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Bibliometric analysis of emerging technologies in the field of computer science helping in ovarian cancer research

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Bibliometric Analysis of Emerging Technologies in the Field of Computer Science Helping in Ovarian Cancer Research

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Abstract: This study is carried out to provide an analysis of the literature available at the intersection of ovarian cancer and computing. A comprehensive search was conducted using Scopus database for English-language peer-reviewed articles. The study administers chronological, domain clustering and text analysis of the articles under consideration to provide high-level concept map composed of specific words and the connections between them.

Keywords: ovarian cancer; text mining, data mining; chemoinformatics; neural network; genetic algorithm; pattern recognition; computational model; bibliometric analysis

Introduction:

Women in the world suffer through a lot of diseases among which ovarian cancer is proved to be seventh most commonly diagnosed cancer in the world [1] and the third most significant cancer among women in India. Real statistics on ovarian cancer indicate that the occurrence and morality rates are intolerably high. It is very common so it is difficult to discriminate whether the masses are benign or malignant. Ovarian cancer affects the ovarian part of the female reproductive system. Ovarian cancer is detected after spreading to the pelvis and the abdomen. It is very tough to treat it at this stage, it can be effectively treated when the disease is limited to the ovary. The latest trends in medical imaging facilitate the diagnosis of most cancers in the first stage. However, in ovarian cancer the diagnosis is inaccurate.

Ovarian cancer can be classified as epithelial tumours, Stromal tumour and Germ cell plants. Epithelial tumours are in the thin layer of tissue that surrounds the ovaries, stromal tumours are in the ovarian tissue containing hormone-producing cells, and germ cell tumours damage the egg-producing cells. This is an unusual cancer type which generally occurs in younger women.

Computer Science and data science have helped doctors in different ways in regards to ovarian cancer. They have provided us major insights into processes involved and the genes in cancer. This has led to more evolved prognostic tests thereby leading to more efficient diagnostics. It has also helped us to understand that every cancer and tumour is different and the approach should be targeted. There is a lot of data that needs processing for example there are 2 billion letters in the genome of a human being. This requires computational experts and high-processing-power computers to implement code to detect meaningful patterns and insights[2]. These tumours need to be studied in order to show how uniquely cancer cells grow and exist as well as emerge. Computer models can be used for hundreds of stimulations to make accurate predictions to slow the metastasis.

Many bibliometric papers from other disciplines were studied so as to infer the work flow [3, 4]. In this bibliometric paper various research papers were studied, analysed and combined together

so as to show the statistics. There are graphs showing statistics about how many research papers are being published over these years regarding ovarian cancer. There are different keywords like as to how computational model is helping in ovarian cancer. There are statistics along with numerical data linked to ovarian cancer in the published papers along with showing how computer science has helped over the years. Top cited articles and findings of a few important research papers have also been added.

Methodology:

Study Criteria:

An intensive search was conducted using Scopus database [5,38] for English-language peer-reviewed articles and academic journals. After identifying search keywords and key terminologies in field of research that is computer technologies helpful in research of ovarian cancer, below is the list of keywords:

Scopus (journal articles, all years):

("Ovarian Cancer" OR "ovarian cancer") AND ("text mining" OR "data mining" OR "chemoinformatics" OR "neural network" OR "genetic algorithm" OR "statistics" OR "pattern recognition" OR "computational model" OR "simulation")

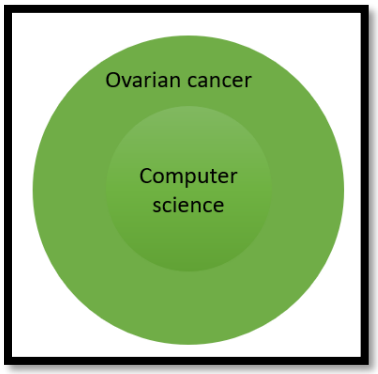


Fig 1: Computer Science in Ovarian Cancer

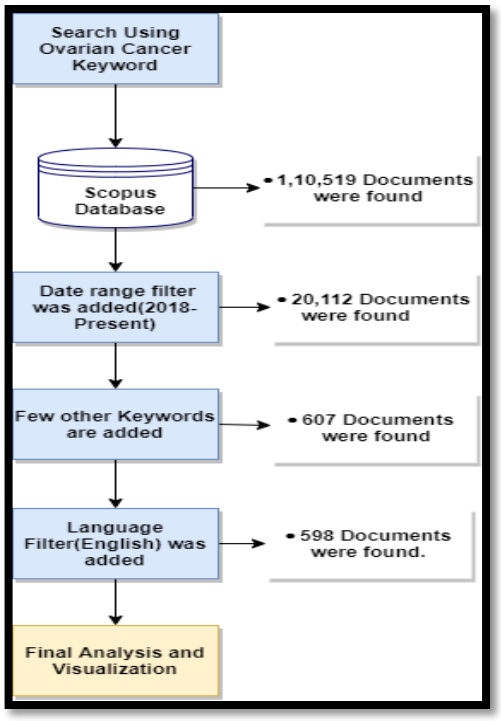


Fig 2: Flowchart showing the Scopus Database Search

Some keywords were also eliminated to restrict the search as the study tried to keep it within the scope of computer science. Terms relating to only chemistry and biology were excluded.

Papers dating back to late 20th century were collected but main focus of this study is papers dating to 2018-2021. The flowchart is shown in Fig. 2. The earlier papers were just used to see the trends and topic shift and by what range the number of papers were published over time.

Results:

A. Most Co-Cited Network:

For determining the citation network the graph was created using vosviewer [6,37] mapping software Fig. 3 shows the countries with more than 10 citations. United States is leading the pack with having the most co-citations. Other participating countries greatly included are China, United Kingdom, Australia etc.

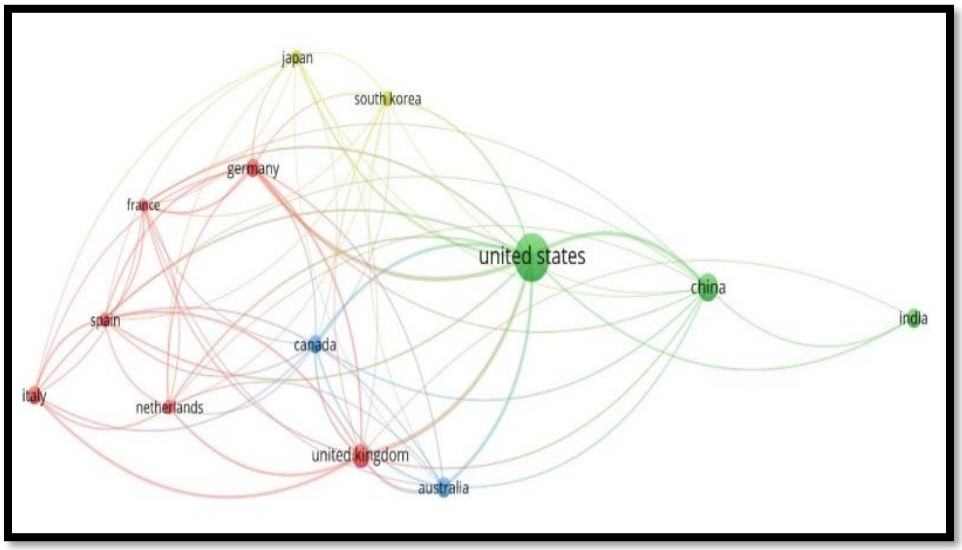


Fig 3: Countries with more than 10 co-citations

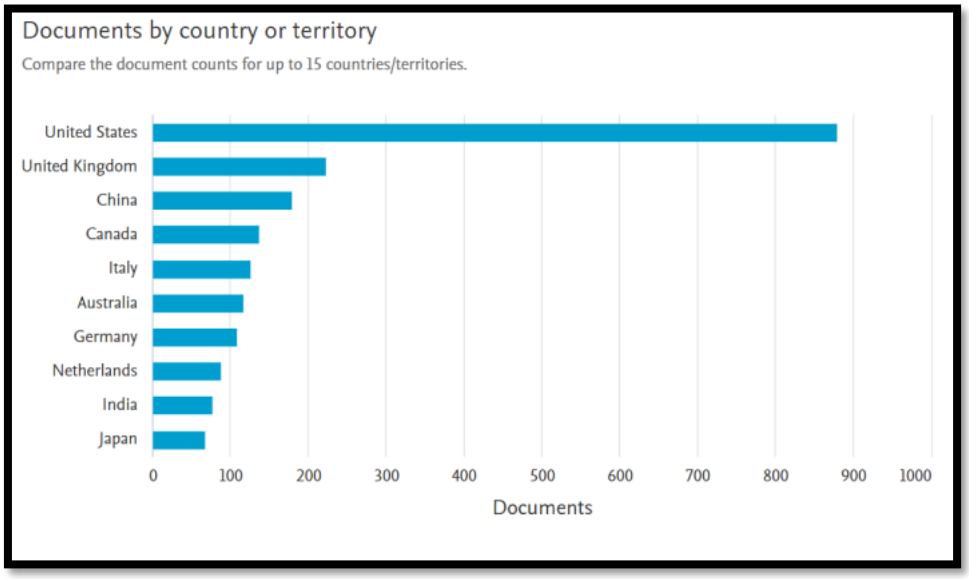


Fig 4: Documents by Country

In Fig 4, the number of documents published in every country can be seen which the most a whopping 879 is in United States.

B. Documents by funding sponsor

The documents were sorted on the basis of funding sponsors to find about the organization which funded papers on these topics. In Fig 5, it is observed that the National Institute of Health funded 421 documents followed by U.S. Department of Health and Human Services which funded 414 followed by National Cancer Institute which funded 340 documents in the Scopus Database.

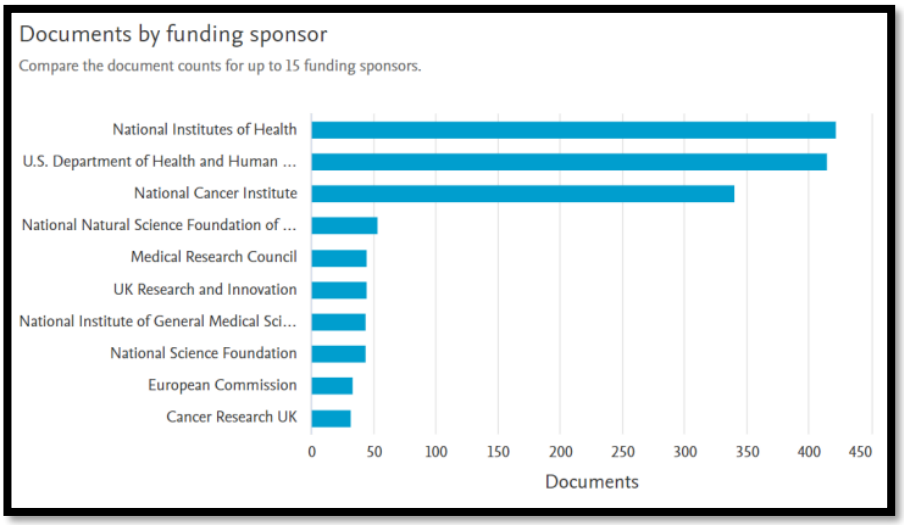


Fig 5: Documents by Funding Sponsor

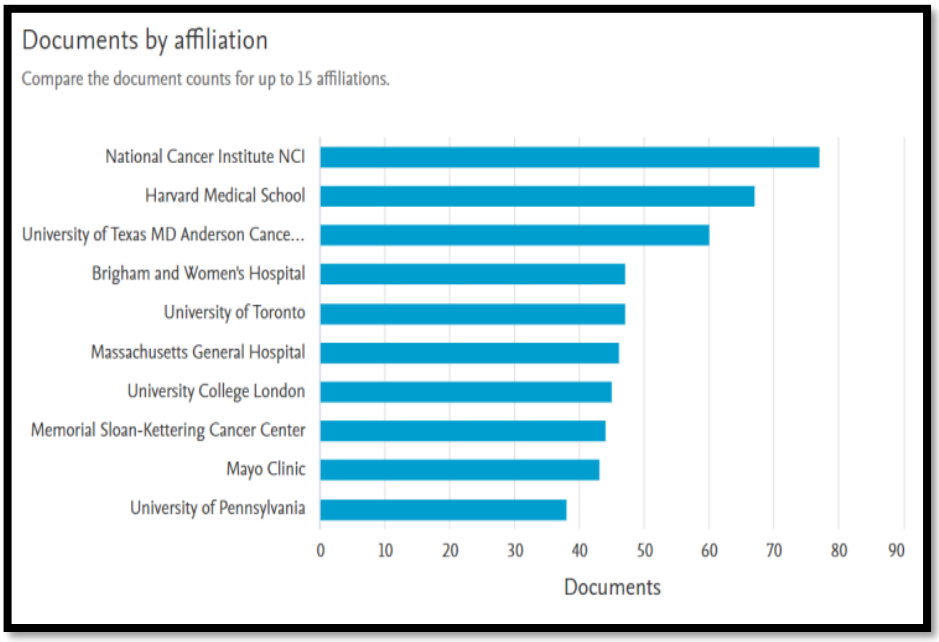


Fig 6: Documents by Affiliation

C. Documents by Affiliation

Fig 6 shows the document affiliations. It can be noted that most of them were affiliated to National Cancer Institute NCI followed by Harvard Medical School and University of Texas MD Anderson Cancer Center and so on.

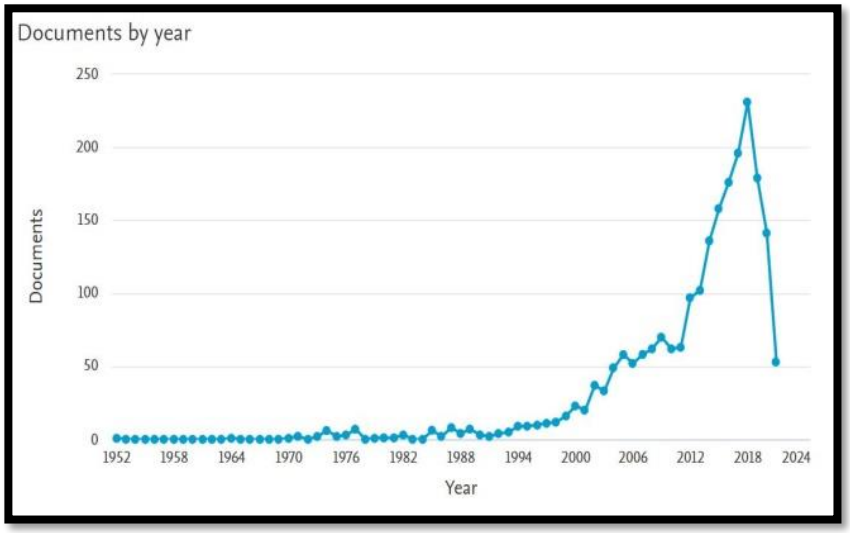


Fig 7: Documents by Year

D. Documents By Year

Starting from the year 1952 the papers published on this subject kept on increasing having its peak in the year 2018 as seen in Fig. 7 with the highest number of published papers being 228.After this there was a slight decline on the papers published on this topic.

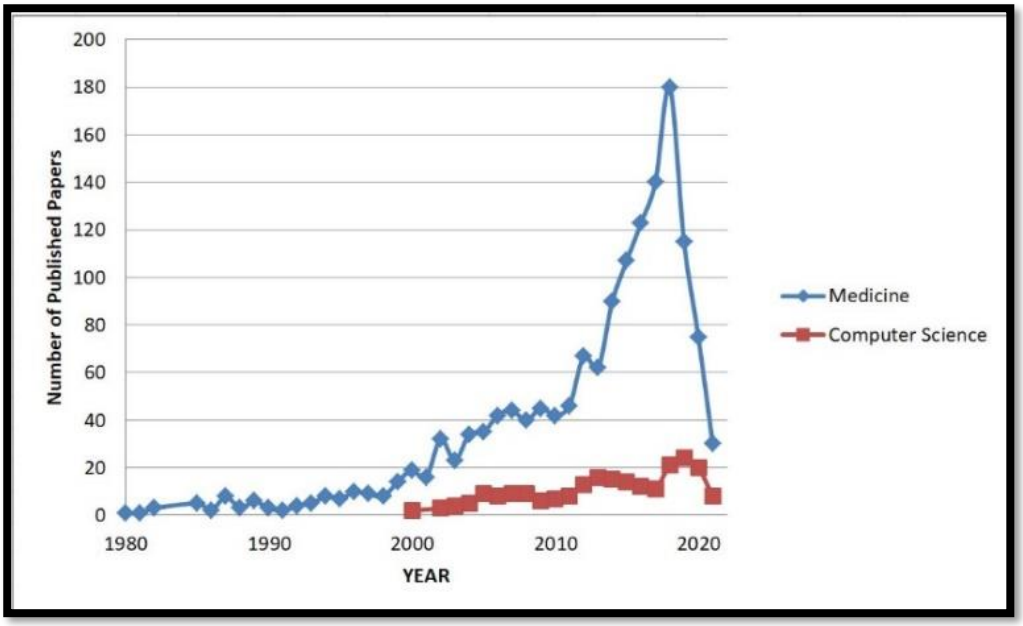


Fig 8: Documents by Subject Area

E. Documents By Subject Area

The documents which were extracted from the Scopus Database using Language filter only ranging from time period 1971 to 2021 were classified on the basis of their subject area. As seen in Fig 8, there were 1437(41.5%) documents published in medicine,774 (22.3%) in Biochemistry, Genetics and Molecular Biology, 225 (6.5%) in Computer Science and so on. In Fig. 9, a graph was constructed to show the emergence of documents in the field of Computer Science usage in Ovarian Cancer since the year 2000. Earlier the papers were in medicine field only. Most papers were published in medicine on ovarian cancer around 2018.

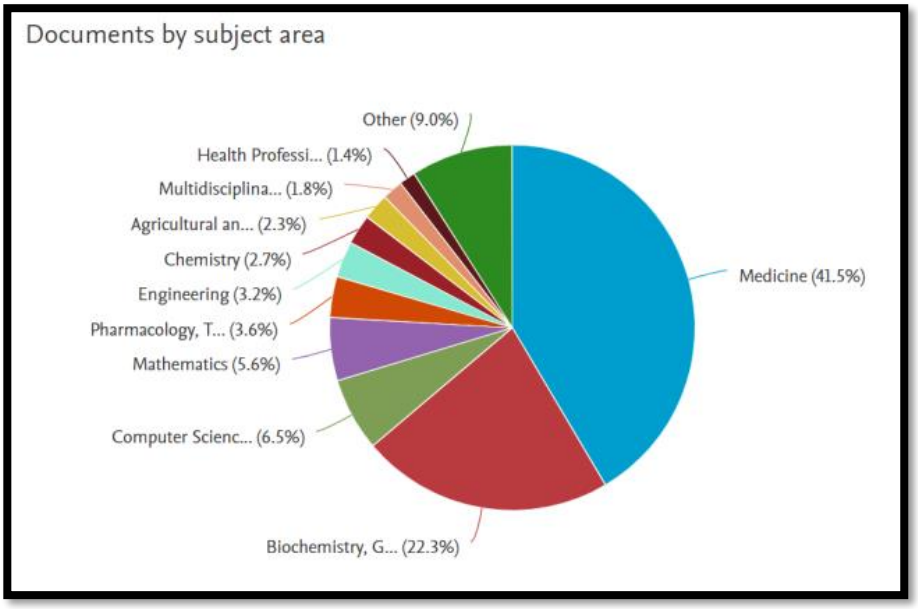


Fig 9: Emergence of documents in the field of Computer Science vs Medicine

F. Keyword Clusters

This article shows the amalgamation of computer science field with ovarian cancer. The research in these fields has considerably increased in the last few years. Fig. 10 shows the clusters of author keywords and index keywords and the connections between them in all the published papers. The keywords like ovary cancer, human, controlled study, adult, female, aged were used the most. These were linked to genetics and breast cancer which leads to a wide range of research.

In Fig. 11, the index keywords are portrayed in clusters using vosviewer software. Ovarian cancer has been used the most. It has been linked to breast cancer as brca1 and brca2 are responsible for ovarian cancer also. Ovarian cancer field is interlinked with computer science as can be seen from the graph data mining, classification, deep learning, machine learning and neural network are connected with it.

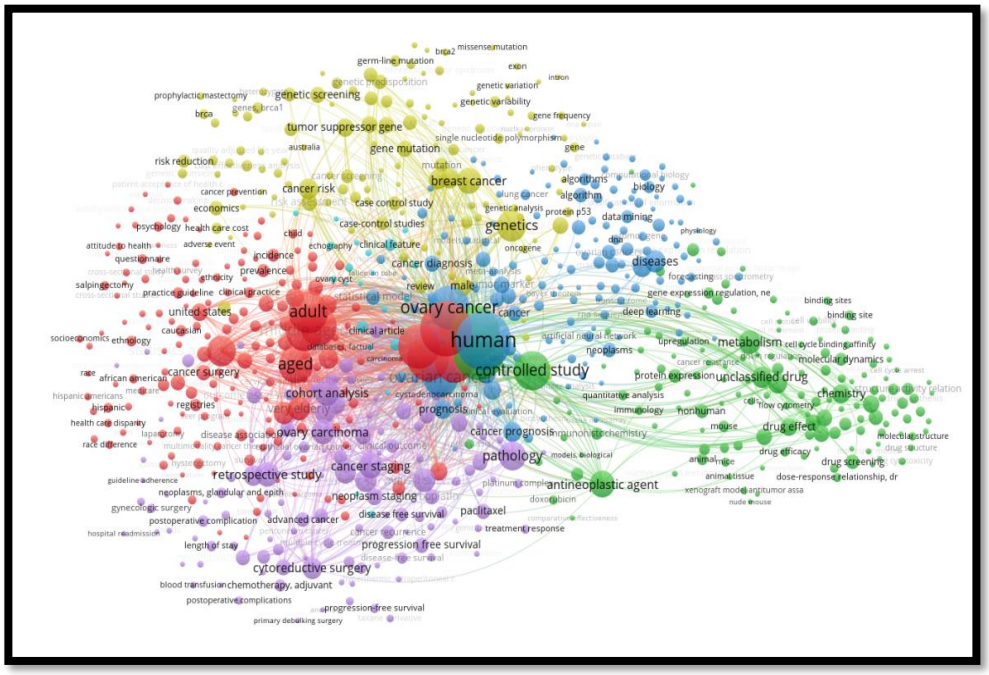


Fig 10: Author and Index Keyword Clusters

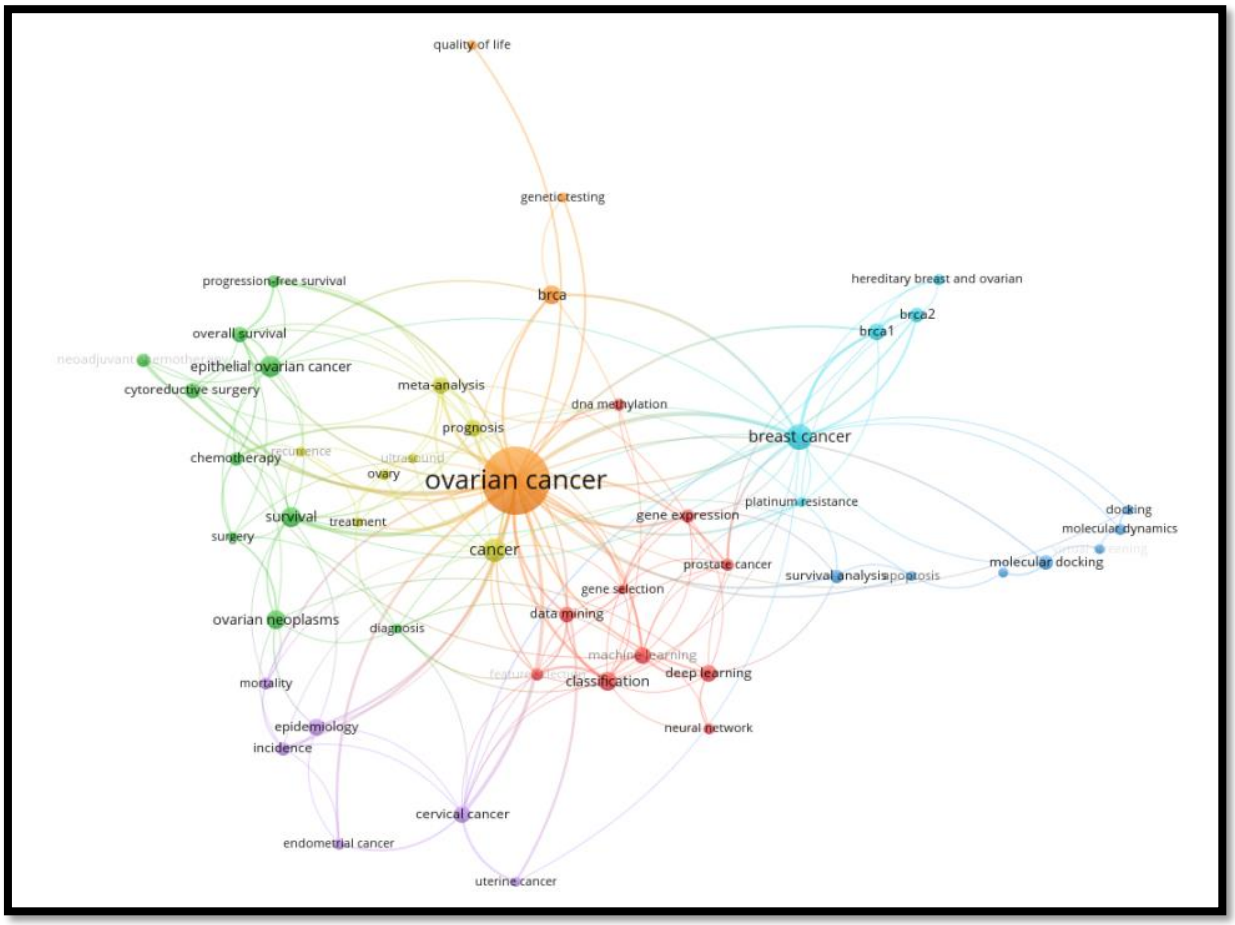
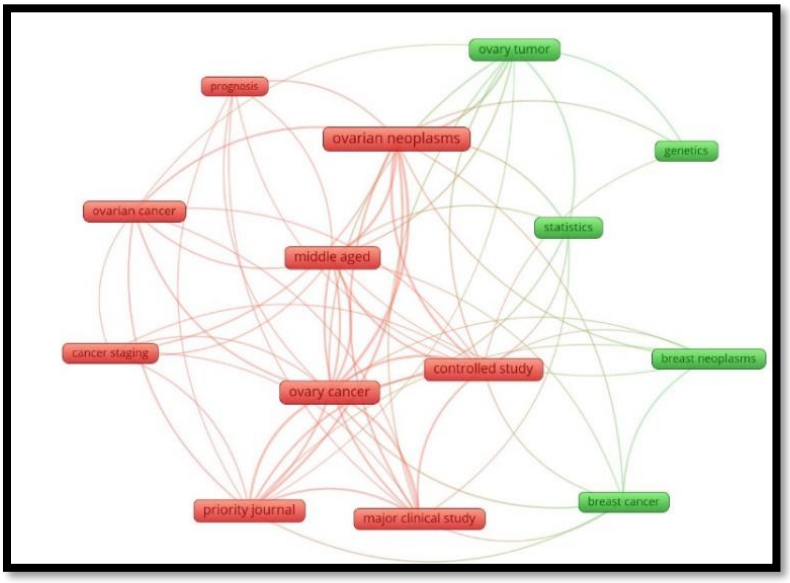


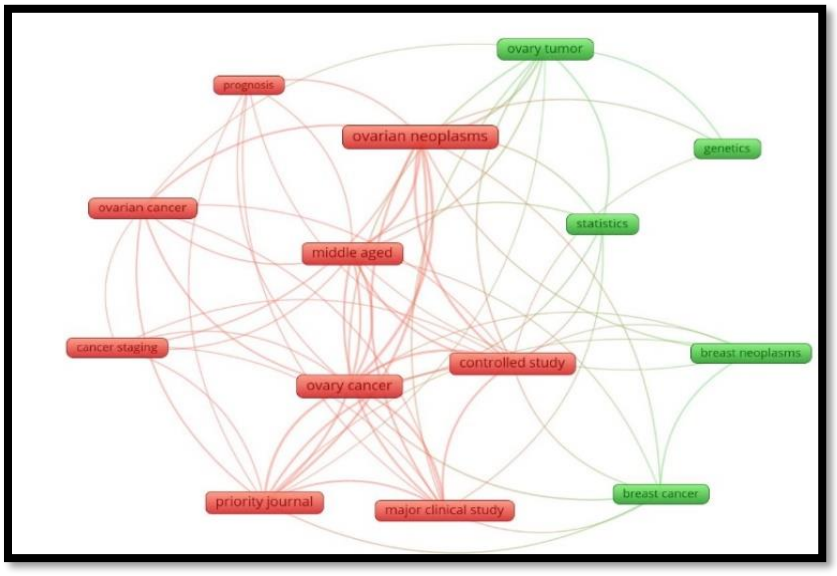
Fig 11: Author Keywords Clusters

G. Shift in Keywords over Time

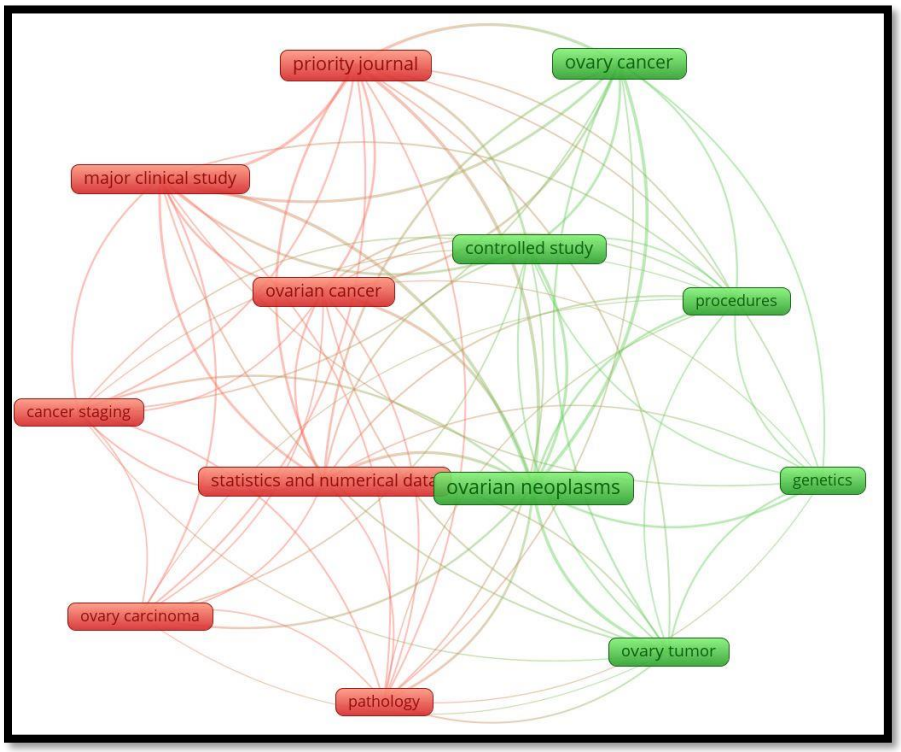
In Fig.12, the main keywords used yearwise have been shown.Ovarian cancer has been linked to middle aged females. It has been linked to statistics and statistical analysis in 2000-2005.The role of genetics came into the picture during 2006-2011 along with ovary tumors. Statistics alongwith numerical data was started linking to ovarian cancer in the published papers during the time of 2012-2017.During the past few years i.e.2018-2021 the importance of cohort analysis and antineoplastic agent can be seen from the diagram.



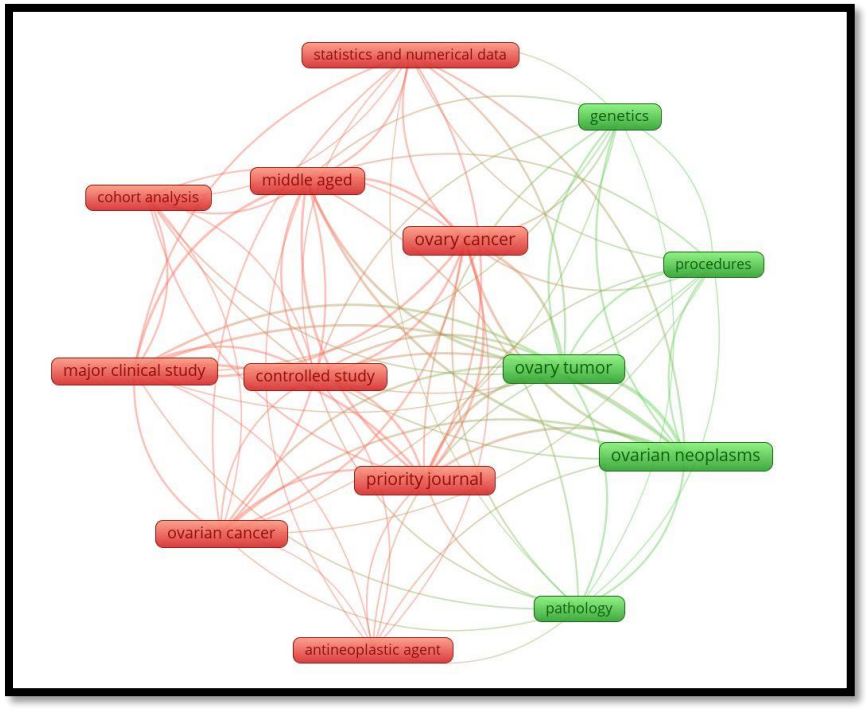
2000-2005 (a)



2006-2011(b)



2012-2017 (c)



2018-2021 (d)

Fig 12: Shift in Keywords over Time

Review Table: To study more on topic, following table gives few papers and their findings

Table 1: Review of 10 publications on the topic

S. No.	Title of Publication	Publication Year	Authors	Journal	Findings
1.	Text-mining in cancer research may help identify effective treatments [7]	2019	Yi-Wen Hsiao ,Tzu-Pin Lu	Translational lung cancer research	Text mining technology helps to identify the most biologically predictable biomarkers and potential drugs, including the discovery of new drugs and drug rehabilitation, to find effective treatment in the future.
2.	From chemoinformatics to deep learning: an open road to drug discovery [8]	2019	Leonardo LG Ferreira, Adriano D Andricopulo	FUTURE MEDICINAL CHEMISTRY	The technology that has particularly affected R&D in drugs is automation that provides advanced testing and combinatorial chemistry.
3.	Algorithms Used in Ovarian Cancer Detection: A Minireview on Current and Future Applications [9]	2018	Vishaal Gupta, Marcus Q Bernardini	The Journal of Applied Laboratory Medicine	Ovarian cancer varies according to pathogenesis, cell origin, prognosis and histotype, cell turnover.
4.	Text Analytics and Mixed Feature Extraction in Ovarian Cancer Clinical and Genetic Data [10]	2021	Bote-Curiel, Ruiz-Llorente, Munoz-Romero, Yague-Fernandez, Barquin, Garcia-Donas, Rojo-Alvarez	Institute of Electrical and Electronics Engineers Inc.	Analytical tools such as (univariate and multivariate)confirms the predictive and prognostic role of widely-known clinical and genetic variables and showing significant association in variables responsible for ovarian cancer.
5.	Transcriptomic analysis reveals tumor stage- or grade-dependent expression of miRNAs in serous ovarian cancer [11]	2021	Berkel .C, Canan .E	Springer Japan	Computational analysis were performed with R to get insight that some of the top miRNAs were found to be associated with shorter survival in serious cases. In OC progression, differentiation, and metastasis, miRNAs prove essential.
6.	Development of a graph-based database for ovarian cancer	2020	Lee, Y.J., Niyu, H.	IOS Press	The symptomatic data existing in the online health communities helped in developing a symptom knowledge data base for these cancer patients. It can be

	symptoms [12]				applied to bigger health communities also.
7.	Systematic analysis of ovarian cancer platinum-resistance mechanisms via text mining [13]	2020	Li, H., Li J., GaoW., Zhen C. , Feng .L	BioMed Central	The mechanisms for platinum molecule in resistance of ovarian cancer were explored. The highest occurring genes were involved in repairing of DNA, transportation of metal, detoxification of drugs and apoptosis and were found to be closely associated to resistance of platinum.
8.	Precision medicine for human cancers with Notch signaling dysregulation [14]	2020	Katoh, M.	Spandidos Publications	For constructing a notch related knowledge base and optimization for notch targeted therapy for ovarian cancer patients integration of human intelligence, cognitive computing and Artificial Intelligence was found important.
9.	Expression of integrin α-6 is associated with multi drug resistance and prognosis in ovarian cancer [15]	2019	Wei L., Yin F., Chen C., Li L.	Spandidos Publications	A higher expression of ITGA6 was found to be associated to resistance to drugs and ovarian cancer. It could be a potential marker for the prognosis of ovarian cancer.
10.	The prevalence, risk factors, and prognostic value of venous thromboembolism in ovarian cancer patients receiving chemotherapy: a systematic review and meta-analysis [16]	2021	Ye L., Cai L., Fu Y., Zhuang D., Hu X., Jie Y	BioMed Central Ltd	The preventive measure in Ovarian cancer were targeted showing the risk factors for chemotherapy related VTE(Venous Thromboembolism).

Top cited recent papers: Medicine and Biochemistry, Genetics and Molecular Biology:

Though citation is just a number and does not guarantee about quality of the paper, it is very widely referred to know about popular publications on related topic. In following table, top 10 papers on the topic from Scopus database are given for reference.

Table 2: Top 10 cited publications on the topic in medicine and biochemistry

S. No.	Title of Publication	Authors	Year	Journal	Clusters	Author denoted Keywords	No. of citations
1.	Ovarian cancer statistics [17]	Torre L.A., Trabert B., DeSantis C.E., Miller K.D., Samimi G., Runowicz C.D., Gaudet M.M., Jemal A., Siegel R.L.	2018	CA Cancer Journal for Clinicians	Medicine	epidemiology; epithelial ovarian cancers; health disparities; ovarian neoplasms	795
2.	Cost-effectiveness of population-based BRCA1, BRCA2, RAD51C, RAD51D, BRIP1, PALB2 mutation testing in unselected general population women [18]	Manchanda R., Patel S., Gordeev V.S., Antoniou A.C., Smith S., Lee A., Hopper J.L., MacInnis R.J., Turnbull C., Ramus S.J., Gayther S.A., Pharoah P.D.P., Menon U., Jacobs I., Legood R.	2018	Journal of the National Cancer Institute	Medicine, Biochemistry, Genetics and Molecular Biology	-	72
3.	Self-associated molecular patterns mediate cancer immune evasion by engaging Siglecs on T cells [19]	Stanczak M.A., Siddiqui S.S., Trefny M.P., Thommen D.S., Boligan K.F., Von Gunten S., Tzankov A., Tietze L., Lardinois D., Heinzelmann-Schwarz V., Von Bergwelt-Baildon M., Zhang W., Lenz H.-J., Han Y., Amos C.I., Syedbasha M., Egli A., Stenner F., Speiser D.E., Varki A., Zippelius A., Läubli H.	2018	Journal of Clinical Investigation	Medicine	-	63
4.	T-cell responses to TP53 "Hotspot" Mutations and unique neoantigens expressed by human ovarian cancers [20]	Deniger D.C., Pasetto A., Robbins P.F., Gartner J.J., Prickett T.D., Paria B.C., Malekzadeh P., Jia L., Yossef R., Langhan M.M., Wunderlich J.R., Danforth D.N., Somerville R.P.T., Rosenberg S.A.	2018	Clinical Cancer Research	Medicine, Biochemistry, Genetics and Molecular Biology	-	45
5.	10-year performance of four models of breast cancer risk: a validation study [21]	Terry M.B., Liao Y., Whittemore A.S., Leoce N., Buchsbaum R., Zeinomar N., Dite G.S., Chung W.K., Knight J.A., Southey M.C., Milne R.L., Goldgar D., Giles G.G., McLachlan S.-A., Friedlander M.L., Weideman	2019	The Lancet Oncology	Medicine	-	41

		P.C., Glendon G., Nesci S., Andrulis I.L., John E.M., Phillips K.-A., Daly M.B., Buys S.S., Hopper J.L., MacInnis R.J.					
6.	No improvement in long-term survival for epithelial ovarian cancer patients: A population-based study between 1989 and 2014 in the Netherlands [22]	Timmermans M., Sonke G.S., Van de Vijver K.K., van der Aa M.A., Kruitwagen R.F.P.M.	2018	European Journal of Cancer	Medicine, Biochemistry, Genetics and Molecular Biology	Chemotherapy; Epithelial ovarian cancer; Overall survival; Surgery	40
7.	Detecting the mutational signature of homologous recombination deficiency in clinical samples [23]	Gulhan D.C., Lee J.J.-K., Melloni G.E.M., Cortés-Ciriano I., Park P.J.	2019	Nature Genetics	Biochemistry, Genetics and Molecular Biology	-	38
8.	Probabilistic cell-type assignment of single-cell RNA-seq for tumor microenvironment profiling [24]	Zhang A.W., O'Flanagan C., Chavez E.A., Lim J.L.P., Ceglia N., McPherson A., Wiens M., Walters P., Chan T., Hewitson B., Lai D., Mottok A., Sarkozy C., Chong L., Aoki T., Wang X., Weng A.P., McAlpine J.N., Aparicio S., Steidl C., Campbell K.R., Shah S.P.	2019	Nature Methods	Biochemistry, Genetics and Molecular Biology	-	36
9.	Performance of in silico prediction tools for the classification of rare BRCA1/2 missense variants in clinical diagnostics [25]	Corinna Ernst, Eric Hahnen, Christoph Engel, Michael Nothnagel, Jonas Weber, Rita K. Schmutzler & Jan Hauke	2018	BMC Medical Genomics	Biochemistry, Genetics and Molecular Biology	BRCA,Classification, Missense variant,Prediction tools,Variant of uncertain significance	32
10.	A mathematical-descriptor of tumor-mesoscopic-structure from computed-tomography images annotates prognostic- and molecular-	Haonan Lu, Mubarik Arshad, Andrew Thornton, Giacomo Avesani, Paula Cunnea, Ed Curry, Fahdi Kanavati, Jack Liang, Katherine Nixon, Sophie T. Williams, Mona Ali Hassan, David D. L. Bowtell, Hani Gabra, Christina Fotopoulou,	2019	Nature Communications	Biochemistry, Genetics and Molecular Biology,	-	30

	phenotypes of epithelial ovarian cancer [26]	Andrea Rockall & Eric O. Aboagye					

Computer Science: Cancer detection is a topic related to medical field while this paper want to show relation between computer science and medical field in early detection of diseases. Following table is highlighting few top publications where computer science is used for the implementation/detection/study purpose.

Table 3: Top 10 cited publications on the topic in medicine and biochemistry with involvement of Computer Science

S. no.	Title of Publication	Authors	Year	Journal	Clusters	Author denoted Keywords	No. of citations
1.	Effective features to classify ovarian cancer data in internet of medical things [27]	Elhoseny M., Bian G.-B., Lakshmanaprabu S.K., Shankar K., Singh A.K., Wu W.	2019	Computer Networks	Computer Science	Adaptive harmony Search optimization; Internet of Things; Optimal neural networks; Ovarian cancer; Self-organizing map	20
2.	Learning a single-hidden layer feedforward neural network using a rank correlation-based strategy with application to high dimensional gene expression and proteomic spectra datasets in cancer detection [28]	Belciug S., Gorunescu F.	2018	Journal of Biomedical Informatics	Computer Science, Medicine	Adaptive hidden nodes initialization; Automated cancer detection; Extreme learning machine; Mass spectrometry; Microarray; Single-hidden layer feedforward neural network	17
3.	A comprehensive review on nature inspired computing algorithms for the diagnosis of chronic disorders in human beings [29]	Gautam R., Kaur P., Sharma M.	2019	Progress in Artificial Intelligence	Computer Science	Ant colony optimization; Antlion optimization; Artificial bee colony; Cancer; Diabetes; Firefly algorithm; Glow-worm swarm optimization	11
4.	Multiple-kernel learning for genomic data mining and prediction [30]	Wilson C.M., Li K., Yu X., Kuan P.-F., Wang X.	2019	BMC Bioinformatics	Computer Science, Mathematics, Biochemistry,	Classification; Data integration; Genomics; Kernel methods; Machine learning; Multiple kernel learning	10

					Genetics and Molecular Biology		
5.	Two-Stage Hybrid Gene Selection Using Mutual Information and Genetic Algorithm for Cancer Data Classification [31]	Jansi Rani M., Devaraj D.	2019	Journal of Medical Systems	Computer Science, Medicine	Cancer data classification; Data mining; Gene selection; Genetic algorithm; Mutual information	9
6.	VaDiR: An integrated approach to Variant Detection in RNA [32]	Neums L., Suenaga S., Beyerlein P., Anders S., Koestler D., Mariani A., Chien J.	2018	GigaScien ce	Computer Science, Medicine	Cancer genomes; Ovarian cancer; RNA-seq; Somatic variant calling; Transcriptome	9
7.	Machine learning and bioinformatics models to identify gene expression patterns of ovarian cancer associated with disease progression and mortality [33]	Hossain M.A., Saiful Islam S.M., Quinn J.M.W., Huq F., Moni M.A.	2019	Journal of Biomedica l Informatic s	Computer Science, Medicine	Clinical factors; Gene expression; Molecular pathways; Ovarian cancer; RNA seq; Survival analysis	8
8.	Neural self-compressor: Collective interpretation by compressing multi-layered neural networks into non-layered networks [34]	Kamimura R.	2019	Neurocom puting	Computer Science	collective interpretation; Model compression; multi-layered neural networks; mutual informaton; self-compression	8
9.	Improved Deep Learning Network Based in combination with Cost-sensitive Learning for Early Detection of Ovarian Cancer in Color Ultrasound Detecting System [35]	Zhang L., Huang J., Liu L.	2019	Journal of Medical Systems	Computer Science, Mathemati cs	Cost-sensitive Learning; Deep Learning; GoogLeNet; Ovarian cysts; Ultrasound detecting; Uniform local binary pattern	7

10.	CoPhosK: A method for comprehensive kinase substrate annotation using co-phosphorylation analysis [36]	Ayati M., Wiredja D., Schlatzer D., Maxwell S., Li M., Koyutürk M., Chance M.R.	2019	PLoS Computational Biology	Computer Science, Mathematics, Biochemistry, Genetics and Molecular Biology	-	7

Conclusion:

The use of Computer Science is the need of the coming times as it can help in saving lives of ovarian cancer patients. So, it's very important for us to inter relate these two fields. In this paper these two fields have been connected along with the bibliometric analysis of the published papers. The documents were sorted and graphs were drawn so as to show the important keywords over the times. A review table was made showing ten important papers and their key findings. Lastly, top cited articles in the field of Medicine, Biochemistry and Computer Science are placed in a table for insight

References:

1] Reid, B.M.,Permuth, J.B.,Sellers, T.A.Epidemiology of ovarian cancer: a review. Cancer Biology and Medicine,Volume 14, Issue 1,(2017), Pages 9-32

2] D. Douglas Miller, Eric W. Brown, Artificial Intelligence in Medical Practice: The Question to the Answer? American Journal of Medicine,Volume 131, Issue 2, (2018)

3] Mohammad S Jalali,Sabina Razak ,William Gordon ,Eric Perakslis,Stuart Madnick. Health care and cybersecurity: Bibliometric analysis of the literature. Journal of Medical Internet Research,Volume 21, Issue 2, Article number e12644 (2019)

4] Nigar Ismayilova. Bibliometric Analysis of Information Security Research, İnformasiya təhlükəsizliyinin multidissiplinar problemləri üzrə II respublika elmi-praktiki konfransı, 14 may 2015-ci il

5] https://www.elsevier.com/en-in/solutions/scopus

6] https://www.vosviewer.com/

7] Hsiao, Y.-W., Lu, T.-P. Text-mining in cancer research may help identify effective treatments (2019) Translational Lung Cancer Research,Volume 8, Pages S460-S463

8] Leonardo LG Ferreira,Adriano D Andricopulo. From chemoinformatics to deep learning: an open road to drug discovery (2019) Future Medicinal Chemistry,Volume 11, Issue 5, Pages 371-374.

9] Vishaal Gupta, Marcus Q Bernardini .Algorithms Used in Ovarian Cancer Detection: A Minireview on Current and Future Applications (2018) The journal of applied laboratory medicine,Volume 3, Issue 2, Pages 290-299.

10] Bote-Curiel, L., Ruiz-Llorente, S., Munoz-Romero, S., Yague-Fernandez, M., Barquin, A., Garcia-Donas, J., Rojo-Alvarez, J.L. Text Analytics and Mixed Feature Extraction in Ovarian Cancer Clinical and Genetic Data (2021) IEEE Access.

11] Berkel, C., Cacan, E. Transcriptomic analysis reveals tumor stage- or grade-dependent expression of miRNAs in serous ovarian cancer (2021) Human Cell.

12] Lee, Y.J., Niyu, H. Development of a graph-based database for ovarian cancer symptoms (2020) Studies in Health Technology and Informatics, 270, pp. 1253-1254.

13] Li, H., Li, J., Gao, W., Zhen, C., Feng, L. Systematic analysis of ovarian cancer platinum-resistance mechanisms via text mining (2020) Journal of Ovarian Research, 13 (1), art. no. 27.

14] Katoh, M., Katoh, M. Precision medicine for human cancers with Notch signaling dysregulation (Review) (2020) International Journal of Molecular Medicine, 45 (2), pp. 279-297.

15] Wei, L., Yin, F., Chen, C., Li, L.,Expression of integrin α-6 is associated with multi drug resistance and prognosis in ovarian cancer, Spandidos Publications (2019) .

16] Ye, L., Cai, L., Fu, Y., Zhuang, D., Hu, X., Jie, Y. The prevalence, risk factors, and prognostic value of venous thromboembolism in ovarian cancer patients receiving chemotherapy: a systematic review and meta-analysis (2021) World Journal of Surgical Oncology, 19 (1), art. no. 12, .

17] Torre L.A., Trabert B., DeSantis C.E., Miller K.D., Samimi G., Runowicz C.D., Gaudet M.M., Jemal A., Siegel R.L., Ovarian cancer statistics, CA Cancer Journal for Clinicians(2018)

18] Manchanda R., Patel S., Gordeev V.S., Antoniou A.C., Smith S., Lee A., Hopper J.L., MacInnis R.J., Turnbull C., Ramus S.J., Gayther S.A., Pharoah P.D.P., Menon U., Jacobs I., Legood R. Cost-effectiveness of population-based BRCA1, BRCA2, RAD51C, RAD51D, BRIP1, PALB2 mutation testing in unselected general population women. Journal of the National Cancer Institute(2018)

19] Stanczak M.A., Siddiqui S.S., Trefny M.P., Thommen D.S., Boligan K.F., Von Gunten S., Tzankov A., Tietze L., Lardinois D., Heinzelmann-Schwarz V., Von Bergwelt-Baildon M., Zhang W., Lenz H.-J., Han Y., Amos C.I., Syedbasha M., Egli A., Stenner F., Speiser D.E., Varki A., Zippelius A., Läubli H. Self-associated molecular patterns mediate cancer immune evasion by engaging Siglecs on T cells. Journal of Clinical Investigation(2018)

20] Deniger D.C., Pasetto A., Robbins P.F., Gartner J.J., Prickett T.D., Paria B.C., Malekzadeh P., Jia L., Yossef R., Langhan M.M., Wunderlich J.R., Danforth D.N., Somerville R.P.T., Rosenberg S.A. T-cell responses to TP53 "Hotspot" Mutations and unique neoantigens expressed by human ovarian cancers. Clinical Cancer Research(2018)

21] Terry M.B., Liao Y., Whittemore A.S., Leoce N., Buchsbaum R., Zeinomar N., Dite G.S., Chung W.K., Knight J.A., Southey M.C., Milne R.L., Goldgar D., Giles G.G., McLachlan S.-A., Friedlander M.L., Weideman P.C., Glendon G., Nesci S., Andrulis I.L., John E.M., Phillips K.-A., Daly M.B., Buys S.S., Hopper J.L., MacInnis R.J. 10-year performance of four models of breast cancer risk: a validation study. The Lancet Oncology(2019)

22] Timmermans M., Sonke G.S., Van de Vijver K.K., van der Aa M.A., Kruitwagen R.F.P.M. No improvement in long-term survival for epithelial ovarian cancer patients: A population-based study between 1989 and 2014 in the Netherlands. European Journal of Cancer(2018)

23] Gulhan D.C., Lee J.J.-K., Melloni G.E.M., Cortés-Ciriano I., Park P.J.Detecting the mutational signature of homologous recombination deficiency in clinical samples. Nature Genetics(2019)

24] Zhang A.W., O'Flanagan C., Chavez E.A., Lim J.L.P., Ceglia N., McPherson A., Wiens M., Walters P., Chan T., Hewitson B., Lai D., Mottok A., Sarkozy C., Chong L., Aoki T., Wang X., Weng A.P., McAlpine J.N., Aparicio S., Steidl C., Campbell K.R., Shah S.P. Probabilistic cell-type assignment of single-cell RNA-seq for tumor microenvironment profiling. Nature Methods(2019)

25] Corinna Ernst, Eric Hahnen, Christoph Engel, Michael Nothnagel, Jonas Weber, Rita K. Schmutzler & Jan Hauke. Performance of in silico prediction tools for the classification of rare BRCA1/2 missense variants in clinical diagnostics. BMC Medical Genomics(2018)

26] Haonan Lu, Mubarik Arshad, Andrew Thornton, Giacomo Avesani, Paula Cunnea, Ed Curry, Fahdi Kanavati, Jack Liang, Katherine Nixon, Sophie T. Williams, Mona Ali Hassan, David D. L. Bowtell, Hani Gabra, Christina Fotopoulou, Andrea Rockall & Eric O. Aboagye. A mathematical-descriptor of tumor-mesoscopic-structure from computed-tomography images annotates prognostic- and molecular-phenotypes of epithelial ovarian cancer. Nature Communications(2019)

27] Elhoseny M., Bian G.-B., Lakshmanaprabu S.K., Shankar K., Singh A.K., Wu W. Effective features to classify ovarian cancer data in internet of medical things. Computer Networks(2019)
28] Belciug S., Gorunescu F. Learning a single-hidden layer feedforward neural network using a rank correlation-based strategy with application to high dimensional gene expression and proteomic spectra datasets in cancer detection. Journal of Biomedical Informatics(2018)
29] Gautam R., Kaur P., Sharma M. A comprehensive review on nature inspired computing algorithms for the diagnosis of chronic disorders in human beings. Progress in Artificial Intelligence(2019)
30] Wilson C.M., Li K., Yu X., Kuan P.-F., Wang X. Multiple-kernel learning. BMC Bioinformatics(2019).
31] Jansi Rani M., Devaraj D. Two-Stage Hybrid Gene Selection Using Mutual Information and Genetic Algorithm for Cancer Data Classification. Journal of Medical Systems(2019)
32] Neums L., Suenaga S., Beyerlein P., Anders S., Koestler D., Mariani A., Chien J. VaDiR: An integrated approach to Variant Detection in RNA. GigaScience(2018)
33] Hossain M.A., Saiful Islam S.M., Quinn J.M.W., Huq F., Moni M.A. Machine learning and bioinformatics models to identify gene expression patterns of ovarian cancer associated with disease progression and mortality. Journal of Biomedical Informatics(2019)
34] Kamimura R. Neural self-compressor: Collective interpretation by compressing multi-layered neural networks into non-layered networks. Neurocomputing(2019).
35] Zhang L., Huang J., Liu L. Improved Deep Learning Network Based in combination with Cost-sensitive Learning for Early Detection of Ovarian Cancer in Color Ultrasound Detecting System. Journal of Medical Systems(2019)
36] Ayati M., Wiredja D., Schlatzer D., Maxwell S., Li M., Koyutürk M., Chance M.R. CoPhosK: A method for comprehensive kinase substrate annotation using co-phosphorylation analysis. PLoS Computational Biology(2019)
37] Dr. Sonali Kothari, Vijayshri Khedkar: Analysis of Recent Trends In Malware Attacks on Android Phone: A Survey Using Scopus Database (2021)
38] Vijayshri Khedkar, Dr. Sonali Kothari, Aarohi Prasad, Arunima Mishra, Varun Saha, Vinay KumarAnalysis of Recent Trends in Continuous Sign Language Recognition using NLP (2021)