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Abstract

Anthrax is an infectious disease which occurs regularly in southern Europe. It is also used as a weapon by a number of countries. This study is an attempt to investigate and analyze about the literature output on Anthrax. The aim of the present study was to identify literature growth over the period, literature distribution and authorship pattern. The data was obtained from PubMed using the keywords "Anthrax". It was found that a total of 1,955 published literatures for the period 2011-2018 in the field of Anthrax were contributed by 8,185 unique authors in 11 languages in 694 journals in 12 publication types. Ten and above authorship pattern contributed a higher percentage of literature while comparing with other authorship patterns and the total degree of collaboration was 0.94. First authors from USA have contributed around 44.6% of the total literature. Most of the literatures published in these years have citation count between 1-10. The literature published in the year 2011 have the highest citation counts. "Humans" was the more popular MeSH/keyword.

Keywords: Anthrax, Bibliometric, Scientometric, Literature growth, Authorship pattern

1. INTRODUCTION:

Anthrax is an infectious disease which occurs regularly in southern Europe. It is caused by the bacterium *Bacillus anthracis*. The bacterium lives in soil and used to infect animals. Humans get infected when they handle the infected animals. In common, it occurs in skin, lungs, intestinal and injection. The symptoms of the disease will not start immediately and it used to begin between one day and two months. It is also used as a weapon by a number of countries. In September 2001 in US, this disease killed five people and sickened 17. It was considered as a worst biological attack in US industry.

This study is significant which applies the Scientometric techniques in the literature of Anthrax to elucidate the progress in the field of "Anthrax". The study explores the literature growth over the period, literature distribution and pattern. The study will be helpful to get to know about the existing literature about "Anthrax".

2. REVIEW OF LITERATURE

Bibliometric studies quantitatively assess the literature produced in a particular field. Few of the significant bibliometric studies are discussed in this section. Morris, S. A., etal (2005) has done a study to visualize the 60 years of anthrax research. A total of 2472 papers in 60 years of anthrax research were included in the study. The timeline visualization of the papers reveals that the anthrax research grew in two distinct phases. A cross map research shows up the overlapping relation among the groups of research topics. The usage plot shows up the temporal emergence and obsolescence of the groups. Vioque, J., etal (2010) studied the scientific literature on obesity research published during the period 1988 - 2007. A total of 58,325 publications were extracted from PubMed. The literature is published in 3613 different journals. Majority of the publications are from North America and Europe. Ye, H., Li, Q., etal (2017) extracted Tuberculosis related publications from Web of Science and analyzed the literature output. A total of 1,071 publications from 422 types of journals were included in the study. Majority of the publications are from China, USA and India. Nafade, V. etal (2018) conducted a study and collected publications in the field of Tuberculosis which are published during the period 2007 to 2016. The publication has an annual growth rate of 7.3%. Majority of the publication are from USA. Collaborations were found more common in high income countries. Savcı, U. (2019) extracted 5,557 bacillus anthracis research publications from Web of science database. Majority of the publications are original articles and from US. The centre for disease control and prevention had published majority of the publications.

3. OBJECTIVES

- To find out year wise literature growth
- To find out the language wise distribution of the literature
- To find out the journal wise distribution of the literature
- To examine the different type of literature, published in the journal
- To identify the authorship pattern in the literature output
- To find the degree of collaboration in the literature output

- To identify the popular Mesh/keyword used to index the literature
- To examine the citation pattern of the literature

4. MATERIALS AND METHODS

The data was obtained from PubMed using the keyword "Anthrax". The scientific literature published in print during the period 2011 - 2018 was considered for the study. A total of 1,955 records were downloaded in XML format from PubMed and converted in to excel using the tool PubMed2Xls. Citation data is extracted from Google scholar during the period 19/nov/2019 – 26/nov/2019. Further analysis was done on Ms-Access and using excel.

5. RESULTS:

A total of 1,955 published papers for the period 2011-2018 in the field of Anthrax were retrieved from PubMed. About 8,185 unique authors were contributed to the literature in 11 languages in 694 journals.

Table 1: Year wise Literature Growth

S.No.	Year	No. of Literature	Percentage	Growth Rate
1	2011	318	16.3%	
2	2012	281	14.4%	-11.6%
3	2013	266	13.6%	-5.3%
4	2014	254	13.0%	-4.5%
5	2015	242	12.4%	-4.7%
6	2016	234	12.0%	-3.3%
7	2017	183	9.4%	-21.8%
8	2018	177	9.1%	-3.3%
	Total	1,955		

Table 1 shows up the year wise literature growth in the field anthrax over the period 2011 – 2018. Percentage is calculated for each year based on the formula $\text{Percentage} = \frac{\text{No. of literature produced in the year}}{\text{total no. of literature}}$. Growth rate is calculated for each year based on the formula $\text{Growth Rate} = \frac{\text{Current year} - \text{Previous year}}{\text{Previous year}}$. Total Published literatures have decay over the period. Total published papers in 2011 are 319. In 2012, the total published literatures are 281 which show up a significant decay of 11.6%. In 2017, total published literatures are 183 which show up a greatest decay of 21.8% while comparing to the other years..

A polynomial trend line is a curved line that is used when data fluctuates. The order of the polynomial can be determined by the number of fluctuations in the data or by how many bends (hills and valleys) appear in the curve. The accuracy of the fit can be interpreted using the R-squared value. As the R-squared value approaches 1, the accuracy of the fit approaches 100%.

Fig 1 shows up the polynomial trend line of the literature growth in the field of anthrax over the period 2011-2018. The polynomial equation of order 5 depicts the model fit. The R-squared value is 0.9893, which is a best fit of the line of the data.

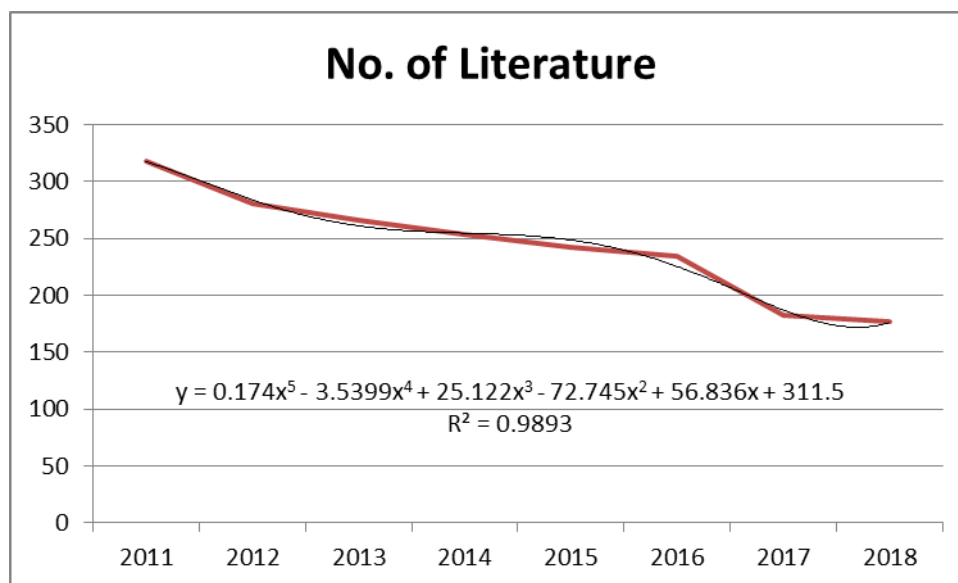


Fig 1. Literature Trend in the field of Anthrax during the period 2011-2018

Table 2: Language wise Distribution

S.No.	Language	No. of Literature (C)	Percentage (C*100/N)
1	English	1,892	96.8%
2	Russian	26	1.3%
3	Chinese	12	0.6%
4	French	8	0.4%
5	Spanish	8	0.4%
6	German	2	0.1%
7	Polish	2	0.1%
8	Turkish	2	0.1%
9	Bulgarian	1	0.1%
10	Finnish	1	0.1%
11	Portuguese	1	0.1%
	Total	1,955	

N=1,995

Table 2 shows up the language wise distribution of literature. English was the main communication medium in the literature. 1,892 articles were published in English which is 96.8% of the total literature. The other 10 languages contributed 63 articles which was 3.2% of the total literature. Top 5 contributing languages were English, Russian, Chinese, French, and Spanish. Among them, Russian was the leading language next to English which contributes 1.3% of literature.

Table 3: Top 10 Journals List:

S.No.	Journal	No. of Literature (C)	Percentage (C*100/N)
1	PloS one	113	5.8%
2	Vaccine	56	2.9%
3	Toxins	48	2.5%
4	Infection and immunity	36	1.8%
5	The Journal of biological chemistry	32	1.6%
6	Clinical and vaccine immunology : CVI	31	1.6%
7	Biosecurity and bioterrorism : biodefense strategy, practice, and science	31	1.6%
8	Antimicrobial agents and chemotherapy	26	1.3%
9	Scientific reports	25	1.3%
10	Proceedings of the National Academy of Sciences of the United States of America	23	1.2%
	Total	421	21.5%

N=1,955

The Literature was published in 694 journals. Table 3 shows up the top 10 journal list in which majority of literature in anthrax is published during the period 2011 – 2018. The top 10 journals published around 21.5% of the total literature. PLoS One was in the first position among the top 10 journals and had published 113 literatures which is around 5.8% of the total literature.

Table 4: Publication type mix of the literature:

S.No.	Publication Type	No. of Literature (C)	Percentage (C*100/N)
1	Journal Article	1,568	80.2%
2	Review	208	10.6%
3	Case Reports	83	4.2%
4	Clinical Trial	23	1.2%
5	Letter	18	0.9%
6	News	15	0.8%
7	Editorial	14	0.7%
8	Biography	8	0.4%
9	Comment	7	0.4%
10	Published Erratum	5	0.3%
11	Meta-Analysis	4	0.2%
12	Interview	2	0.1%
	Total	1,955	

N=1,955

Table 4 shows up the publication type mix of literature. The literature is published in 12 publication types. A total of 1,568 literatures were produced in the form of journal articles which was 80.2% of the total literature.

Table 5: Authorship pattern:

S.No.	Authorship	2011	2012	2013	2014	2015	2016	2017	2018	Total (C)	Percentage (C*100/N)	Rank
1	Single Author	23	23	20	15	11	8	9	7	116	5.93%	10
2	Two Authors	29	33	23	25	28	23	12	14	187	9.57%	6
3	Three Authors	37	25	34	36	30	24	19	15	220	11.25%	4
4	Four Authors	48	29	32	30	35	22	24	16	236	12.07%	2
5	Five Authors	33	32	29	34	27	27	22	18	222	11.36%	3
6	Six Authors	38	26	22	26	24	25	18	29	208	10.64%	5
7	Seven Authors	28	30	23	24	22	20	19	19	185	9.46%	7
8	Eight Authors	16	25	21	13	11	23	10	18	137	7.01%	8
9	Nine Authors	21	16	19	17	11	15	16	11	126	6.45%	9
10	Ten and above Authors	45	41	42	31	41	43	33	29	305	15.60%	1
	Total	318	280	265	251	240	230	182	176	1,942	99.34%	

N=1,955

Author data is available for 1,942 literatures. A total of 8,185 unique authors contributed to the literature corpus. Table 5 shows up the authorship pattern. Ten and above authors produced around 15.6% of the literature and the pattern is in the first rank. Four authors produced around 12.07% of the literature and the pattern is in the second rank. Five authors produced around 11.36% of the literature and the pattern is in the third rank.

Table 6: Degree of Collaboration

S.No.	Year	Single Author (Ns)	Multiple Authors (Nm)	Degree of Collaboration $C=Nm/(Nm+Ns)$
1	2011	23	295	0.927673
2	2012	23	257	0.917857
3	2013	20	245	0.924528
4	2014	15	236	0.940239
5	2015	11	229	0.954167
6	2016	8	222	0.965217

7	2017	9	173	0.950549
8	2018	7	169	0.960227
	Total	116	1,826	0.940268

Table 6 shows up the degree of collaboration. It was clear from the above analysis that single-authored papers were less than that of multi-authored papers. To determine the extent of collaboration in quantitative terms, the formula given by K.Subramanyam is used.

The formula is: $C = Nm/Nm/Ns$. The total degree of collaboration is 0.940268

Table 7: Top 10 Countries contribution in the literature

S.No.	Country	No. of authors (C)	Percentage (C*100/N)
1	USA	872	44.6%
2	China	121	6.2%
3	UK	94	4.8%
4	India	73	3.7%
5	Germany	59	3.0%
6	Canada	52	2.7%
7	France	45	2.3%
8	Turkey	36	1.8%
9	Italy	31	1.6%
10	Republic of Korea	29	1.5%
	Total	1412	72.2%

N=1,955

The first author affiliation details are analyzed to find out the country wise contribution to the literature. Among the 1,955 published literatures, 1,753 (89.6%) first authors have the proper affiliation details. Their countries are ranked and the top 10 countries contributed in the literature is listed in the Table 7. These top 10 countries contributed around 72.2% of the total literature. First authors from USA have contributed around 44.6% of the total literature.

Table 8: Citation group of literature published over the years

Citation Group	2011	2012	2013	2014	2015	2016	2017	2018	Total
No Citation	11	11	4	11	13	28	25	53	156
1-10	75	80	93	119	138	142	132	112	891
11-20	86	74	68	55	48	34	18	8	391
21-30	49	41	49	33	19	18	2	3	214
31-40	40	23	22	11	6	2	3	0	107
41-50	18	9	8	8	4	3	0	1	51
51-60	10	11	5	3	4	3	3	0	39
61-70	11	8	4	3	2	1	0	0	29

71-80	4	6	3	1	2	0	0	0	16
81-90	3	4	0	2	1	0	0	0	10
91-100	3	3	3	0	1	0	0	0	10
101 and above	8	11	7	8	4	3	0	0	41
Total	318	281	266	254	242	234	183	177	1,955

Among the 1,955 literature, 8% of the literatures don't have any citation data. The maximum cited literature is titled "High-throughput screening of a CRISPR/Cas9 library for functional genomics in human cells" and it is cited 522 times. Table 8 cross tabulates the no. of literature published in each year and the citation pattern of the literature. Most of the literatures published in the years have citation count between 1-10.

Table 9: Citation Trend of the literature over the years

S.No.	2011	2012	2013	2014	2015	2016	2017	2018	Total
1-10	410	423	492	654	697	626	560	366	4,228
11-20	1,299	1,094	974	791	713	489	250	110	5,720
21-30	1,226	1,023	1,220	803	472	458	54	66	5,322
31-40	1,377	822	758	387	202	74	106	0	3,726
41-50	792	403	358	358	183	134	0	41	2,269
51-60	552	626	278	163	232	154	169	0	2,174
61-70	724	512	252	198	135	66	0	0	1,887
71-80	304	455	224	78	147	0	0	0	1,208
81-90	247	353	0	173	84	0	0	0	857
91-100	283	285	280	0	98	0	0	0	946
101 and above	1,252	2,147	1,061	1,741	885	341	0	0	7,427
Total	8,466	8,143	5,897	5,346	3,848	2,342	1,139	583	35,764

The total number of citations received by the 1,955 literature is 35,764. Table 9 cross tabulates the years and the no. of citations in each citation group in each year. The literature published in the year 2011 have the highest citation counts.

Table 10: Top 10 Popular MeSHterms/Keywords Ranking List:

Rank	MeSHterms/Keywords	Count
1	Humans	982
2	Animals	883
3	Female	366
4	Mice	366
5	Male	277
6	Adult	159
7	Cell Line	118

8	Middle Aged	116
9	Disease Models, Animal	112
10	Mice, Inbred BALB C	99
	Total	3,478

Total distinct MeSH/Keywords found in the literature were 7,219 and they all appeared 21,944 times in the total literature. All the MeSH/keywords were ranked by calculating the total occurrence in the literature for the eight years. And top 10 popular words were picked up from the list. The table 10 shows up the top 10 keywords. These 10 keywords is appeared around 3,478 times in the total literature. The popular keyword is Humans.

6. CONCLUSION:

The results of the study revealed that total Published papers had decay over the period. It was found that a total of 1,955 published literatures for the period 2011-2018 in the field of Anthrax were contributed by 8,185 unique authors in 11 languages in 694 journals in 12 publication types. Ten and above authorship pattern contributed a higher percentage of literature while comparing with other authorship patterns and the total degree of collaboration was 0.94. First authors from USA have contributed around 44.6% of the total literature. Most of the literatures published in the years have citation count between 1-10. The literature published in the year 2011 have the highest citation counts. “Humans” was the more popular MeSH/keyword.

In Conclusion, these results can give an idea to Clinicians and Researchers, to understand about the current scientific literature produced and identify the gaps in the field Anthrax for further research opportunities.

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