI-E 2000-2010

As figure 1 shows, total number of 37397 papers were indexed under topic of Biomarkers in SCI-E in the period of 2000-2010. The number of scientific publication in the field of Biomarkers increased exponential through the period of under study. It reached from 701 papers in 2000 to 8603 papers in 2010.

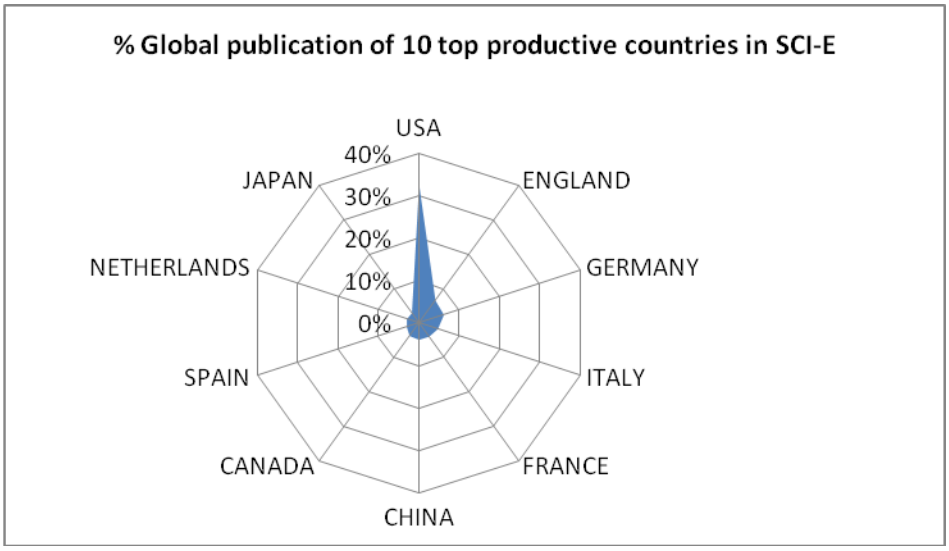

Figure 2. Global percentage of publication in the field of Biomarkers contributed by 10 top productive countries in SCI-E 2000-2010

Figure 2 shows the 10 top productive countries sharing scientific profiles in the field of Biomarkers. As it could be seen, 7% of world's profile was produced by 10 top productive countries. Except Russia all other G8 countries were among 10 top productive countries. USA, sharing 33% (16141 papers) of global publication, was the most productive country followed by England 7% (3,237 papers), Germany 6% (3,049 papers), Italy 5% (2,298 papers), France 4% (1,979 papers), Canada 4% (1,970 papers), Spain 3% (1,510 papers), Netherlands 3% (1,499 papers) and Japan 3% (1,430 papers), respectively.

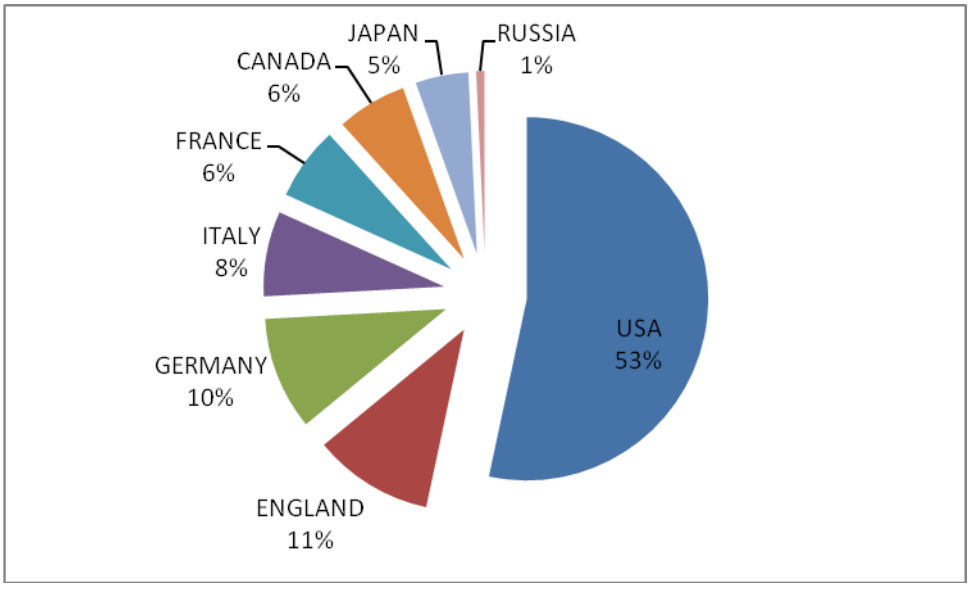

Figure 3. Percentage of publication in the field of Biomarkers contributed by G8 countries 2000-2010

The G8 countries altogether contributed 30,249 papers in SCI-E database. This number

accounted for 61% of world's publication in the field in SCI-E. Figure 3 shows the percentage share of scientific profiles by each G8 countries in the field of Biomarkers among themselves. From a total number of 30,249 papers published by G8 countries, 53% was produced by USA, 11% by England, 10% by Germany, 8% by Italy, 6% by France, 6% by Canada, 5% by Japan and 1% by Russia, respectively.

Table 1

Frequency of Documents Type for publication in the field of Biomarkers in SCI-E 2000-2010

Document Types	Records	Percent
ARTICLE	27069	68%
REVIEW	4909	12%
MEETING ABSTRACT	3854	10%
PROCEEDINGS PAPER	2368	6%
EDITORIAL MATERIAL	1047	3%
LETTER	270	1%
NEWS ITEM	148	0%
BOOK CHAPTER	102	0%
CORRECTION	83	0%
REPRINT	10	0%
BIOGRAPHICAL ITEM	4	0%
SOFTWARE REVIEW	2	0%
DATABASE REVIEW	1	0%
Total	39867	100%

Journal articles, consisting 68% of total publications type, was the most dominant format of publication followed by Review articles (12%) and Meetings abstract (10%). Some papers were published in two or more formats. That is why the number of publication types shown in table 1 is greater than the number of retrieved papers from SCI-E shown in figure 1.

English, consisting 36757 papers (98.3%), was the most frequent language followed by French 175 papers (0.5%), German 159 papers (0.4%), and Spanish 122 papers (0.3%). Some papers were found in other languages such as Chinese (46 papers), Portuguese (37 papers), polish (24 papers), Russian (23 papers), Japanese (11 papers), Czech (10 papers), Korea (8 papers), Italian (7 papers), Serbian (6 papers), Turkish (4 papers), Croatian (2 papers), Malay (2 papers), Slovenian (2 papers), and one paper in Dutch, Estonian, Lithuanian, and Romanian.

Table 2

Top twenty subject areas of publication in the field of Biomarkers in SCI-E 2000-2010

Rank	Research Areas	Records	Percent
1	ONCOLOGY	5733	10%
2	BIOCHEMISTRY MOLECULAR BIOLOGY	4686	8%
3	TOXICOLOGY	3390	6%
4	ENVIRONMENTAL SCIENCES ECOLOGY	2790	5%
5	PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	2461	4%
6	PHARMACOLOGY PHARMACY	2405	4%
7	CHEMISTRY	2235	4%
8	NEUROSCIENCES NEUROLOGY	2225	4%
9	CARDIOVASCULAR SYSTEM CARDIOLOGY	2181	4%
10	RESEARCH EXPERIMENTAL MEDICINE	1339	2%
11	BIOTECHNOLOGY APPLIED MICROBIOLOGY	1305	2%
12	ENDOCRINOLOGY METABOLISM	1266	2%
13	NUTRITION DIETETICS	1224	2%
14	GENERAL INTERNAL MEDICINE	1125	2%
15	PATHOLOGY	1088	2%
16	CELL BIOLOGY	1074	2%
17	GENETICS HEREDITY	1074	2%
18	UROLOGY NEPHROLOGY	997	2%
19	MARINE FRESHWATER BIOLOGY	889	2%
20	MEDICAL LABORATORY TECHNOLOGY	867	2%

Regarding the subject categories, oncology, consisting 10% of world's publication in the field of Biomarkers, was the most dominant subject area of researches related to the Biomarkers followed by "Biochemistry Molecular Biology" (8%), and "Toxicology" (6%) (Table 2).

Table 3

Twenty top core journals publishing papers in the field of Biomarkers in SCI-E 2000-2010

Rank	Source Titles	Record Count	percentage
1	CANCER EPIDEMIOLOGY BIOMARKERS PREVENTION	1163	3.12%
2	JOURNAL OF PROTEOME RESEARCH	409	1.10%
3	CLINICAL CANCER RESEARCH	380	1.02%
4	PROTEOMICS	320	0.86%

Rank	Source Titles	Record Count	percentage
5	ORGANIC GEOCHEMISTRY	308	0.83%
6	BIOMARKERS	234	0.63%
7	CLINICAL CHEMISTRY	234	0.63%
8	CIRCULATION	233	0.63%
9	MOLECULAR CELLULAR PROTEOMICS	224	0.60%
10	CANCER RESEARCH	223	0.60%
11	ENVIRONMENTAL HEALTH PERSPECTIVES	216	0.58%
12	JOURNAL OF CLINICAL ONCOLOGY	215	0.58%
13	PLOS ONE	214	0.57%
14	AQUATIC TOXICOLOGY	208	0.56%
15	PROTEOMICS CLINICAL APPLICATIONS	194	0.52%
16	ECOTOXICOLOGY AND ENVIRONMENTAL SAFETY	189	0.51%
17	BIOMARKERS IN MEDICINE	187	0.50%
18	ANALYTICAL CHEMISTRY	180	0.48%
19	TOXICOLOGY LETTERS	178	0.48%
20	JOURNAL OF NUTRITION	176	0.47%

A total number 3186 journal provided papers in the field of Biomarkers through 2000-2010. Twenty top prolific of them is shown in Table 3. The journal of "Cancer EPIDEMIOLOGY Biomarkers Prevention" publishing 1,163 papers was the most prolific journal among core journals followed by "Journal of Proteome Research" publishing 409 papers, "Clinical Cancer Research" 380 papers, and journal of "Proteomics" publishing 320 papers.

Table 4

Most productive Institutes distributing papers in the field of Biomarkers in SCI-E 2000-2010

Rank	Institution	Records	Percent
1	HARVARD UNIV	1128	1.2%
2	NCI	764	0.8%
3	UNIV WASHINGTON	488	0.5%
4	JOHNS HOPKINS UNIV	465	0.5%
5	UNIV TORONTO	428	0.5%
6	BRIGHAM WOMENS HOSP	405	0.4%
7	UNIV MICHIGAN	405	0.4%
8	UNIV TEXAS	397	0.4%
9	UNIV CALIF SAN FRANCISCO	396	0.4%

Rank	Institution	Records	Percent
10	UNIV PENN	394	0.4%
11	UNIV PITTSBURGH	382	0.4%
12	DUKE UNIV	368	0.4%
13	UNIV CALIF LOS ANGELES	368	0.4%
14	UNIV N CAROLINA	357	0.4%
15	UNIV MINNESOTA	345	0.4%
16	MAYO CLIN	331	0.4%
17	FRED HUTCHINSON CANC RES CTR	324	0.4%
18	MASSACHUSETTS GEN HOSP	318	0.4%
19	UNIV CALIF SAN DIEGO	299	0.3%
20	CHINESE ACAD SCI	292	0.3%

A total number of 18,528 institutes shared their work in SCI-E. Harvard University, publishing 1.2% (1,128 papers) of global profiles in the field of Biomarkers, was the most prolific Institute followed by NCI sharing 764 papers, and University of Washington sharing 488 papers.

Discussion and Conclusion

Analysis of data indicated that the number of scientific publication in the field of Biomarkers increased exponential through the period under study. USA, sharing 33% of global publication in the field, was the most productive country followed by England (7%), Germany (6%), Italy (5%), France (4%), Canada (4%), Spain (3%), Netherlands (3%) and Japan (3%), respectively. According to the results, 71% of world's profile was produced by these 10 top productive countries. Except Russia all G8 countries appeared among 10 top productive countries.

The G8 countries altogether contributed 61% of global publications in the field of Biomarkers in SCI-E database. From a total number of 30,249 papers published by G8 countries, 53% came from USA, 11% from England, 10% from Germany, 8% from Italy, 6% from France, 6% from Canada, 5% from Japan and only 1% came from Russia. English consisting 98.3% of total publications language was the most frequent language of publications in the field. This phenomoe should not come as a surprise, because the editorial policy of languages in this database has focused on indexing papers in English rather than other languages (Biglu, 2007). The majority of publications types (68%) were in the format of Journal articles followed by Review articles (12%) and Meetings abstract (10%). American authors, accounting for 33% of global publications, were the most productive in the field followed by authors from England (7%), Germany (6%) and Italy (5%). This is an

expected suggestion, because a large number of institutes engaging with biomarkers are located in North America and Western Europe. Regarding the subject categories, Oncology consisting 10% of world's publication in the field of Biomarkers, was the most dominant subject area of researches in the field of Biomarkers. This is a hint that this branch of medicine has drawn the concern of oncologists to deals with tumors, including study of their development, diagnosis, treatment, and prevention. The following subject areas were "Biochemistry Molecular Biology" (8%), and "Toxicology" (6%). Based on the Bradford's scattering law the journal of "*Cancer Epidemiology Biomarkers Prevention"* publishing 1,163 papers was the most prolific journal among core journals followed by "Journal of Proteome Research", "Clinical Cancer Research", and "Proteomics". Among universities and Institutes the Harvard University, sharing 1.25% of global profiles in the field of Biomarkers, was the most prolific University followed by NCI, and University of Washington.

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