



Worldwide Research Status of Kaposi's Sarcoma: A Bibliometric Analysis (2004–2025)

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Abstract

Background: In recent decades, understanding the causes and development of Kaposi's sarcoma (KS) has been a major focus in medical research, yet patient survival rates have not seen notable enhancement. Although numerous studies and articles exist on the topic, a comprehensive bibliometric and visual examination of this body of work has yet to be conducted.

Objection: To perform a bibliometric and visual examination of literature pertaining to knowledge sharing, with the goal of clearly and intuitively illustrating the existing knowledge framework and possible future research directions in this area.

Methods: Data pertaining to KS-related publications from 2004 to 2025 was gathered from the Web of Science Core Collection database. Visual analysis was conducted utilizing various tools, including Microsoft Excel, VOSviewer, CiteSpace, and the bibliometrix R package, among others.

Results: A total of 5,519 publications related to KS were identified, indicating a steady increase in the number of publications. The United States led in publication quantity, citation influence, centrality, and sigma metrics; the National Cancer Institute (NCI) emerged as the top institution in terms of output; the Journal of Virology was identified as the most significant journal; and Shou-jiang Gao was recognized as the leading author. Analysis of keywords indicated a decrease in research interest in KS subfields such as sarcoma-associated herpesvirus, lytic replication, and lytic switch protein, while topics related to risk factors and antiviral treatments saw a rise in interest. Co-citation analysis of references revealed a shift in KS research focus from ORF50 transactivator, LANA, protein-coupled receptors, and infected cells to KSHV-related areas, including microRNA, glycolysis inhibition, pattern recognition receptors, and eicosanoid receptors, ultimately transitioning to KSHV-associated diseases from 2004 to 2025.

Conclusion: This investigation offers an extensive bibliometric evaluation of KS studies, highlighting prevailing research patterns and potential future avenues. Currently, foundational research is predominant in this area, while new subfields such as risk factors and antiviral treatments are anticipated to gain prominence in upcoming research efforts.

Keywords: Kaposi's sarcoma; Bibliometric analysis; Visual analysis

Introduction

Kaposi's sarcoma (KS) exhibits notable variations in its distribution across different regions and populations globally. Epidemiologically, KS is categorized into four types: classic, endemic (epidemic), iatrogenic (related to transplants), and AIDS-associated [1]. In regions with high prevalence of Kaposi's

sarcoma-associated herpesvirus (KSHV, also known as Human Herpesvirus 8, HHV-8), such as sub-Saharan Africa, endemic KS is prevalent among the general populace. Conversely, in areas with lower prevalence like Europe and the United States, KS primarily affects individuals with HIV or those who have undergone organ transplants [2]. For solid organ transplant

recipients, KSHV infection can arise from donor transmission, new infections post-surgery, or reactivation of dormant virus; a study involving 185 transplant patients revealed that 48% experienced postoperative KSHV infection, with 61% of these individuals developing KS, some also facing complications like Multicentric Castleman Disease, Primary Effusion Lymphoma, or KSHV Inflammatory Cytokine Syndrome (KICS) [3]. Furthermore, 40% of liver transplant recipients with primary KSHV infection developed KICS, and 50% of heart transplant recipients who were seropositive succumbed to severe KS, underscoring the necessity for early detection. The prevalence of KSHV DNA in the serum of patients with epidemic KS (55.6%) was significantly greater than that in the HIV-positive control group without KS (11.1%), reinforcing the link between viral load and disease severity [4]. Recognizing the significance of developing effective strategies for managing KS, numerous studies have been conducted; however, these investigations lack systematic organization, analysis, and visual representation. Consequently, this research gathered literature on KS from the Web of Science Core Collection, covering the years 2004 to 2025. Utilizing bibliometric techniques and visualization tools, it assessed the research contributions of various countries, institutions, and authors, while also creating a knowledge graph for KS studies. The goal is to uncover new research trends and offer guidance for KS prevention, treatment, and future research avenues.

Data and Methods

The Implementation Process of This Study

Bibliographic entries were sourced from the Web of Science Core Collection through specific search parameters. The gathered data underwent a cleaning and deduplication process, allowing for the extraction and arrangement of details like authors, keywords, countries, and citation metrics in an organized manner. Subsequently, bibliometric analysis was conducted with VOS viewer and Cite Space to create networks illustrating co-authorship, co-citation, and keyword co-occurrence. The findings were represented as knowledge maps to highlight research trends, thematic groupings, and collaboration patterns within the discipline. The Implementation Process of This Study was outlined as (Figure 1).

Data sources and search strategies

On December 26, 2025, literature related to KS from the years 2004 to 2025 was gathered from the Web of Science Core Collection database. The search strategy employed was: TS = (Sarcoma* OR Cancer* OR Tumor* OR Malignant*) AND TS = (Kaposi's sarcoma* OR AIDS-KS* OR KS*). The selection was restricted to articles and reviews, with no limitations on language. Bibliographic details of these publications were compiled and exported in a plain text format, which included full records and cited references. Subsequently, the data was processed in CiteSpace to remove duplicates for further analysis. Additionally, this research did not include any animal studies or human trials, thus negating the need for ethical approval.

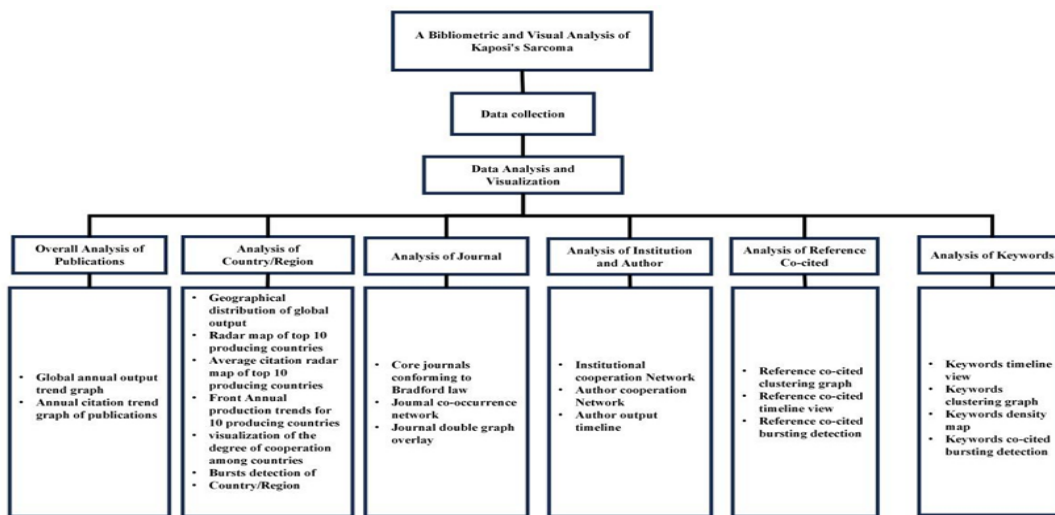


Figure 1: Workflow of bibliometric analysis.

Data Analysis and Visualization

The research utilized several tools for bibliometric and visual analysis, including Microsoft Excel (2021 Personal Edition), VOSviewer (version 1.6.20), CiteSpace (version 6.4.R2), the R

package bibliometrix (version 3.1), and Pajek (version 5.14). Microsoft Excel facilitated the creation of trend graphs, annual citation trends for literature, and radar charts. VOSviewer was employed to illustrate intricate co-citation networks, highlighting collaborative dynamics and temporal patterns among countries,

institutions, and individuals. In this context, the size of nodes indicates the volume of articles, the thickness of lines signifies the strength of correlations, and the color of nodes differentiates various clusters or time periods. CiteSpace was utilized for visualizing knowledge domains and identifying emerging trends, incorporating cluster analysis, journal dual-map overlays, timeline visualizations, and burst detection for cited references and keywords. The size of circles corresponds to either the number of articles or total citation counts, while the color of the circles represents the year of publication, with warmer colors indicating more recent years; the thickness of lines between circles reflects the frequency of co-occurrence. Bibliometrix was applied for an in-depth scientific mapping analysis of the literature, including an examination of core journals based on Bradford's Law.

Results

Overall Analysis of Literature

From the Web of Science Core Collection database, 5,519 pieces of literature related to KS were gathered, comprising 4,772 articles and 747 reviews. Figure 2A illustrates the timeline of publications and the analysis of curve fitting. The total count of literature has shown a linear increase, demonstrating consistent growth from 2004 through 2025. The general pattern of yearly publication numbers remained fairly constant, reflecting a gradual evolution in KS research without significant breakthroughs, while the variations in annual publication figures imply potential shifts in certain areas of the field. Analysis of citations in the Web of Science revealed that these works were referenced by 75,697 other publications (excluding self-references), accumulating a total of 116,193 citations. Each article received an average of 29.94 citations, and the h-index stood at 147, indicating that 147 works were cited a minimum of 147 times. As illustrated in Figure 2B, the yearly citation rate has shown a consistent upward trend. This, along with the h-index, suggests that literature related to KS is of significant quality and is garnering growing interest.

Country/Region Analysis

Between 2004 and 2025, 124 nations and regions contributed to the literature on KS. As illustrated in (Table 1), (Figure 3A, Figure 3B, and Figure 3C), the United States led in both the volume of publications and citation counts, with China and Italy following closely behind. Together, these three countries produced 3,582 articles, representing 64.90% of the total global output. Remarkably, the United States also boasted the highest average citation rate (see Figure 3D), with France and Germany trailing. Additionally, the U.S. exhibited the greatest centrality and sigma value, indicating its pivotal role and substantial influence within the research network. In summary, the United States holds a dominant position in this sector; however, over the

last three years, there has been a noticeable increase in the volume of literature published in China, while other nations have either seen a slight decrease or maintained their output (Figure 3E). The data illustrates that nearly all countries have engaged in collaboration with the United States, with China being the most closely aligned partner (Figure 3B). Furthermore, burst detection analysis indicates that countries such as China, Turkey, and Mexico have intensified their research efforts on KS in recent years (Figure 3F).

Journal Analysis

A total of 5,519 publications appeared across 200 different journals. As illustrated in Figure 4A, the primary journals within the KS domain align with Bradford's Law, which indicates that a small number of journals account for the majority of articles on a specific subject, while the majority of journals contribute fewer. The top 10 journals are detailed in (Table 2), with approximately 25% of the total literature originating from these sources. The Journal of Virology leads with 642 articles related to KS, receiving 22,711 citations, averaging over 35 citations per article. Following it are PLOS Pathogens with 227 articles and 8,044 citations, and the Journal of Medical Virology with 106 articles and 975 citations. (Figure 4B) depicts the citation relationships among these journals. Furthermore, this research examined 7,904 source journals referenced in the 5,519 publications, revealing that the Journal of Virology had the highest frequency and centrality of citations. The dual-map overlay in (Figure 4C) highlights several key citation pathways. It is noteworthy that both cited and citing works predominantly focus on areas such as molecular biology, immunology, physiology, medicine, dermatology, dentistry, surgery, and related fields. Additionally, the internal citation pathways for both cited and citing works are primarily concentrated in disciplines leaning towards clinical medical research.

Institutional and Author Analysis

A total of 5,519 publications were authored by 275 individuals affiliated with 293 different institutions (refer to Tables 3 and 4). The National Cancer Institute (NCI) led in productivity with 192 publications, followed by the University of North Carolina with 141 and the University of Pennsylvania with 134 (Figure 5A). (Figure 5B) illustrates the strong collaborative efforts among authors and institutions globally, reflecting the partnerships between countries and the increasing volume of literature, likely linked to the rising severity of Kaposi's Sarcoma (KS) and the ongoing scientific development in this area. The three most prolific authors include Shou-Jiang Gao from the Keck School of Medicine at USC, who has 117 publications, Blossom Damania from the University of North Carolina at Chapel Hill with 89, and Denise Whitby from the Frederick National Laboratory for

Cancer Research with 84. These researchers demonstrate significant momentum in KS studies, evidenced by a consistent rise in their annual publication rates and impact (illustrated in

Figure 5C). Furthermore, this research highlights the journals and key topics they emphasize within the KS domain (Figure 5D).

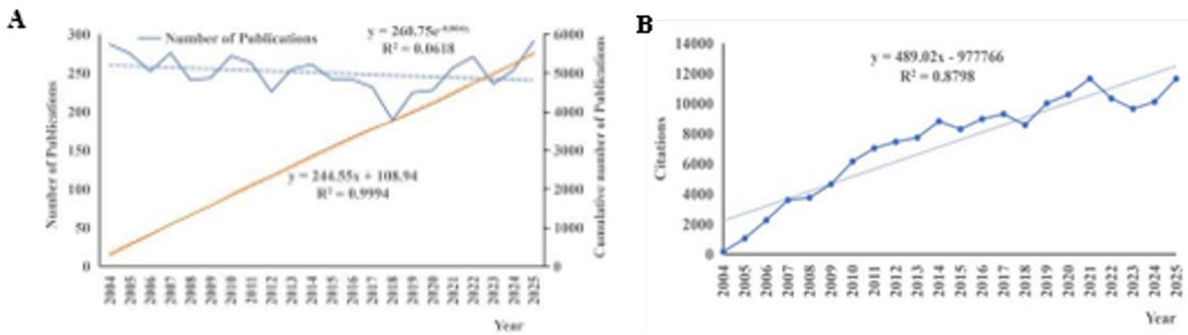
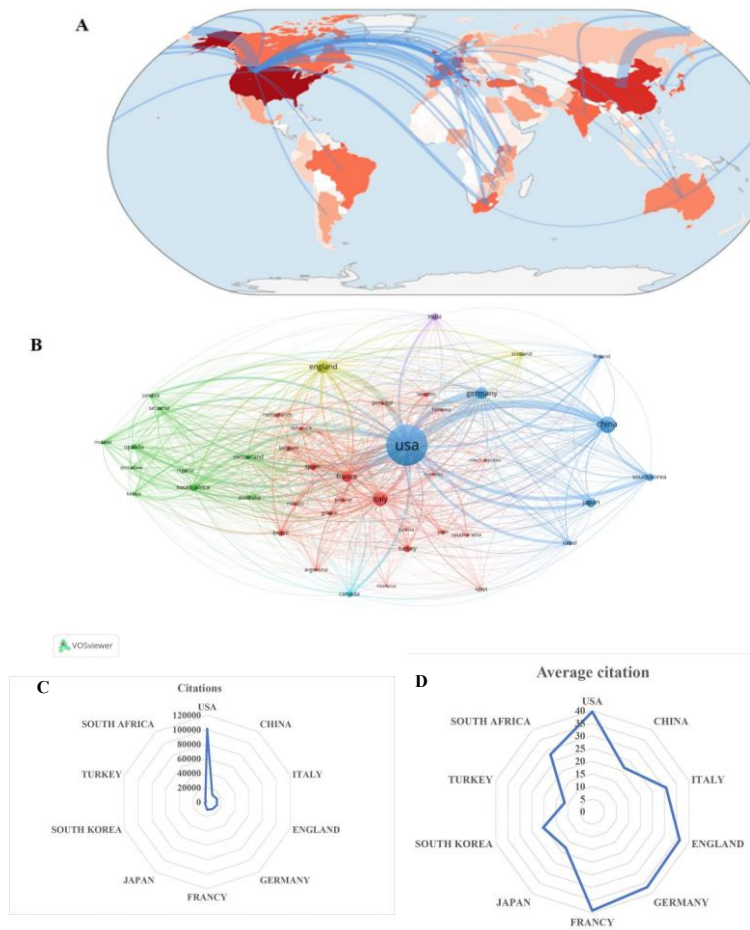


Figure 2: Comprehensive Review of Publications (A) Worldwide Yearly Output Trends: This graph depicts the yearly fluctuations in the quantity of publications within the KS domain, effectively indicating whether research in this area is increasing, decreasing, or maintaining a steady state over the years; (B) Yearly Citation Trends for Publications: This graph presents the annual citation counts for KS publications, providing insight into the evolving impact or prominence of the field.



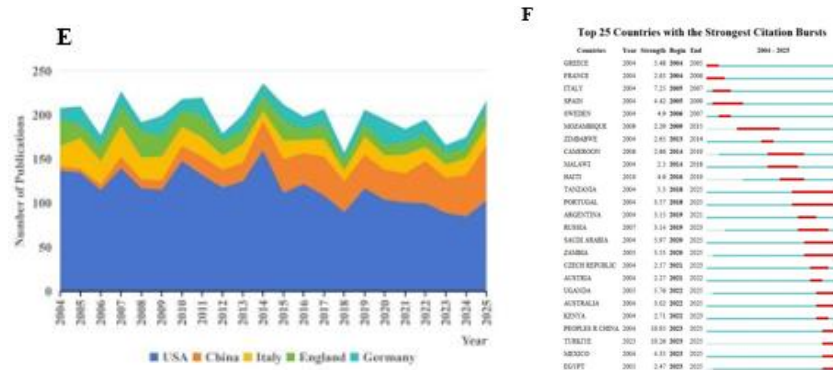


Figure 3: Distribution of KS Research Across Regions (A) Global Research Output Distribution: This map depicts the worldwide distribution of published KS research, emphasizing the nations that play a major role in this field and offering a visual overview of the international research environment. (B) Network of Country Collaborations: This diagram represents the connections between countries that often work together; (C) Radar Visualization of the Leading 10 Countries: This radar chart showcases the ten nations with the most citations in KS research, highlighting their prominence in this area; (D) Radar Visualization of Average Citation Rates for Leading 10 Countries: This radar chart contrasts the average citation rates among the top ten nations producing KS research; (E) Trends in Annual Publications from Leading Countries: This graph monitors the publication trends of KS research from the top ten contributing nations over time, indicating whether their output is on the rise or decline; (F) Detection of Research Activity Bursts by Country/Region: This chart identifies countries or regions experiencing a notable increase in KS research publication activity.

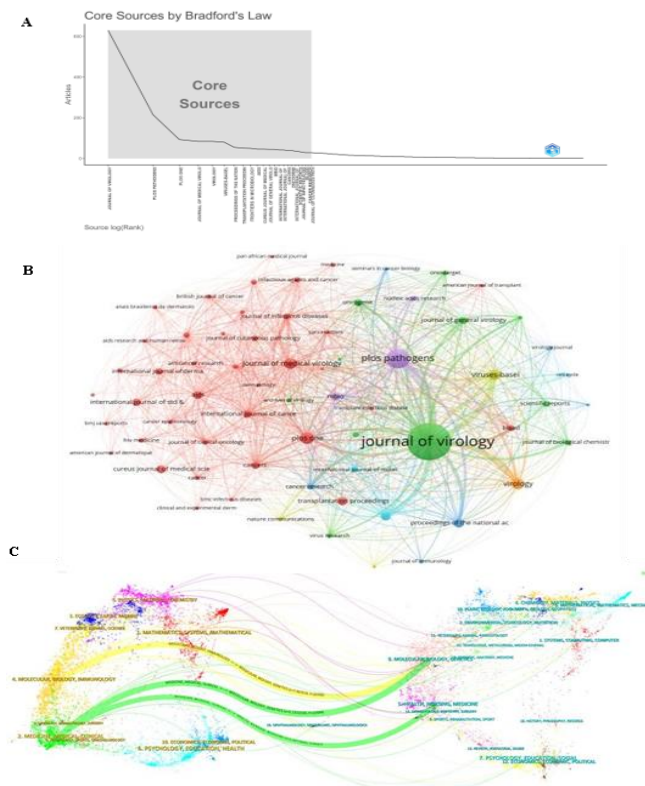


Figure 4: Examination of KS Research Publications (A) Principal Journals Following Bradford's Law: This illustration depicts the main journals in KS research that align with Bradford's Law, which posits that a limited number of journals contribute to the bulk of research on a specific subject, while the majority of journals publish fewer articles. The illustration emphasizes the key journals in the KS domain that represent the majority of research output. (B) Journal Citation Network: This network diagram showcases the connections between journals that often reference each other. (C) Journal Overlay Visualization: This figure presents the leading

research areas (including molecular biology, genetics, medicine, and surgery) where KS-related publications receive the highest citation frequency.

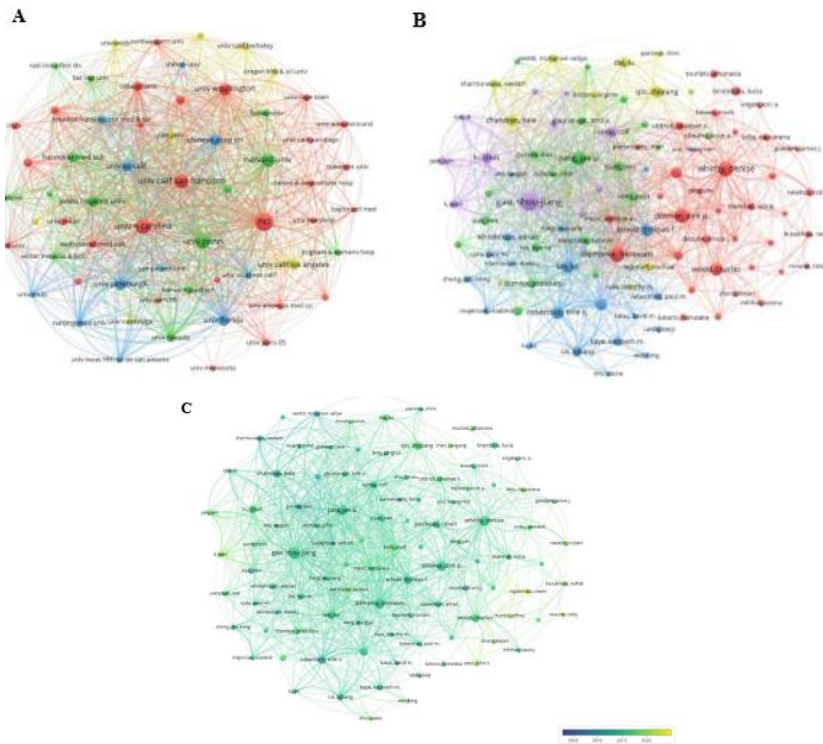


Figure 5: Examination of organizations and contributors in KS studies (A) Network of institutional partnerships: This graphic depicts the cooperative relationships between institutions globally in KS studies; (B) Network of author partnerships: This graphic represents the collaborative efforts among authors internationally in KS studies; (C) Publication timeline for authors: This graph displays the typical timeline for publications by authors in the KS domain.

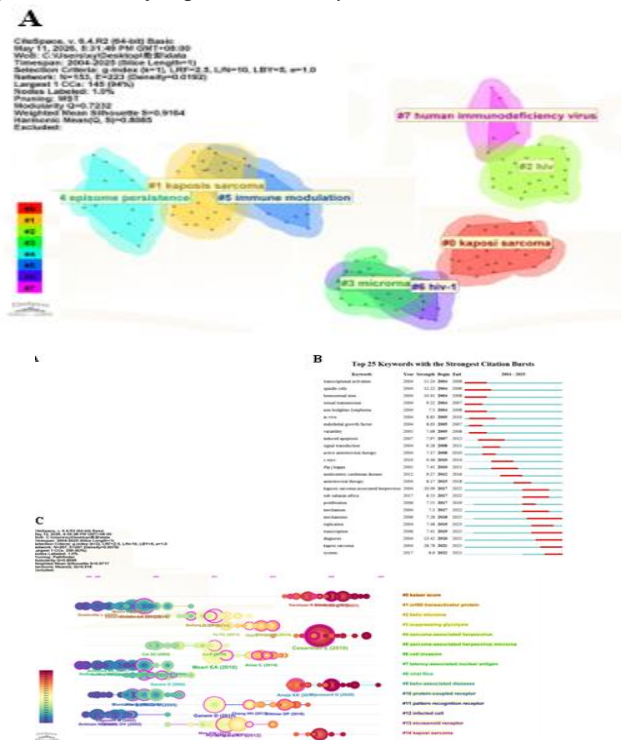


Figure 6: Analysis of co-citation among references in KS studies (A) Clustering plot of co-cited references: This illustration depicts the distribution frequency of references that are co-cited in KS studies along with their clustering tendencies. Each cluster signifies a specific area of research; the values for modularity (Q) and average silhouette (S) confirm the reliability of the clustering outcomes, aiding in the identification of key research themes and domains that underpin KS studies; (B) Timeline view of co-citation: This timeline presents the shifting focus of KS research over time, allowing for the observation of changing research trajectories and the emergence of new focal points within KS studies; (C) Detection of co-citation bursts: This graphic emphasizes references that have experienced a notable increase in attention during certain timeframes; this approach effectively pinpoints influential papers that have recently gained considerable recognition in KS research.

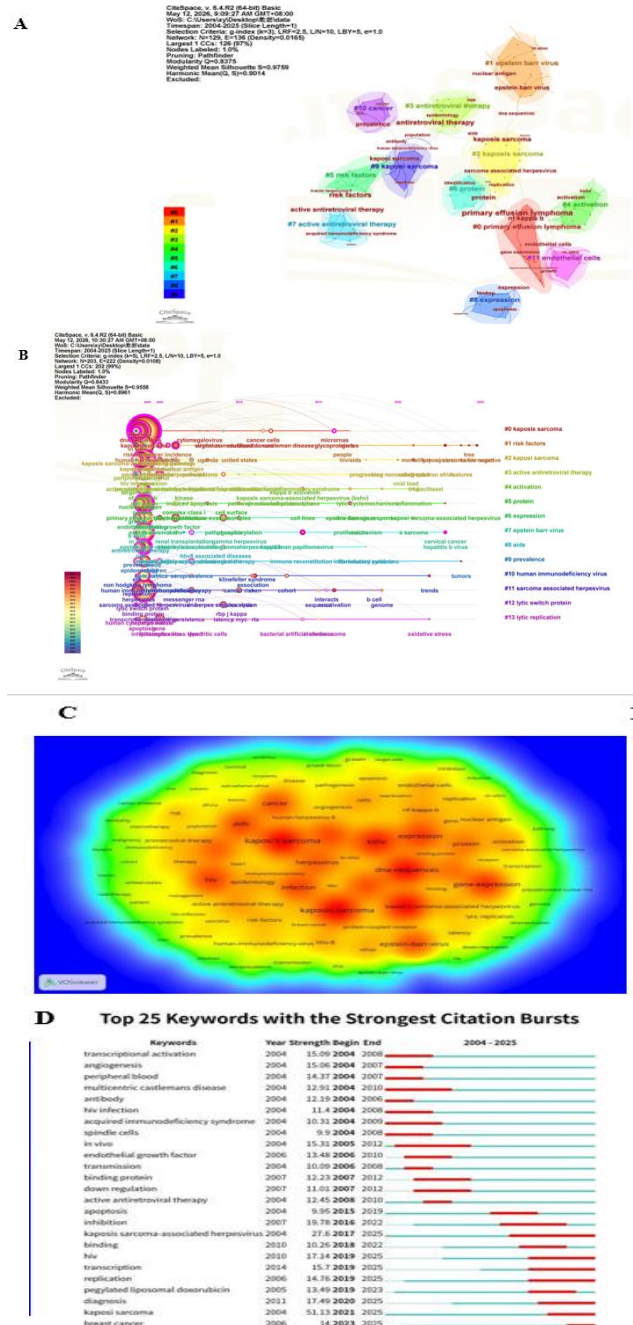


Figure 7: Examination of Keywords in KS Studies (A) Keyword Grouping Diagram: This diagram depicts the distribution and grouping of keywords found in various KS study references. (B) Keyword Historical Overview: This overview presents the evolving trends of KS research keywords throughout different periods. (C) Keyword Frequency Map: This map illustrates how often keywords

appear together in KS literature. (D) Detection of Keyword Co-citation Surges: This graph emphasizes keywords that have seen a notable increase in interest in recent times.

Table 1: The TOP 10 countries in the KS field.

Country/Region	Publications	Citation	Average	Centrality	Sigma	Half life
USA	2574	101245	39.5334	0.37	1624.67	18.57
CHINA	616	12069	21.4751	0.02	294.89	14.95
ITALY	462	14081	30.6776	0.05	230.41	19.13
ENGLAND	392	14036	36.2687	0.11	226.97	19.17
GERMANY	333	12168	36.8727	0.12	221.15	18.07
FRANCY	275	10665	39.0659	0.36	184.46	18.99
JAPAN	234	4043	17.7325	0.02	78.32	17.19
SOUTH KOREA	165	3394	20.3234	0.03	67.83	16.96
TURKEY	144	1708	11.4631	0.02	27.51	18.86
SOUTH	144	4116	28	0.05	80.94	17.31

Table 2: The TOP 10 journals that published articles in the KS field.

Journal	Publications	IF (2025)	Quartile in category (2025)	Centrality
Journal of Virology	642	3.8	Q2	92
Plos Pathogens	227	4.9	Q1	88
Journal of Medical Virology	106	2.6	Q1	85
PLoS One	94	4.6	Q2	86
Viruses Basel	88	2.4	Q2	83
Virology	85	3.5	Q2	82
Proceedings of the National Academy of Sciences of the USA	57	9.1	Q1	90
Frontiers in Microbiology	54	0.8	Q1	78
Transplantation Proceedings	51	4.5	Q4	81
AIDS	49	3.1	Q2	79

Table 3: The TOP 10 authors that published articles in the KS field.

Authors	Publications	Citations	Average citations
Gao, Shou-jiang	117	4728	48.2449
Damania, Blossom	89	3738	52.6479
Whitby, Denise	84	3081	43.3944
Dittmer, Dirk P.	69	2907	42.1304
Jung, Jae U.	63	3275	51.9841
Wood, Charles	54	1033	19.1296
Robertson, Erle S.	53	2053	38.7358
Schulz, Thomas F.	50	1522	30.44
Lan, Ke	49	1436	29.3061
Verma, Subhash C.	47	1592	33.8723

Table 4: The TOP 10 institutions that published articles in the KS field.

Institutions	Publications	Citations
NCI	192	10134
University of Carolina	141	7864
University of Pennsylvania	134	5915
University of California, San Francisco	126	6978
Harvard University	113	6886
University of Washington	98	3345
University of Pittsburgh	97	3468
University of Florida	91	3488
University of California	88	4651
Chinese Academy of Sciences	87	2815

Table 5: The TOP 10 cited references in KS research.

Title	citations	Journal	IF	Year
Cancer after kidney transplantation in the United States	853	American Journal of Transplantation	10.500	2004
Sirolimus for Kaposi's sarcoma in renal-transplant recipients	733	New England Journal of Medicine	176.07	2005
Kaposi's sarcoma and its associated herpesvirus	647	Nature Review of Cancer	78.500	2010
Kaposi's sarcoma-associated herpesvirus expresses an array of viral microRNAs in latently infected cells	491	Proceedings of the National Academy of Sciences of the United States of America	9.100	2005
Human viral oncogenesis: a cancer hallmarks analysis	487	Cell Host & Microbe	30.500	2014
A viral microRNA functions as an orthologue of cellular miR-155.	475	Nature	64.800	2007
Kaposi's sarcoma	454	Nature Reviews Disease Primers	65.100	2019
Sirolimus therapy after early cyclosporine withdrawal reduces the risk for cancer in adult renal transplantation	409	Journal of the American Society of Nephrology	14.500	2006
Diverse herpesvirus microRNAs target the stress-induced immune ligand MICA to escape recognition by natural killer cells	395	Cell Host & Microbe	30.500	2009

Kaposi's sarcoma-associated herpesvirus encodes an ortholog of miR-155	363	Journal of Virology	3.800	2007
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Table 6: The TOP 10 Keywords in KS research.

Rank	Keywords	Count	Centrality
1	Kaposi's sarcoma	1415	0.09
2	Sarcoma-associated herpesvirus	846	0.04
3	DNA sequences	763	0.11
4	Human herpesvirus 8	654	0.09
5	gene expression	644	0.1
6	expressions	572	0.06
7	Epstein-Barr virus	561	0.1
8	primary effusion lymphoma	517	0.1
9	infections	501	0.06
10	Kaposi's sarcoma	488	0.08

Reference Co-citation Analysis

A total of 5,519 publications referenced 77,453 sources. This research identified the ten most frequently cited works (Table 5), all of which concentrated on fundamental and clinical investigations into the progression of KS. Subsequently, CiteSpace was employed to create a co-citation network of references and to conduct clustering, resulting in eight distinct clusters. The clustering analysis revealed a modularity Q value of 0.7232 ($Q > 0.3$) and an average silhouette value S of 0.9164 ($S > 0.5$), confirming the reliability of the clustering outcomes (refer to Figure 6A). The underlying network illustrates the academic foundations of KS, while the cluster labels highlight emerging areas of research. Additionally, a timeline view (Figure 6B) was utilized to depict the development of each cluster and the interrelations among them. The findings indicated that between 2004 and 2025, the focus of KS research transitioned from topics such as ORF50 transactivator, LANA, protein-coupled receptors, and infected cells to KSHV-related areas including microRNA, glycolysis inhibition, pattern recognition receptors, and eicosanoid receptors, ultimately leading to KSHV-associated diseases. Burst detection was applied to identify references or keywords that experienced a significant surge in interest during specific timeframes. As illustrated in (Figure 6C), the publication with the highest burst intensity and the longest duration was authored by Cesarman E.

Keyword Analysis

From a total of 5,519 publications, 269 keywords were identified, leading to the formation of 12 unique clusters through cluster analysis using CiteSpace software (Figure 7A). The Modularity Q value for this analysis stands at 0.8397, while the Weighted Mean

Silhouette is recorded at 0.9759. Importantly, there has been a noticeable shift in research focus, with diminishing interest in certain KS subfields like sarcoma-associated herpesvirus, lytic replication, and lytic switch protein. In contrast, new areas of interest have emerged, particularly concerning risk factors and antiviral treatments (Figure 7B). The density map (Figure 7C) illustrates the frequency of keyword co-occurrences, highlighting current research trends and focal points. Kaposi's sarcoma ranks as the most significant keyword, appearing 1,415 times, followed by sarcoma-associated herpesvirus, human herpesvirus, DNA sequences, and gene expression (Table 6). Furthermore, a time series analysis utilizing burst detection (Figure 7D) revealed that diagnosis and pegylated liposomal doxorubicin are recent keywords exhibiting the highest burst intensity.

Discussion

Basic situation analysis

The research encompassed 5,519 pieces of literature pertaining to KS, sourced from the Web of Science Core Collection between 2004 and 2025. These works were authored by 275 individuals affiliated with 293 institutions across 124 countries and regions, appearing in 200 academic journals. They referenced a cumulative total of 77,453 sources and identified 269 keywords. The study organized this data using bibliometric and visual analysis techniques, providing a clear overview of recent KS research findings. The body of literature on KS demonstrates a rising trajectory and has reached a relatively advanced phase, yet the various internal subfields continue to evolve, and their structure may undergo modifications. By analyzing the growth pattern alongside Thomas Kuhn's theory [5], one can infer that KS research is currently experiencing a phase of paradigm accumulation, where knowledge and comprehension of the

discipline are progressively built upon through the ongoing emergence of new findings and perspectives. Nevertheless, the five-year survival rate has consistently remained low over the past four decades, highlighting a scientific crisis—indicating that the prevailing scientific framework is inadequate in addressing contemporary challenges. When examining the distribution of cooperation among countries and regions, it becomes evident that the volume of literature correlates strongly with economic status, with a significant concentration of high output in developed nations [6]. Although China has experienced economic growth in recent years, the rise in its literary output may be partially attributed to inadequate management of risk factors. Analyzing journals can help pinpoint leading publications for monitoring recent literature or for manuscript submissions [7]. The findings of this study indicate that the Journal of Virology stands out as the most favored journal in the realm of KS research, focusing on the dissemination of fundamental, translational, or clinical studies. However, it appears that articles related to KS in this journal predominantly emphasize basic research. Furthermore, the citation patterns revealed by the dual-map overlay of journals and the primary subjects of the top ten journals are largely centered on disciplines leaning towards clinical medical research, suggesting a relative deficiency in basic research within the KS research domain. Examining the contributions of authors allows scholars to gain insight into the evolution of key figures in this domain, which aids in attracting talent to universities and conducting think tank studies [8]. Among the four leading authors, Blossom Damania and Denise Whitby exhibit the strongest collaboration, focusing their recent efforts on the early detection, pathological classification, and prognostic evaluation of KS.

Analysis of keywords

Analyzing keywords and conducting reference co-citation analysis can illuminate the development of the knowledge domain in KS, identify emerging trends, and forecast future research directions. By examining keyword co-occurrence, clustering, and burst patterns, it becomes evident that many researchers in the KS domain are currently focused on fundamental studies, with terms like human-associated herpesvirus, HIV, and DNA sequences prevalent in areas such as gene expression, KSHV virus, and viral activation. As research progresses, these topics have become more established and less popular, shifting the focus towards clinical investigations that assess risk factors, treatment strategies, and diseases associated with Kaposi's sarcoma. Among the treatment options is antiretroviral therapy (ART), which plays a crucial role in managing KS by effectively suppressing HIV replication and lowering viral load. Studies have shown that in HIV-related KS patients receiving ART with controlled viral load (<200 copies/mL), the disease can still progress, suggesting that although HIV replication is effectively inhibited, the pathogenesis

of KS is still partially independent of HIV activity [9]. However, large-scale epidemiological data clearly show that the wide application of ART is closely related to the significant decline in KS incidence. For example, in the North American AIDS Cohort Collaboration on Research and Design, after 61,155 male HIV-infected individuals received ART, if viral load suppression was achieved, CD4 count ≥ 500 cells/mm³, and treatment lasted for ≥ 1 year, KS incidence decreased significantly; from 2009 to 2019, KS incidence decreased from 132 cases per 100,000 patient-years to 43 cases [10]. In addition, long-term cancer registration data in Harare also confirmed that with the improvement of ART coverage and the decline of HIV prevalence, KS incidence decreased significantly [11]. These evidences indicate that although ART cannot completely block the occurrence of KS, it can significantly reduce the risk of KS by strongly inhibiting HIV replication.

This research utilized keyword and co-citation analysis to pinpoint diagnosis and pegylated liposomal doxorubicin as emerging areas and potential future directions in Kaposi's Sarcoma (KS) studies. It is evident that these new areas are intricately linked to previously mentioned domains that are experiencing a decline in research focus, with some even being offshoots of those fields. Pegylated liposomal doxorubicin is associated with KS treatment and has been validated as a dependable model for assessing prognosis and shaping treatment strategies [12]. In-depth analysis of the molecular pathogenesis of KSHV/HHV-8 not only helps to clarify the pathogenesis and progression pathway of KS, but also provides a theoretical basis for targeted intervention and precise treatment. Studies have shown that KSHV regulates host cell fate through its latent and lytic biphasic life cycle: LANA protein expressed in the latent phase can mediate the attachment of viral genome to host chromosomes and inhibit the p53 pathway [13], while lytic phase activation relies on key transcription factors such as RTA to drive viral replication and promote tumor microenvironment formation [14]. A variety of virally encoded proteins, such as vGPCR, K15, vFLIP, can hijack host signaling pathways (such as PI3K/AKT, NF- κ B, Src, etc.), induce endothelial cell proliferation, and migration, as well as endothelial-mesenchymal transition (EMT) or mesenchymal-endothelial transition (MEndT), ultimately promoting the formation of spindle-shaped tumor cells [15-18]. At the same time, KSHV achieves efficient immune escape by interfering with IFN signaling through vIRF-1 [19], maintaining long-term infection of monocytes/macrophages through vIL-6 [20], and regulating the STAT3/GATA3 axis to promote invasion through the miRNA network (such as miR-155) [14]. These mechanisms not only reveal the complexity of viral carcinogenesis, but also indicate potential therapeutic targets. For example, targeting Bcl-xL can selectively eliminate latently infected cells [21], inhibiting the interaction between vGPCR or

K15-PLC γ 1 is expected to block pro-angiogenic signals [17], and regulating androgen receptor (AR) may inhibit the expression of viral non-coding RNA PAN, thereby limiting reactivation [22]. In addition, mRNA-LNP vaccines based on K8.1 glycoprotein have shown potential in reducing viral load and reactivation levels in animal models [23], opening a new path for preventive strategies. Therefore, the continuous exploration of KSHV molecular mechanism is gradually promoting the leap from basic discovery to clinical transformation, providing scientific support for the precise prevention and control of KS and related diseases.

The clinical variability of KS, along with its association with various KSHV-related conditions, underscores the necessity for early and precise diagnosis to enhance treatment approaches. Historically, KS diagnosis has depended on histopathological analysis paired with immunohistochemical detection of KSHV latent-associated nuclear antigen (LANA) [24]. While this technique is considered the benchmark, it presents significant practical challenges. Firstly, tissue biopsies are invasive and not suitable for repeated dynamic monitoring; secondly, in areas with limited resources, the capacity for pathological diagnosis is severely lacking, resulting in delays in diagnosis and treatment for many patients. Additionally, the diverse clinical manifestations of KS can lead to confusion with other skin conditions, such as endemic leishmaniasis, resulting in misdiagnosis [25]. Emerging diagnostic techniques encompass liquid biopsy methods (such as circulating tumor cells and circulating free nucleic acid detection), innovative KSHV detection technologies (including isothermal amplification and digital PCR), and etiological biomarkers (like KSHV nucleic acid and viral capsid protein antibodies). Biomarkers related to etiology are essential for diagnosing Kaposi's Sarcoma (KS) [26-28]. Research indicates that the presence of KSHV DNA in the serum or plasma of KS patients is markedly greater compared to individuals without the disease. For instance, a study involving 27 patients with epidemic KS and 27 HIV-positive controls revealed that 55.6% of KS patients tested positive for KSHV DNA in their serum, in contrast to just 11.1% in the control group [29]. Additionally, a cohort study focusing on individuals infected with HIV-1 found that the prevalence of KSHV DNA in the plasma of KS patients was 44%, significantly higher than the 9% observed in those without KSHV-related conditions; furthermore, a viral load of ≥ 0.05 copies/ μ L was linked to various negative clinical outcomes [30]. These findings suggest that KSHV viral load may serve as a valuable biomarker for identifying acute infections and complications associated with KS [31]. While the Web of Science Core Collection offers a broad range of literature, it is not without its gaps, which introduces limitations to this research. Furthermore, as the database is regularly updated, there is a possibility that some recently released high-quality studies may be overlooked, leading to an incomplete dataset.

Conclusion

This study summarizes KS research from 2004 to 2025. Findings indicate that the KS area is currently experiencing a phase of accumulating scientific paradigms, where knowledge and comprehension are progressively built upon through ongoing discoveries and insights. This research underscores the evolving nature of KS studies, marked by enhanced global collaboration, ongoing changes in research priorities, and the rise of new scientific focal points. These findings can inform future avenues for KS research and clinical approaches to diagnosis and treatment. This study offers a clearer perspective for understanding the foundational knowledge framework and emerging trends in the KS field, significantly benefiting researchers, especially those new to the area.

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Conflict of interest

The authors declare that they have no financial or other conflicts of interest.

Data access statement

The data supporting the findings of this study were retrieved from the Web of Science Core Collection database (Clarivate Analytics, <https://www.webofscience.com>). The search query was: TS= ("Kaposi sarcom" OR "Kaposi's sarcom") AND PY=(2004-2025). The raw records are subject to Clarivate licensing agreements and cannot be publicly shared; however, they can be accessed by authorized users through the Web of Science platform. The analyzed summary tables and keyword lists are provided in the main text and supplementary materials.

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SUNTEXT REVIEWS

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