



Visualizing the Clusters and Dynamics of HPV Research Area

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Abstract

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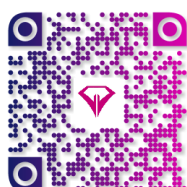
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Background and Aims: Co-word analysis, based on Co-occurrence, as one of the important techniques of Scientometrics and bibliometrics, enables the analysis of the content of scientific documents of the specific Research Area. The purpose of the present study is visualize HPV clusters relationships and thematic trends in the world.

Materials and Methods: The research type is an applied one with analytical approach and it has been done using co-word analysis. The population of this study consists of articles' keywords indexed during 2014-2018 in the Web of Science (WoS) in HPV subject area. The total numbers of the retrieved and analyzed keywords in this study were 13249. Some software like SPSS, UCINET and VOSviewer were used for data integration and analysis.

Results: The findings showed that the keyword "CERVICAL CANCER" have had the highest frequency and with "CERVICAL INTRAEPITHELIAL NEOPLASIA" and they were co-word couples. The results of the strategic diagram showed that the most clusters in HPV placed in third area of strategic diagram, it means these subjects (clusters) were emerging or declining.

Conclusion: Co-word analysis is suitable method for discover and visualize different sciences and their prominent patterns, hidden relationships and thematic trends research' subject areas. The results of these analysis and findings of such researches will help research policy makers

Keywords: Human Papilloma Virus, Papillomavirus, Co-occurrence, Co-Word Analysis, strategic diagram, UCINET, VOSviewer, HPV, bibliometrics, Scientometrics, Knowledge Structure, Visualizing

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Introduction

HPV is the most common sexually transmitted infection (STIs) that causes cervical cancer, genital warts (1), and other human cancers such as genital, oral, head and neck, skin, anus, vagina, and penis cancers (2-4). As one of the most challenging fields, many HPV kinds of research were done, where the number of international scientific publications in this area is quantitatively remarkable. Incessant researches over time have led to the formation of the scientific structure of the HPV research area in medical sciences. Most of HPV's authoritative and essential articles are indexed in internationally accredited citation databases (Web of Science and Scopus), which are used in scientometrics studies and analyses.

The research method used for scientific mapping and science measurement studies is Co-word analysis. This method studies the conceptual structure and evolution of a research field using document keywords and opens the possibility of revealing emerging clusters as well as developed clusters to predict research future for researchers (5, 6).

Given the importance of scientific papers as a suitable metric for measuring science progression, HPV results' analyses identify strengths and weaknesses in research areas related to that. They then discover the potentialities for research work to follow and use in support of that. This issue and ultimately, the path towards greater affection is the way-to-go for the planners, decision-makers, and policymakers at the Ministry of Health and

Medical Education and exclusively, for the scientific communities and the researchers. Therefore, given the strategic importance of this study and the fact that no research has been conducted so far, the necessity of doing so is deeply felt. Based on the theoretical framework explained before, the purpose of this study is to visualize the clusters and HPV dynamicity.

Materials and Methods

The present study is an applied one that was done using Co-word analysis, which is one of the scientific methods. This method illustrates HPV articles' thematic structure and content by calculating the number of occurrences and hidden connections between the words and concepts in HPV. To add to this, Data was collected from the Web of Science (WoS) Citation Database. The statistical population of this study includes all articles' keywords in the HPV subject area indexed in Web of Science (WoS) from 2014 to 2018. Worthy of mentioning, HPV specific keywords were extracted from Medical Subject Headings (MeSH).

Hierarchical clustering was performed using SPSS software (SPSS Inc., Chicago, Ill. USA). Visualization was also performed using VOSviewer software to show the high-frequency keyword structure. The threshold was set to 28 for analyzing the co-occurrence of 17278 keywords from 13249 articles.

Results

Table 1. Top 10 HPV Subject Area keywords' ranking based on co-word analysis (2014-2018)

No.	Keywords Title	Frequency
1	CERVICAL CANCER	1919
2	HPV VACCINE	772
3	HEAD AND NECK CANCER	582
4	CERVICAL INTRAEPITHELIAL NEOPLASIA	475
5	HPV VACCINATION	434
6	SQUAMOUS CELL CARCINOMA	362
7	HIV	325
8	P16	289
9	OROPHARYNGEAL CANCER	284
10	HEAD AND NECK SQUAMOUS CELL CARCINOMA	239

Table 2. Top 10 co-word pairs' Ranking in HPV Subject Area (2014-2018)

No.	co-word pairs	Frequency
1	CERVICAL CANCER**CERVICAL INTRAEPITHELIAL NEOPLASIA	153
2	HPV VACCINE** CERVICAL CANCER	131
3	HPV VACCINATION** CERVICAL CANCER	90
4	ADOLESCENT** HPV VACCINE	83
5	HEAD AND NECK CANCER** OROPHARYNGEAL CANCER	66
6	HIV** CERVICAL CANCER	66
7	GENOTYPE** CERVICAL CANCER	66
8	SQUAMOUS CELL CARCINOMA** HEAD AND NECK CANCER	64
9	RADIATION THERAPY** HEAD AND NECK CANCER	62
10	HPV16** CERVICAL CANCER	55

Table 3. Density and centrality of clusters derived from the co-word analysis in HPV subject area (2014-2018)

Cluster name	Centrality	Density
1. Tobacco and alcohol consumption	0	16
2. Targeted Therapy	20.75	10.62
3. Immune and biological systems	2.4485	1.1765
4. HPV Deaths	10.5	13
5. HPV Symptoms and Diseases	1.133	0.3908
6: HPV Diagnosis and Suppression Methods	8.25	4.9556
7. HPV Cancer	7.3333	4.3571
8. HPV Growth Cycle	0	32
9. Timely detection of HPV genotypes and cells	33.0455	6.5385
10. Cervical Cancer	12.8	7.0667
11. Sexual and communicable diseases	20.6667	14.1
12. Vaccination and prevention of genital warts	8.6667	3.5091
13. Safety and Security	0	22
14. Adolescent Immunization	29.2	13.3333
Mean	12227.83279	3962.891227

Table 4. Clusters' names in quadrants of strategic diagram

Clusters	Quadrant
C 8. HPV Growth Cycle C 13. Safety and Security	Quadrant II
C 1. Tobacco and alcohol consumption C 3. Immune and biological systems C 4. HPV Deaths C 5. HPV Symptoms and Diseases C 6: HPV Diagnosis and Suppression Methods C 7. HPV Cancer C 10. Cervical Cancer C 12. Vaccination and prevention of genital warts	Quadrant III
C 2. Targeted Therapy C 9. Timely detection of HPV genotypes and cells C 11. Sexual and communicable diseases C 14. Adolescent Immunization	Quadrant IV

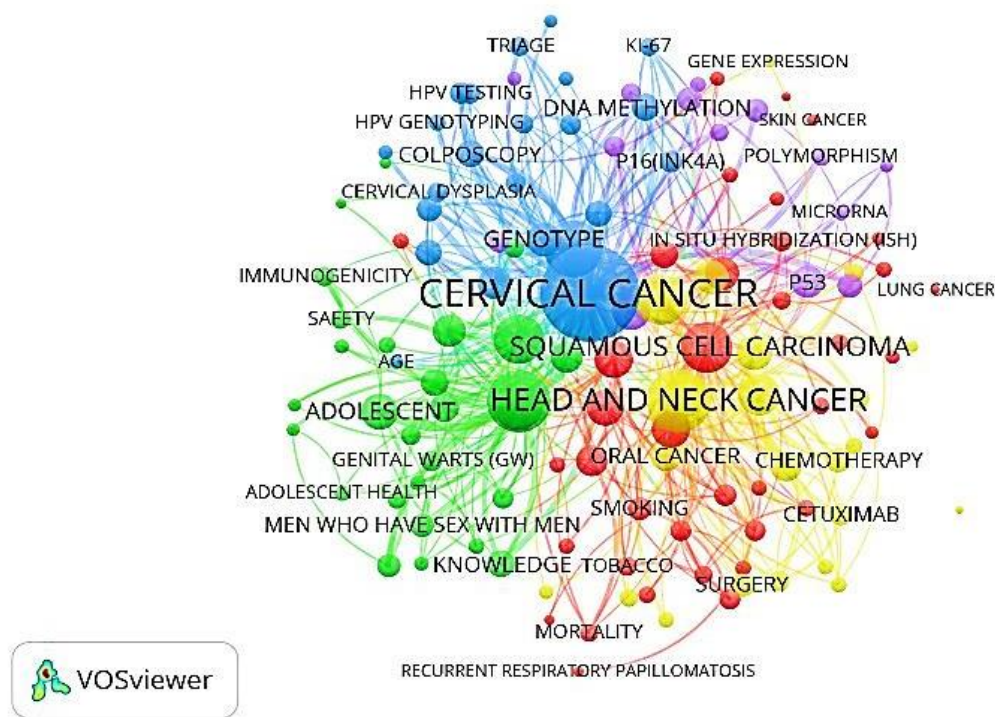


Figure 1. The network structure of high-frequency keywords in HPV subject area (2014-2018)

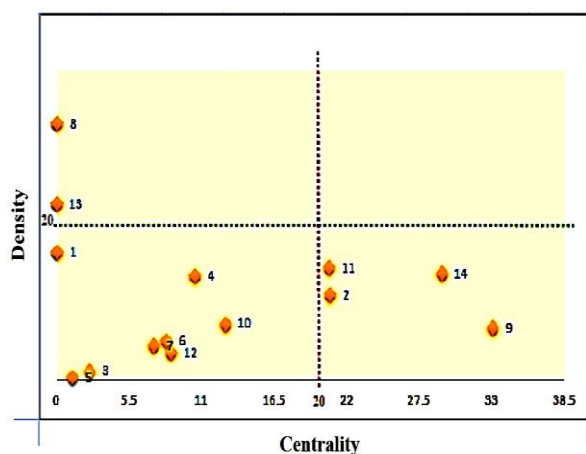


Figure 2. Strategic Diagram of HPV Subject Area Structure (2014-2018)

In Figure 1, the size of the nodes represents the weight of each author's scientific output, and the colors also represent the clusters formed.

A strategic diagram was designed to determine the maturity and development of clusters using concepts of centrality and density plotted on a two-dimensional grid. The x-axis of the grid shows how strongly a cluster connected to others, and the y-axis shows a cluster's development.

Clusters of 8, 13, and 1 the highest density and clusters of 9, 14, and 2, respectively, have the highest centrality (Figure 2). The origin of the strategic diagram is adjusted according to the mean centrality and density of the clusters.

Discussion and Conclusion

The present paper followed previous bibliometrics. So far, Research findings indicate that the most frequent keyword among HPV studies is "CERVICAL CANCER." Using a hierarchical clustering method to identify the intellectual structure of this subject area resulted in the formation of 14 subject clusters (Table 3). The plotting results of the distribution of clusters in the strategic diagram (Figure 2) indicated that the thematic areas of "HPV-induced cancers," "vaccination," "prevention", and "genital warts" are the most important emerging areas in this subject area. Last but not least are the subject areas of drug, cancer treatment, timely diagnosis, sexually transmitted diseases, and immunization of adolescent health, which expect further research in the future.

Clusters located in the second region of the strategic diagram ([Figure 2](#)) are not axial but considered developed. The third region clusters have lower centrality and density than the other clusters, so they are marginal, and at the same time, emerging and declining. The fourth region clusters present a strategic diagram that is pivotal but general and broad.

Co-word analysis is an appropriate way of discovering and mapping science, knowledge tracking, visualization, conceptual dynamics, and transformation, identifying and analyzing research fields in the subject areas by researchers that help planners and policymakers.

In the end, we suggested that another research be done in Persian scientific journals (Persian articles) with the focus of the HPV research area (using Co-word Analysis) so that the results will

compare with the ones obtained in this study. Finally, researchers also suggested that in another study, all HPV publications in this subject area through the world and from the first article publication so far, do with co-occurrence analysis and the results are available to medical policymakers in the country and other international health organizations.

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Conflict of Interest

This article is the result of an independent study conducted without organizational financial support. In the present study, the authors showed no conflict of interest.