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# Curability of Ebola Virus – A Scientometric Approach to Ebola Virus Research

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**Abstract:**

*Ebola virus cause hemorrhagic fevers — illnesses marked by severe bleeding (hemorrhage), organ failure and, in many cases, death. This is native to Africa, where sporadic outbreaks have occurred for decades. Ebola virus live in animal hosts, and humans can contract the viruses from infected animals. After the initial transmission, the viruses can spread from person to person through contact with body fluids or contaminated needles. No drug has been approved to treat this virus. This is a pioneering study on the trend of Ebola Virus Research. This study attempts to analyse the trend of research, authorship pattern, leading authors in this subject field, transient and continuant authors in this field and application of Kumaravel's Prepotency index to identify the specialist in this field.*

**Key words:** entrepreneurship training, entrepreneurial features, sport experts

## Introduction

Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever, is a severe, often fatal illness in humans.

The virus is transmitted to people from wild animals and spreads in the human population through human-to-human transmission. The Ebola virus causes an acute, serious illness which is often fatal if untreated. Ebola virus disease (EVD) first appeared in 1976 in 2 simultaneous outbreaks, one in Nzara, Sudan, and the other in Yambuku, Democratic Republic of Congo. The latter occurred in a village near the Ebola River, from which the disease takes its name. There is no known treatment for Ebola in humans. Doctors can offer supportive therapy, such as hydration, oxygen and treatment of complicating infections, but mortality rates are still very high. Because the natural reservoir and origin of transmission remains unknown, there are no established methods of primary prevention. Instead, prevention efforts focus on outbreak control in healthcare settings. Research is in progress to prevent and cure the dangerous Ebola Virus. This investigation is a pioneering attempt to analyze the global research productivity in the field of Ebola Virus.

## Materials and methods

Publications used in this analysis were extracted from the Pubmed database. The query used for downloading the records was "Ebola" in MESH field. The total records thus downloaded was 1078 and the period of coverage was 1979 to 2013. Analysis parameters include the trend of research, authorship pattern, journals. The records in text format are parsed using Visual basic code to generate the necessary tables for analysis.

## Discussion

Though Ebola Virus had its outbreak in 1976, the research in this area started in 979. The first paper about Ebola Virus was by the French scholar Courtois, D who reviewed the clinical, epidemiological and virological aspects of Ebola virus disease

are and suggested precautionary measures to be taken by medical and nursing staff to avoid infection. Though this virus had been identified first in Zaire (Democratic Republic of the Congo - DRC), Sudan and England, the first research paper was published in France. The research productivity in this field is also very low with maximum publications in the year 2011. The average growth rate of research publications in this field is found to be 0.02 which is very negligible. After 2011, there is a decline in the research productivity. The cases of Ebola virus in the year 1976 was 318 in Congo while this is 57 in the year 2012 (World Health Organisation - http://www.who.int/mediacentre/factsheets/fs103/en/). Perhaps the reason for the low research productivity in this subject area may be due to the reason that the prevalence is low and the cure might have been invented.

An analysis of the authorship pattern in the field of Ebola virus research shows that more number of papers are by three and more authors. Also it is found that the solo research is to the maximum extent of 11.78 per cent of the total output (Table 2). The inference from the authorship pattern is that research in Ebola virus is more collaborative in nature and the optimum number of researchers in a collaborative research is 3 to 5.

As in many scientific researches, the Research papers in the field of Ebola virus are also published mostly from USA ( 60.20%) and the next leading country is England (15.77%). Though the disease is found mainly in African Countries, researches are found mostly outside African regions.

In order to identify the most prolific authors in Ebola Virus Research, the authors are ranked in three ways namely a) Publication Count 2) Equal Share method and 3) Positional share method. In publication count method, each paper published by an author, whether solo or collaborative, is given an integer value of 1. In equal share method, the weightage is shared among the collaborating authors. In a collaborative

publication, each author is given equal share according to the number of collaborators. For example if a publication is by five authors, each author gets a weightage of 1/5. In positional share method, each author is given weightage according to their position in the named list of authors. The positional value is calculated as PV = (n – p +1) / n∑ where n∑ = 1+2+3+ …[1] n where n is the number of authors in a collaborative publication and p is the position of the author in the named list of authors.

The three most prolific authors are Feldmann H (USA), Geisbert TW (USA) and Sanchez A (USA). These three authors have high productivity and rank in the first three positions when ordered according to publication count, equal share method and positional share method. Rollin PE, having 43 publications is in the fourth rank; but is moved to the 10th place when ordered according to positional share method. From this, it can be inferred that it is not the publication alone that decides the rank of the author, but the other deciding factor shall be the place where an author stands in the author list in a publication.

In a collaborative publication it is not necessarily that all the co-authors contribute equal effort in the research. It is a common procedure that the author named first in a collaborative publication might have put maximum effort. As the position of the author name moves from the first to the last position, the effort of the co-authors may decrease. Kumaravel (2012)[1] has introduced a new index prepotency index to measure the concentration of an author in a collaborative publication. The prepotency index is calculated as

PI = PV/N
Where PV = (n – p +1) / n∑ where n∑ = 1+2+3+ … n and PV ≤ 1

[1] Kumaravel, J P S et al. (2014). Herbal Medicine Research – A Scientometric View. EUROPEAN ACADEMIC RESEARCH. Vol.II(4). Pp.5302-5322

According to Kumaravel's potency index, the PI value nearer to 1 indicates the higher involvement of the author in most of his collaborative publications. The PI value nearer to zero indicates that the author has been involved in majority of his collaborative publications for name sake. Hence the authors are ranked on the basis of weighted share by their position in the author list. (Table 5). From this table it can be inferred that Feldmann H who has highest publication count (100 papers) is having less PI value indicating that he had not put most effort in many of his publications. Similarly, Wool-Lewis RJ who has published only 7 papers is having highest PI value of 0.45 indicating his specialization in the subject. From this it can be inferred that authors who have high PI value are specialists in the subject and such authors who have high specialization in Ebola Virus research are listed in Table 6.

In any subject, the scholars who are publishing their scientific communication continuously are called as continuant authors and those who publish sporadically are termed as transient authors. The more the continuant authors, the more will be the liveliness of the subject area. The total scholars who are continuously publishing for five years are considered as continuants. In the research area of Ebola Virus, only less number of authors are active and continuous. The percentage of continuant authors have grown from 0.53 per cent during the period 1995-99 to 1.12 per cent during the period 2009-13 (Table 7). This is a healthy atmosphere of the field and shows that still research have to be conducted to eradicate the deadly virus Ebola.

The scholars who are still continuously engaged in Ebola Virus research are listed in Table 8. Feldmann H who has the highest publication count is still in the field. The other noteworthy continuous authors are Rollin PE, Hensley LE, Basler CF, Geisbert JB etc. Courtois, D who was the opening batsman in Ebola virus research in the year 1976 did not publish any paper in this field later.

## Conclusion

Without an approved vaccine or treatments, Ebola outbreak management has been limited to palliative care and barrier methods to prevent transmission. The third meeting of the Emergency Committee convened by the WHO Director-General under the IHR 2005 regarding the 2014 Ebola virus disease (EVD, or "Ebola") outbreak in West Africa was conducted said that "As of 22 October 2014, the number of total cases stands at 9936 total cases, with 4877 deaths. Cases continue to increase exponentially in Guinea, Liberia, and Sierra Leone; the situation in these countries remains of great concern". Hence there is an urgent need to find out the preventive measures and cure for the deadly Ebola Virus. The present study has indicated the slow nature of research in this area. Hence it is time for the medical practitioners to involve in this subject area.

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**Table 1 Trend of Research in Ebola Virus**

| Year | Publications | Percent | Growth Rate |
|---|---|---|---|
| Before 1985 (1979-84) | 59 | 5.47 | |
| 1985-89 | 25 | 2.32 | |
| 1990-94 | 44 | 4.08 | 0.76 |
| 1995 | 42 | 3.90 | -0.05 |
| 1996 | 22 | 2.04 | -0.48 |
| 1997 | 19 | 1.76 | -0.14 |
| 1998 | 26 | 2.41 | 0.37 |
| 1999 | 53 | 4.92 | 1.04 |
| 2000 | 33 | 3.06 | -0.38 |
| 2001 | 43 | 3.99 | 0.30 |
| 2002 | 42 | 3.90 | -0.02 |
| 2003 | 61 | 5.66 | 0.45 |
| 2004 | 47 | 4.36 | -0.23 |
| 2005 | 44 | 4.08 | -0.06 |
| 2006 | 56 | 5.19 | 0.27 |
| 2007 | 65 | 6.03 | 0.16 |
| 2008 | 30 | 2.78 | -0.54 |
| 2009 | 47 | 4.36 | 0.57 |
| 2010 | 69 | 6.40 | 0.47 |
| 2011 | 100 | 9.28 | 0.45 |
| 2012 | 83 | 7.70 | -0.17 |
| 2013 | 68 | 6.31 | -0.18 |
| | 1078 | 100.00 | 0.15 |

**Table 2 Authorship Pattern in Ebola Virus Research**

| No of Authors | Publications | Percent |
|---|---|---|
| 0 | 33 | 3.06 |
| 1 | 127 | 11.78 |
| 2 | 88 | 8.16 |
| 3 | 125 | 11.60 |
| 4 | 123 | 11.41 |
| 5 | 109 | 10.11 |
| 6 | 102 | 9.46 |
| 7 | 71 | 6.59 |
| 8 | 80 | 7.42 |
| 9 | 51 | 4.73 |
| 10 | 42 | 3.90 |
| 11 | 28 | 2.60 |
| 12 | 33 | 3.06 |
| 13 | 13 | 1.21 |
| 14 | 13 | 1.21 |
| 15 | 11 | 1.02 |
| 16 | 11 | 1.02 |
| 17 | 3 | 0.28 |
| 18 | 4 | 0.37 |
| 19 | 6 | 0.56 |
| 21 | 1 | 0.09 |
| 22 | 1 | 0.09 |

| | | |
|---|---|---|
| 23 | 2 | 0.19 |
| 37 | 1 | 0.09 |
| | 1078 | 100.00 |

**Table 3 Country of Publication**

| S.No | Country | Publications | Percent |
|---|---|---|---|
| 1. | United States | 649 | 60.20 |
| 2. | England | 170 | 15.77 |
| 3. | Netherlands | 74 | 6.86 |
| 4. | Russia | 38 | 3.53 |
| 5. | Switzerland | 29 | 2.69 |
| 6. | France | 25 | 2.32 |
| 7. | Japan | 13 | 1.21 |
| 8. | Germany | 12 | 1.11 |
| 9. | Russia (Federation) | 12 | 1.11 |
| 10. | Austria | 11 | 1.02 |
| 11. | China | 8 | 0.74 |
| 12. | BELGIUM | 6 | 0.56 |
| 13. | Canada | 4 | 0.37 |
| 14. | USSR | 3 | 0.28 |
| 15. | GERMANY, WEST | 3 | 0.28 |
| 16. | Denmark | 2 | 0.19 |
| 17. | PUERTO RICO | 2 | 0.19 |
| 18. | SENEGAL | 2 | 0.19 |
| 19. | Czech Republic | 1 | 0.09 |
| 20. | India | 1 | 0.09 |
| 21. | ISRAEL | 1 | 0.09 |
| 22. | KENYA | 1 | 0.09 |
| 23. | AUSTRALIA | 1 | 0.09 |
| 24. | POLAND | 1 | 0.09 |
| 25. | Portugal | 1 | 0.09 |
| 26. | SOUTH AFRICA | 1 | 0.09 |
| 27. | Sweden | 1 | 0.09 |
| 28. | Tanzania | 1 | 0.09 |
| 29. | THAILAND | 1 | 0.09 |
| 30. | TURKEY | 1 | 0.09 |
| 31. | Uganda | 1 | 0.09 |
| 32. | United Arab Emirates | 1 | 0.09 |
| 33. | New Zealand | 1 | 0.09 |
| | | 1078 | 100.00 |

**Table 4 Most Prolific Authors**

| Author Name | Total Papers published | Rank According to Publication Count | Rank According to Equal Share method | Rank According to Positional Share method |
|---|---|---|---|---|
| Feldmann H | 100 | 1 | 1 | 2 |
| Geisbert TW | 50 | 2 | 2 | 1 |
| Sanchez A | 45 | 3 | 3 | 3 |
| Rollin PE | 43 | 4 | 8 | 10 |
| Klenk HD | 41 | 5 | 5 | 9 |
| Ksiazek TG | 40 | 6 | 17 | 23 |
| Jahrling PB | 39 | 7 | 14 | 28 |
| Hensley LE | 33 | 8 | 16 | 25 |
| Takada A | 31 | 9 | 4 | 4 |
| Peters CJ | 31 | 10 | 7 | 14 |
| Bray M | 31 | 11 | 6 | 5 |
| Bavari S | 29 | 12 | 30 | 101 |
| Warfield KL | 28 | 13 | 13 | 8 |
| Nichol ST | 28 | 14 | 29 | 83 |
| Gonzalez JP | 25 | 15 | 11 | 19 |
| Becker S | 25 | 16 | 15 | 27 |
| Chepurnov AA | 24 | 17 | 10 | 6 |
| McCormick JB | 24 | 18 | 9 | 16 |
| Basler CF | 24 | 19 | 22 | 44 |
| Volchkov VE | 23 | 20 | 21 | 13 |

**Table 5 Application of Kumaravel's Prepotency Index**

| Author | Count | Potency Value (PV) | Rank According to Publication Count | Rank According to PV | PI |
|---|---|---|---|---|---|
| Wool-Lewis RJ | 5 | 2.27 | 196 | 51 | 0.45 |
| Barrientos LG | 7 | 2.75 | 133 | 37 | 0.39 |
| van der Groen G | 12 | 4.68 | 62 | 11 | 0.39 |
| Shimojima M | 6 | 2.27 | 149 | 50 | 0.38 |
| Subbotina EL | 5 | 1.80 | 175 | 73 | 0.36 |
| Morikawa S | 6 | 2.12 | 156 | 57 | 0.35 |
| Bausch DG | 8 | 2.72 | 107 | 38 | 0.34 |
| Manicassamy B | 7 | 2.38 | 115 | 48 | 0.34 |
| Lee JE | 6 | 1.93 | 161 | 64 | 0.32 |
| Dadaeva AA | 14 | 4.41 | 46 | 15 | 0.32 |
| Elliott LH | 7 | 2.20 | 123 | 52 | 0.31 |
| Hartman AL | 6 | 1.88 | 157 | 66 | 0.31 |
| Gupta M | 8 | 2.50 | 96 | 43 | 0.31 |
| Le Guenno B | 5 | 1.56 | 200 | 88 | 0.31 |
| Kondratowicz AS | 6 | 1.86 | 152 | 68 | 0.31 |
| Mahanty S | 8 | 2.48 | 100 | 46 | 0.31 |
| Takada A | 31 | 9.32 | 9 | 4 | 0.30 |
| Kuhl A | 5 | 1.47 | 185 | 96 | 0.29 |
| Chepurnov AA | 24 | 7.03 | 17 | 6 | 0.29 |
| Licata JM | 7 | 1.95 | 118 | 62 | 0.28 |

**Table 6 Ranked authors according to Prepotency index**

| Author | Publication Count | Rank According to Publication Count | Rank According to PV | PI |
|---|---|---|---|---|
| Wool-Lewis RJ | 5 | 196 | 51 | 0.45 |
| Barrientos LG | 7 | 133 | 37 | 0.39 |
| van der Groen G | 12 | 62 | 11 | 0.39 |
| Shimojima M | 6 | 149 | 50 | 0.38 |
| Subbotina EL | 5 | 175 | 73 | 0.36 |
| Morikawa S | 6 | 156 | 57 | 0.35 |
| Bausch DG | 8 | 107 | 38 | 0.34 |
| Manicassamy B | 7 | 115 | 48 | 0.34 |
| Lee JE | 6 | 161 | 64 | 0.32 |
| Dadaeva AA | 14 | 46 | 15 | 0.32 |
| Elliott LH | 7 | 123 | 52 | 0.31 |
| Hartman AL | 6 | 157 | 66 | 0.31 |
| Gupta M | 8 | 96 | 43 | 0.31 |
| Le Guenno B | 5 | 200 | 88 | 0.31 |
| Kondratowicz AS | 6 | 152 | 68 | 0.31 |
| Mahanty S | 8 | 100 | 46 | 0.31 |
| Takada A | 31 | 9 | 4 | 0.30 |
| Kuhl A | 5 | 185 | 96 | 0.29 |
| Chepurnov AA | 24 | 17 | 6 | 0.29 |
| Licata JM | 7 | 118 | 62 | 0.28 |
| Leroy E | 9 | 82 | 45 | 0.28 |
| Steele KE | 6 | 155 | 84 | 0.27 |
| Martinez O | 11 | 67 | 33 | 0.27 |
| Noda T | 22 | 25 | 7 | 0.27 |
| Han Z | 7 | 122 | 70 | 0.26 |
| Bray M | 31 | 11 | 5 | 0.26 |
| Regnery RL | 6 | 162 | 89 | 0.26 |
| Reid SP | 7 | 128 | 74 | 0.25 |
| Bradfute SB | 7 | 119 | 75 | 0.25 |
| Hunt CL | 6 | 151 | 95 | 0.25 |

**Table 7 Transient and continuant authors**

| Year | No of Papers | No of Authors | Percapita Authorship | Continuant | Percent of Continuant Authors |
|---|---|---|---|---|---|
| 1995-1999 | 162 | 367 | 2.27 | 2 | 0.54 |
| 1996-2000 | 153 | 391 | 2.56 | 2 | 0.51 |
| 1997-2001 | 174 | 403 | 2.32 | 4 | 0.99 |
| 1998-2002 | 197 | 447 | 2.27 | 4 | 0.89 |
| 1999-2003 | 232 | 569 | 2.45 | 3 | 0.53 |
| 2000-2004 | 226 | 487 | 2.15 | 2 | 0.41 |
| 2001-2005 | 237 | 558 | 2.35 | 2 | 0.36 |
| 2002-2006 | 250 | 679 | 2.72 | 5 | 0.74 |
| 2003-2007 | 273 | 758 | 2.78 | 10 | 1.32 |
| 2004-2008 | 242 | 730 | 3.02 | 10 | 1.37 |
| 2005-2009 | 242 | 774 | 3.20 | 13 | 1.68 |
| 2006-2010 | 267 | 888 | 3.33 | 12 | 1.35 |

| | | | | | |
|---|---|---|---|---|---|
| 2007-2011 | 311 | 1094 | 3.52 | 12 | 1.10 |
| 2008-2012 | 329 | 1204 | 3.66 | 10 | 0.83 |
| 2009-2013 | 367 | 1339 | 3.65 | 15 | 1.12 |

**Table 8 Active Authors as on 2013**

| **Author** | **Publications in various periods** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Before 1991** | **1991-2000** | **2001-2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
| Feldmann H | 0 | 10 | 48 | 6 | 4 | 12 | 8 | 12 | 100 |
| Rollin PE | 1 | 17 | 13 | 3 | 1 | 2 | 4 | 2 | 43 |
| Hensley LE | 0 | 1 | 15 | 1 | 7 | 1 | 3 | 5 | 33 |
| Basler CF | 0 | 0 | 1 | 4 | 12 | 4 | 1 | 2 | 24 |
| Geisbert JB | 0 | 2 | 15 | 1 | 1 | 1 | 1 | 1 | 22 |
| Noda T | 0 | 0 | 13 | 1 | 2 | 2 | 1 | 3 | 22 |
| Watanabe S | 0 | 3 | 6 | 3 | 1 | 2 | 1 | 1 | 19 |
| Marzi A | 0 | 0 | 3 | 1 | 1 | 5 | 3 | 6 | 19 |
| Groseth A | 0 | 0 | 7 | 1 | 3 | 1 | 3 | 3 | 18 |
| Ruthel G | 0 | 0 | 8 | 2 | 4 | 1 | 1 | 1 | 17 |
| Halfmann P | 0 | 0 | 3 | 1 | 2 | 3 | 2 | 5 | 16 |
| Hoenen T | 0 | 0 | 3 | 2 | 2 | 1 | 2 | 5 | 15 |
| Feldmann F | 0 | 0 | 4 | 2 | 1 | 3 | 1 | 2 | 13 |
| Delos SE | 0 | 0 | 1 | 2 | 2 | 1 | 1 | 2 | 9 |
| Richardson JS | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 5 |