Summer 5-1-2020

Indian Contribution on Antibiotic Resistance: A Bibliometric Mapping and Visualization

Mahender Pratap Singh
DLIS, Babasaheb Bhimrao Ambedkar University, Lucknow,Uttar Pradesh,India., mpsinghdlis@gmail.com

Vijay Kumar Bharati
Central Library, Mahatma Gandhi Kashi Vidyapith ,Varanasi, Uttar Pradesh,India., bharati.bhu@gmail.com

Indian Contribution on Antibiotic Resistance: A Bibliometric Mapping and Visualization

Prof. M. P. Singh[1] Vijay Kumar Bharati[2]

Professor, Department of Library and Information Science, Babasaheb Bhimrao Ambedkar Central University, Lucknow (UP) India, Email: mpsinghdlis@gmail.com
[2] Assistant Librarian, Central Library, MGKVP, Varanasi & Ph.D. Scholar, DLIS, BBAU, Lucknow (UP) India , Email: bharati.bhu@ gmail .com

Abstract

Background: Antibiotic is a medicine that gradually reduces the effect of the bacteria available in our body and kills it, but if antibiotics are used continuously, the mutation in bacteria creates a resistance to it, which is called antibiotic resistance, and if antibiotic resistance has occurred then these antibiotics cannot kill the bacteria and patient may die. **Objectives:** Antibiotic medicine is closely related to human life and day by day antibiotic resistance increasing, so there is a need to count the research productivity of Indian scientists on AR. This study was undertaken to examine the research productivity of the literature published on antibiotic resistance indexed by the Scopus database from 2010 to 2019. **Methods:** Data were extracted from the Scopus database developed by Elsevier in the Netherlands. (TITLE (antibiotic resistance) AND PUBYEAR > 2010 AND PUBYEAR < 2019 AND (LIMIT-TO (AFFILCOUNTRY,"India"))) are used in one query. A total of 445 papers were retrieved for this study which indexed by the Scopus database from 2010 to 2019. **Results:** This is the find out that the most productive year is recognized as 2017 with 67 (15.05 %) articles. Maximum AGR 61.90 percent was recorded in the year 2012 while the minimum (-) 22.22 percent AGR recorded in the year 2011. Maximum 0.58 RGR was recorded in the year 2011 and the minimum 0.14 RGR recorded in the year 2019. Maximum 4.95 Dt is calculated in the year 2019 while the minimum of 1.19 Dt is recorded in the year 2011. Karolinska Institute ranked 1st with 16(3.59 %) publications and the Journal of Clinical and Diagnostic Research secured the first position with 15(3.37 %) articles among 159 Journals. Tamhankar, A.J. is ranked topmost productive corresponding author (1st position) with 11 articles. **Conclusions:** The number of antibiotics is almost certain and too many antibiotics have almost the same family and formula. Now, if antibiotic resistance is made in this case, it will be very difficult to prevent the infection of bacteria and this will increase the number of people who die. There is needed to be evolving in more research on antibiotic resistance at the national level.

Key words: Antibiotic Resistance, Antibiotics, Anti-Bacterial Agents, Bibliometric, Scientometric, India

INTRODUCTION:

At present, the effects of bacterial resistance are being seen all over the world and they are growing rapidly. World Health Organization has warned that antibiotic resistance is very dangerous for the entire human race, food security and its development at present. Diseases caused by bacterial infection are the second-largest disease in the world. Around more than 15 lakh peoples die every year due to infection of bacteria all over the world. Realizing its seriousness, we need to be vigilant

about antibiotic resistance but its seriousness will be known to us only when we know what antibiotic is? & how it works and at the same time, it is also necessary to know what the antibiotic resistance is and how it affects our life. Antibiotic is a Greek word, which is made up of two words antio and bios. Antio means anti-bacteria and bios means bacteria i.e. antibiotic means antagonist of bacteria. In this way, antibiotics are medicines to prevent and treat bacterial infections but sometimes it happens that many antibiotics do not work on our body and the infection does not stop. This condition is called antibiotic resistance. These bacteria become antibiotic-resistant and are not eliminated even with antibiotics which are very harmful conditions for our life. Bibliometrics is a study in which a process is used to evaluate the position and development trend of a particular subject with the help of mathematical, statistical and measurement methods. Bibliometrics are being used to examine various dimensions of research progress in the area of the subject concerned. E. J. Garfield (1979) considers Scientometrics as a measure of the scientific and technological progress of any subject. Its calculation is based on quantitative measurement of a subject or a variety of indicators.

LITERATURE REVIEW:

Gomez-Rias & Ramiraz-Malule (2019) presented a bibliometric overview of global research on multidrug and antibiotics resistance. **Frid-Nielsen, Rubin & Baekkeskov (2019)** investigated the bibliometric characteristics of the genealogy of social science research into antimicrobial resistance (AMR). For this study data were collected from the Web of Science database. **Sweileh, Al-Jabi, Zyoud, Sawalha & Abu-Taha (2018)** presented a bibliometric study on Global research output in antimicrobial resistance among uropathogens. The Scopus was used to retrieve relevant data for the period 2002–2016. A total of 1087 journal articles were retrieved. In this study, only journal articles were included and author keywords were analyzed using VOSviewer. **Sweileh, Sawalha, Al-Jabi & Zyoud (2017)** presented a bibliometric overview of the literature on triazole antifungal drug resistance. **Sweileh et. al. (2016)** carried out a bibliometric study of literature on carbapenem resistance. They calculated the number of publications, top productive countries and institutes, highly cited articles, citation analysis, co-authorships, international collaboration, top active authors, and journals publishing articles on carbapenem resistance. **Head et.al (2015)** mapped the pneumonia research of UK investments from 1997-2013. The study reveals that research funding is increasing in the UK during the 1997-2013. **Brandt, C.at al. (2014)** presented a scientometric picture of antibiotics and antimicrobial resistance. The Data for the study is extracted from the semantic search engine 'GoPubMed'..

METHODS AND DATA ANALYSIS:

A total of 445 papers were retrieved for this study which indexed by the Scopus database from 2010 to 2019. Microsoft Excel is used for graphical representation of the data for document type and funding agencies etc. and the VOS viewer science mapping framework (Van Eck & Waltman, 2020) is used for analyzing the research trends; collaboration among countries visualization, author keywords occurrence visualization, and author citations.

Table 1: Year-Wise Ranking and growth on Antibiotic Resistance publication during the period from 2010 to 2019

Standard Competition Ranking	Year	Total	(%)
1st	2017	67	**15.05**
2nd	2019	61	**13.70**
3rd	2018	57	**12.80**
4th	2016	57	**12.80**
5th	2015	45	**1011**
6th	2014	44	**9.88**
7th	2012	34	**7.64**
8th	2013	32	**7.19**
6th	2010	27	**6.06**
10th	2011	21	**4.71**

This table shows the no. of articles that are published in a particular year on Antibiotic resistance. The Most productive year is recognized 2017with 67 (15.05 %) articles followed by the year 2019 with 61 (13.70%) publications while the year 2018 counted as 3rd position with 57 (12.80 %) articles. Further, it is also calculated that a minimum of 21(4.71) papers have been published in 2011.

Table 1.1: Annual Growth Rate of Antibiotic Resistance Publication:

Detail calculation of Annual Growth Rate of Antibiotic resistance publication is based on the following formula which is given by Kumar and Kaliyaperumal in 2015.

$$\mathbf{AGR} = \frac{\mathbf{W2 - W1}}{\mathbf{W1}} \times \mathbf{100}$$

In this formula AGR represent Annual Growth Rate, W2 present the end value of the publication and W1 present the first/ initial value of the publication

Year	Initial /First Value of Publication W1	End Value of the Publication W2	AGR
2010	0	27	Not define
2011	27	21	-22.22
2012	21	34	61.90
2013	34	32	-5.88
2014	32	44	37.5
2015	44	45	2.27
2016	45	57	26.66
2017	57	67	17.54
2018	67	57	-14.92
2019	57	61	7.10

Annual growth rate is calculated by above-mentioned formula. It is found that the maximum AGR 61.90 percent was recorded in the year 2012 followed by 37.5 percent in 2014 during 2011-2020. Further, it is also seen that the minimum (-) 22.22 percent AGR recorded in the year 2011 followed by (-) 14.92 in 2018.

Table 1.2: Relative Growth Rate (RGR) on the Antibiotic Resistance Research and Doubling Time:

Relative growth rate on the Antibiotic resistance research publications are calculated by a certain formula. The RGR will be calculated by the following formula:

$$\textbf{Relative Growth Rate (RGR)} = \frac{W2-W1}{T2-T1}$$

In this formula, RGR represent the relative growth rate, W1 is finding out by Log^e value of initial no. of publication, W2 is finding out by Log^e value of end number of publication, T1 represent the initial year and T2 represents the end year

The Doubling time of the publications: The doubling time of the publication on Antibiotic resistance research is calculated by the following formula:

$$\textbf{Doubling Time (Dt)} = \frac{0.693}{R}$$

Whereas 0.639 is the constant value in the formula and R represent the relative growth rate (RGR) in the concerned year.

Year	Initial Value of Publications	New added Publications	End Value of Publication	W1	W2	RGR	Dt
2010	0	27	27	0	3.29	0	0
2011	27	21	48	3.29	3.87	0.58	1.19
2012	48	34	82	3.87	4.40	0.53	1.30
2013	82	32	114	4.40	4.73	0.33	2.10
2014	114	44	158	4.73	5.06	0.33	2.10
2015	158	45	203	5.06	5.31	0.25	2.77
2016	203	57	260	5.31	5.56	0.25	2.77
2017	260	67	327	5.56	5.78	0.22	3.15
2018	327	57	384	5.78	5.95	0.17	4.07
2019	384	61	445	5.95	6.09	0.14	4.95

The above table shows the value of the relative growth rate of publications on Antibiotic resistance research. The maximum 0.58 RGR was recorded in the year 2011 followed by 0.53RGR recorded in 2012 and the minimum 0.14 RGR recorded in the year 2019. Further, the calculation has been made for doubling time for the publications of antibiotic resistance research. It is found that the doubling time of the publication is increasing year by year. Maximum 4.95 Dt is calculated in the year 2019 followed by 4.07 in the year 2018. Minimum 1.19 Dt is recorded in the year 2011 followed by 1.30 in the year 2012.

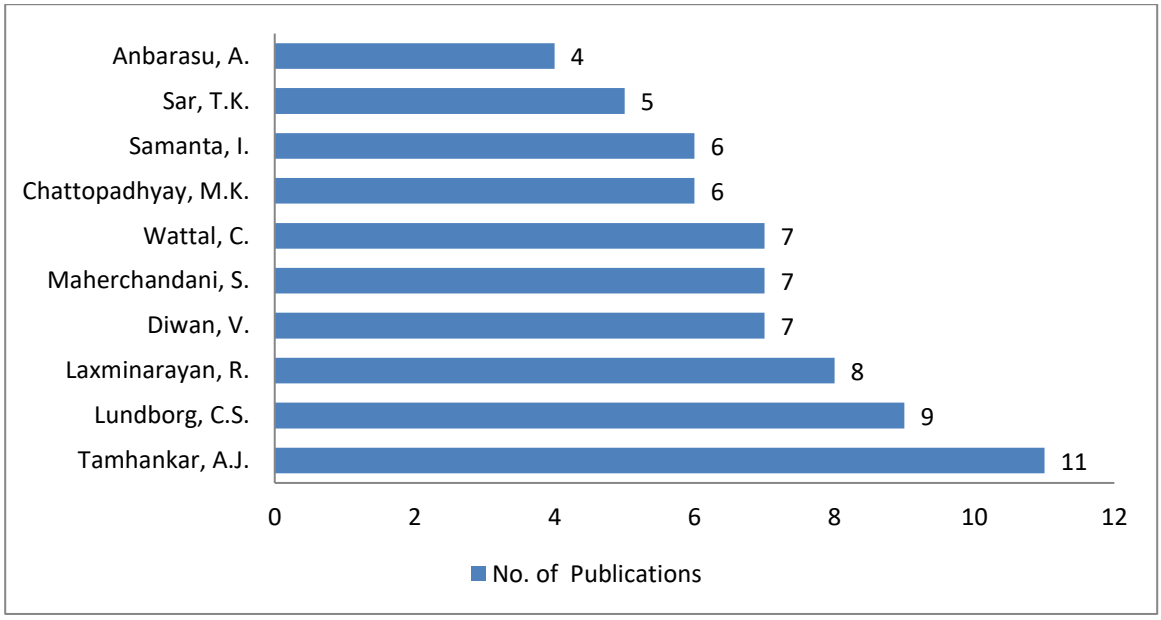
Table 2: Most Productive Journals with Antibiotic Resistance Articles during the period from 2010 to 2019.

Standard Competition	Journal	Total	(%)

Ranking			
1st	Journal of clinical and diagnostic research	15	**3.37**
2nd	Journal of pure and applied microbiology	13	**2.92**
3rd	Journal of association of physicians of india	9	**2.02**
3th	Microbial pathogenesis	9	**2.02**
4th	Asian journal of pharmaceutical and clinical research	8	**1.79**
5th	Indian journal of medical microbiology	7	**1.57**
5th	Asian journal of microbiology biotechnology and environmental sciences	7	**1.57**
6th	International journal of environmental research and public health	6	**1.34**
6th	Research journal of pharmacy and technology	6	**1.34**
6th	International journal of pharma and bio sciences	6	**1.34**

This shows the ranking of the most productive journals with antibiotic resistance articles during the period from 2011 to 2019. It is observed that the retrieved papers were published in 159 journals. The Journal of Clinical and Diagnostic Research secured the first position with 15(3.37 %) articles among 159 Journals followed by the Journal of Pure and Applied Microbiology with 13(2.92 %) articles. It is also seen that various journals are ranked as an equivalent position to each other.

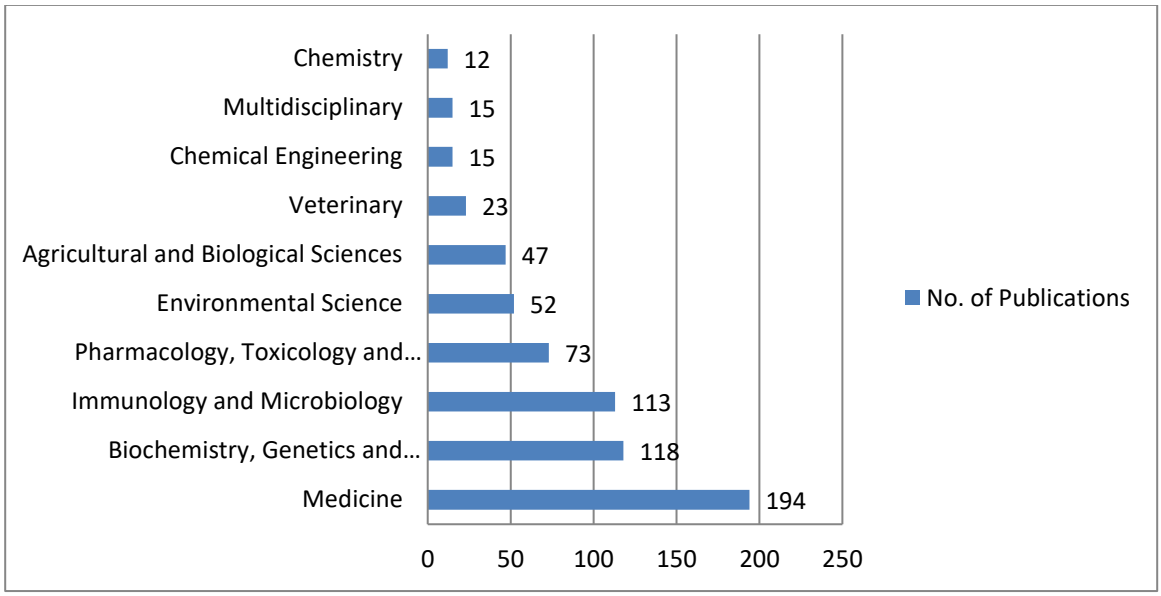
Graph 1: Most Productive Corresponding Authors with Antibiotic Resistance Articles during the period from 2010 to 2019



The above graph shows the most productive corresponding authors with Antibiotic resistance articles during the period from 2011 to 2019. It is found that the 158 authors have been written their papers on Antibiotic resistance during the last ten years. Out of 158, Tamhankar, A.J. is ranked topmost productive corresponding author (1st position) with 11 articles followed by Lundborg, C.S.with 9

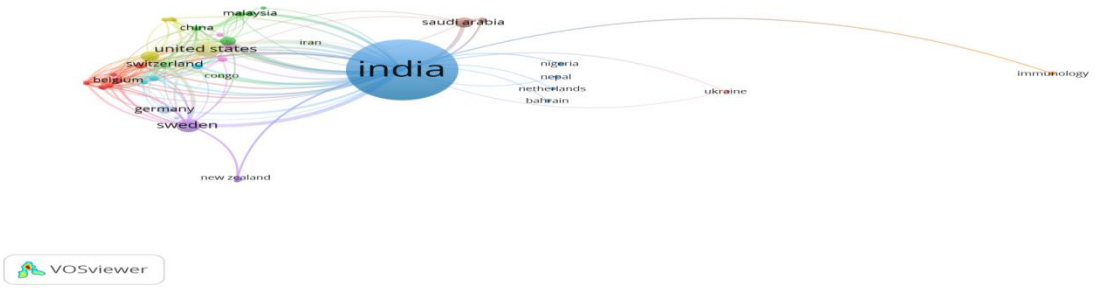
articles followed by Laxminarayan, R. with 8. Further, it is also observed that Anbarasu, A. secured at 7th position with the publication of 4 articles.

Graph 2: Most Productive Subjects with Antibiotic Resistance Articles during the period from 2011 to 2019.



The above graph displays the dominant subjects which are publishing more articles on the Antibiotic resistance. After the counting subject wise publication it is found that 25 subjects published articles on Antibiotic resistance, Of which a maximum of 113(25.39 %) papers have been published under the Medicine subject as on top followed by 73(16.40 %) papers in Biochemistry, Genetics and Molecular Biology followed by Immunology and Microbiology. Chemistry subjects ranked in the 9th position with 12(2.69 %) publications.

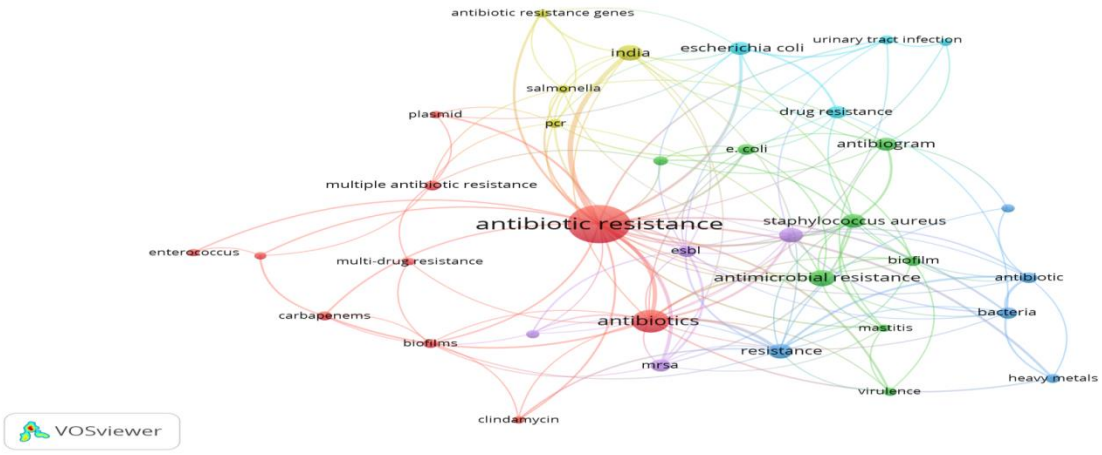
Figure 1: Visualization of the Most Collaborative Countries:



The above figure presents the network visualization of the most collaborative countries. It is found that a total of 48 countries published scholarly papers on Antibiotic resistance. All the 48 countries were taken for mapping. The collaboration can be seen by the circle, bigger the circles, larger the research publications, and more collaborative relationships among the countries. With the help of the

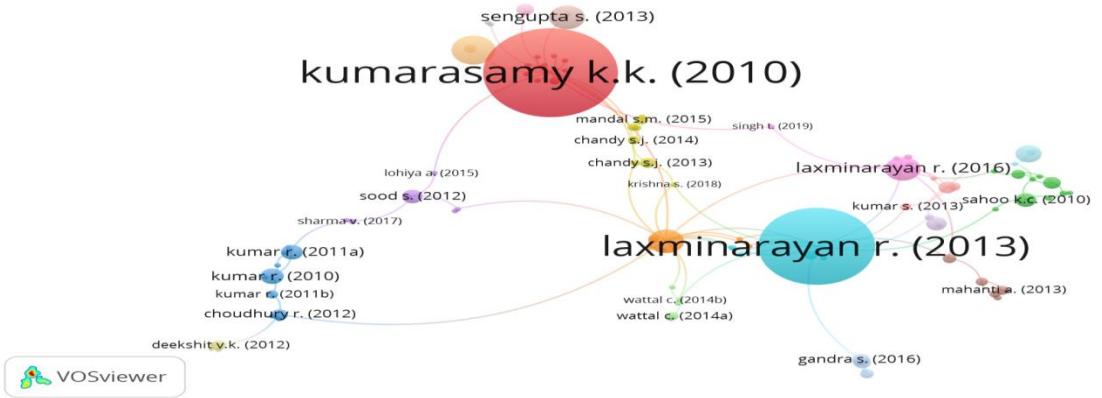
map, it is found that the United States circle is bigger than another; it means the USA is the biggest collaborative country that has a larger number of scholarly publications followed by Sweden, Saudi Arabia, etc.

Figure 2: Visualisation of the Author Keywords Clustering Analysis



The above figure represents the network visualization of author keywords used in scholarly publications on Antibiotic resistance. A total of 1036 records were taken, however; only 35 keywords meet the threshold for visualization mapping where the minimum number of the occurrences of keywords was considered at 3. The no. of keywords can be seen by the size of the circle, bigger the circles, larger no of the research publications used these keywords. It is seen by the map that the "antibiotic resistance" is the biggest circle; it means this term is used maximum time as keyword followed by "antibiotic" and "antimicrobial resistance".

Figure 3: Top most productive Highly Cited Documents article (Title) with author(s) published on Antibiotic resistance during the period from 2010 to 2019



This graph represents the top ten highly cited documents title with their citations during 2010-2019. During analysis, it is found that Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: A molecular, biological, and epidemiological study authored by kumarasamy, K.K.et al. received the highest 1818 citations, followed by Antibiotic resistance-the need for global

solutions authored by Laxminarayan, R. et al with 1380 citations. Further, it is seen that the Antibiotic resistance and extended-spectrum beta-lactamases: Types, epidemiology, and treatment authored by Shaikh, S. et al. received third-highest citation while Antibiotic resistance in Pseudomonas aeruginosa and alternative therapeutic options authored by Chatterjee.M. et. al. ranked at 10th position with 70 citations.

FINDINGS :

In this study, data were extracted from the Scopus database developed by Elsevier in the Netherlands. A total of 445 records have been extracted from the Scopus database published on Antibiotic resistance from 2010- 2019. This is the find out that the most productive year is recognized as 2017 with 67 (15.05 %) articles. Maximum AGR 61.90 percent was recorded in the year 2012 while the minimum (-) 22.22 percent AGR recorded in the year 2011. Maximum 0.58 RGR was recorded in the year 2011 and the minimum 0.14 RGR recorded in the year 2019. Maximum 4.95 Dt is calculated in the year 2019 while the minimum of 1.19 Dt is recorded in the year 2011. Karolinska Institute ranked 1st with 16(3.59 %) publications and the Journal of Clinical and Diagnostic Research secured the first position with 15(3.37 %) articles among 159 Journals. Tamhankar, A.J. is ranked topmost productive corresponding author (1st position) with 11 articles. Maximum 113(25.39 %) papers have been published under the Medicine subject. and Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: A molecular, biological, and epidemiological study authored by Kumarasamy, K.K. et al. received the highest 1818 citations.

CONCLUSION:

The study reveals the bibliometric analysis of Indian contribution to antibiotic resistance. Antibiotic resistance is a very relevant topic for public health not only in India but across the world, which will gain even more dimensions in the future. The number of antibiotic resistance indicates the danger that if this situation continues in the future, we can go back to the 19th-century environment and avoid infection. We should always focus on Fleming's words 'Using antibiotics judiciously or otherwise losing them forever'. We should use antibiotics only when prescribed by a doctor. This is also need to aware that the number of antibiotics is almost constant and too many antibiotics have almost the same family and formula. Now, if antibiotic resistance is made in this case, it will be very difficult to prevent the infection of bacteria and this will increase the number of people who die, So There is needed to be evolving in more research on antibiotic resistance at national level.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES:

1. Antibiotic resistance (TITLE(antibiotic resistance) AND PUBYEAR > 2010 AND PUBYEAR < 2019 AND (LIMIT-TO (AFFILCOUNTRY,"India”))), Scopus database, Retrieved from https://www.scopus.com/

2. Brandt, C.,et.al. (2014).The bigger picture: The history of antibiotics and antimicrobial resistance displayed by scientometric data, *International Journal of Antimicrobial Agents*, 44(5), 424-430.
3. Frid-Nielsen, S.S., Rubin, O. and Baekkeskov, E.(2019).The state of social science research on antimicrobial resistance, Social Science and Medicine,242,112596.
4. Garfield, E. (1979). Scientometrics comes to age. Current Contents, 46, 5-10.
5. Gomez-Rios, D. and Ramirez-Malule, H.(2019).Bibliometric analysis of recent research on multidrug and antibiotics resistance (2017-2018),Journal of Applied Pharmaceutical Science,9(5),112-116.
6. Head, M.G., et al.(2015).Mapping pneumonia research: A systematic analysis of UK investments and published outputs 1997-2013, EBioMedicine,2(9),1193-1199.
7. Sweileh, W.M., et.al. (2016)Bibliometric analysis of global scientific research on carbapenem resistance (1986-2015), *Annals of Clinical Microbiology and Antimicrobials*,15(1),56.
8. Sweileh, W.M., Al-Jabi, S.W., Zyoud, S.H., Sawalha, A.F. and Abu-Taha, A.S. (2018).Global research output in antimicrobial resistance among uropathogens: A bibliometric analysis (2002–2016), *Journal of Global Antimicrobial Resistance*,13,104-114.
9. Sweileh, W.M., Sawalha, A.F., Al-Jabi, S. and Zyoud, S.H.(2017).Bibliometric analysis of literature on antifungal triazole resistance: 1980 – 2015,*GERMS*,7(1),19-27
10. VOS viewer Manual (2020) developed by Nees Jan van Eck and Ludo Waltman at Leiden University's Centre,for Science and Technology Studies (CWTS). Retrieved https://www.vosviewer.com/