

Supplementary Table S1.

PANEL A: Detailed search strategy, query strings, and filtering criteria used for data retrieval from the Web of Science Core Collection (WoSCC).

Search Set	Description	Search Query (Field Tag: TI = Title)
#1	Immunotherapy & Agents	("immunotherap*" OR "immuno-oncolog*" OR "immune checkpoint inhibitor*" OR "checkpoint blockade" OR "PD-1" OR "PD-L1" OR "CTLA-4" OR "LAG-3" OR "TIGIT" OR "TIM-3" OR "nivolumab" OR "pembrolizumab" OR "cemiplimab" OR "dostarlimab" OR "atezolizumab" OR "durvalumab" OR "avelumab" OR "ipilimumab" OR "tremelimumab" OR "relatlimab" OR "tiragolumab" OR "botensilimab" OR "camrelizumab" OR "sintilimab" OR "toripalimab" OR "tislelizumab" OR "penpulimab" OR "zimberelimab" OR "serplulimab" OR "sugemalimab" OR "envafolimab" OR "prolgolimab" OR "balstilimab" OR "retifanlimab" OR "cadonilimab" OR "ivonescimab" OR "CAR-T" OR "CAR T-cell*" OR "chimeric antigen receptor*" OR "CAR-NK*" OR "NK cell therap*" OR "TIL therapy" OR "tumor infiltrating lymphocyte*" OR "lifileucel" OR "TCR-T" OR "adoptive cell therap*" OR "oncolytic virus*" OR "oncolytic virotherap*" OR "T-VEC" OR "talimogene" OR "interleukin*" OR "cytokine therap*" OR "interferon*" OR "cancer vaccin*" OR "tumor vaccin*" OR "neoantigen vaccin*" OR "sipuleucel-T" OR "bispecific antibod*" OR "BiTE" OR "T-cell engager*" OR "tarlatamab" OR "amivantamab" OR "tebentafusp" OR "immune agonist*" OR "immune modulat*" OR "STING agonist*")
#2	Solid Tumors Inclusion	("cancer*" OR "oncolog*" OR "tumor*" OR "neoplasm*" OR "carcinoma*" OR "malignanc*" OR "sarcoma*" OR "melanoma*" OR "glioblastoma*" OR "neuroblastoma*" OR "mesothelioma*" OR "metastasis*" OR "metastatic")
#3	Hematology Exclusion	("leukemia*" OR "lymphoma*" OR "myeloma*" OR "hematologic*")

Search Set	Description	Search Query (Field Tag: TI = Title)
#4	Final Combined Strategy	(#1 AND #2) NOT #3
#5	Filters & Refinements	Indices: SCI-EXPANDED, ESCI. Document Types: Article, Review. Language: English. Time Span: 2000–2025. Research Areas: Oncology; Immunology; Pharmacology Pharmacy; Cell Biology; Medicine Research Experimental; Biochemistry Molecular Biology; Medicine General Internal.

Note: TI denotes "Title Search". This strategy ensures high specificity by retrieving records where the keywords appear primarily in the title of the manuscript.

PANEL B: Detailed search strategy, query strings, and filtering criteria used for data retrieval from the Scopus database.

Search Set	Description	Search Query (Field Tag: TITLE-ABS-KEY)
#1	Immunotherapy & Agents	("immunotherap*" OR "immuno-oncolog*" OR "immune checkpoint inhibitor*" OR "checkpoint blockade" OR "PD-1" OR "PD-L1" OR "CTLA-4" OR "LAG-3" OR "TIGIT" OR "TIM-3" OR "nivolumab" OR "pembrolizumab" OR "cemiplimab" OR "dostarlimab" OR "atezolizumab" OR "durvalumab" OR "avelumab" OR "ipilimumab" OR "tremelimumab" OR "relatlimab" OR "tiragolumab" OR "botensilimab" OR "camrelizumab" OR "sintilimab" OR "toripalimab" OR "tislelizumab" OR "penpulimab" OR "zimberelimab" OR "serplulimab" OR "sugemalimab" OR

Search Set	Description	Search Query (Field Tag: TITLE-ABS-KEY)
		"envafolimab" OR "prolgolimab" OR "balstilimab" OR "retifanlimab" OR "cadonilimab" OR "ivonescimab" OR "CAR-T" OR "CAR T-cell*" OR "chimeric antigen receptor*" OR "CAR-NK*" OR "NK cell therap*" OR "TIL therapy" OR "tumor infiltrating lymphocyte*" OR "lifileucel" OR "TCR-T" OR "adoptive cell therap*" OR "oncolytic virus*" OR "oncolytic virotherap*" OR "T-VEC" OR "talimogene" OR "interleukin*" OR "cytokine therap*" OR "interferon*" OR "cancer vaccin*" OR "tumor vaccin*" OR "neoantigen vaccin*" OR "sipuleucel-T" OR "bispecific antibod*" OR "BiTE" OR "T-cell engager*" OR "tarlatamab" OR "amivantamab" OR "tebentafusp" OR "immune agonist*" OR "immune modulat*" OR "STING agonist*")
#2	Solid Tumors Inclusion	("cancer*" OR "oncolog*" OR "tumor*" OR "neoplasm*" OR "carcinoma*" OR "malignanc*" OR "sarcoma*" OR "melanoma*" OR "glioblastoma*" OR "neuroblastoma*" OR "mesothelioma*" OR "metastasis*" OR "metastatic")
#3	Hematology Exclusion	("leukemia*" OR "lymphoma*" OR "myeloma*" OR "hematologic*")
#4	Final Combined Strategy	(#1 AND #2) NOT #3
#5	Filters & Refinements	Source Type: Journal Document Types: Article, Review. Language: English. PUBYEAR: >1999 AND <2026.

Search Set	Description	Search Query (Field Tag: TITLE-ABS-KEY)
		Subject Areas: Medicine; Biochemistry, Genetics and Molecular Biology; Immunology and Microbiology; Pharmacology, Toxicology and Pharmaceutics

Note: TITLE-ABS-KEY denotes "Article title, Abstract, Keywords". This strategy aims to test whether global structural patterns are stable across databases.

Final String for both WoSCC and Scopus.:

("immunotherap*" OR "immuno-oncolog*" OR "immune checkpoint inhibitor*" OR "checkpoint blockade" OR "PD-1" OR "PD-L1" OR "CTLA-4" OR "LAG-3" OR "TIGIT" OR "TIM-3" OR "nivolumab" OR "pembrolizumab" OR "cemiplimab" OR "dostarlimab" OR "atezolizumab" OR "durvalumab" OR "avelumab" OR "ipilimumab" OR "tremelimumab" OR "relatlimab" OR "tiragolumab" OR "botensilimab" OR "camrelizumab" OR "sintilimab" OR "toripalimab" OR "tislelizumab" OR "penpulimab" OR "zimberelimab" OR "serplulimab" OR "sugemalimab" OR "envafolimab" OR "prolgolimab" OR "balstilimab" OR "retifanlimab" OR "cadonilimab" OR "ivonescimab" OR "CAR-T" OR "CAR T-cell*" OR "chimeric antigen receptor*" OR "CAR-NK*" OR "NK cell therap*" OR "TIL therapy" OR "tumor infiltrating lymphocyte*" OR "lifileucel" OR "TCR-T" OR "adoptive cell therap*" OR "oncolytic virus*" OR "oncolytic virotherap*" OR "T-VEC" OR "talimogene" OR "interleukin*" OR "cytokine therap*" OR "interferon*" OR "cancer vaccin*" OR "tumor vaccin*" OR "neoantigen vaccin*" OR "sipuleucel-T" OR "bispecific antibod*" OR "BiTE" OR "T-cell engager*" OR "tarlatamab" OR "amivantamab" OR "tebentafusp" OR "immune agonist*" OR "immune modulat*" OR "STING agonist*") AND ("cancer*" OR "oncolog*" OR "tumor*" OR "neoplasm*" OR "carcinoma*" OR "malignanc*" OR "sarcoma*" OR "melanoma*" OR "glioblastoma*" OR "neuroblastoma*" OR "mesothelioma*" OR "metastasis*" OR "metastatic") NOT ("leukemia*" OR "lymphoma*" OR "myeloma*" OR "hematologic*")

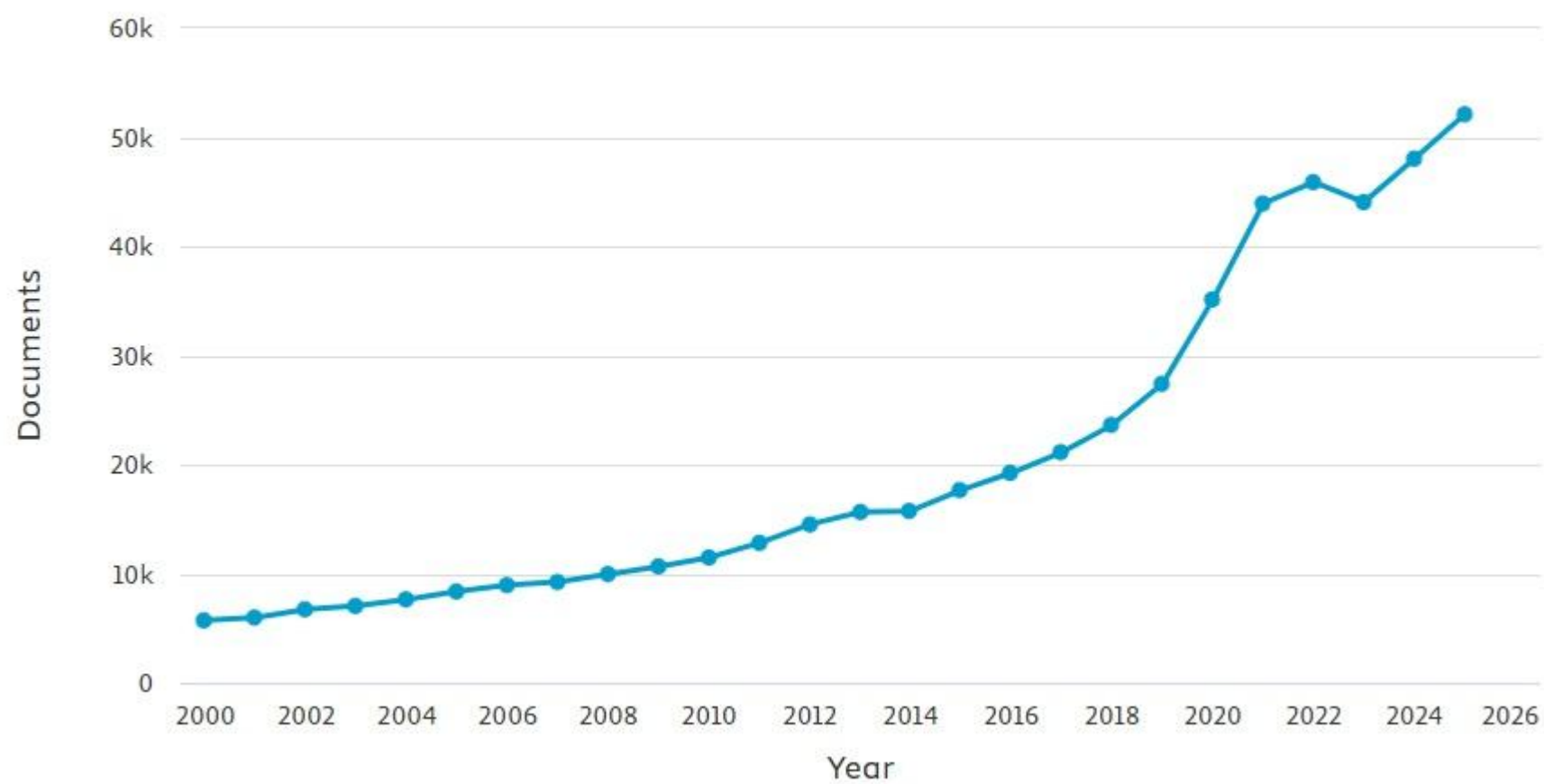
SUPPLEMENTARY MATERIAL

Supplementary Figure 1. Comparative subset analysis of bibliometric trends using the Scopus database.

- (A)** Annual publication output (2000–2025) derived from Scopus, demonstrating an exponential growth trajectory consistent with the primary WoSCC findings.
- (B)** The top 10 most productive countries/regions in the Scopus dataset, illustrating descriptive parallels with the leading contributions of China and the USA.
- (C)** The top 10 most productive journals in the field.
- (D)** VOSviewer keyword co-occurrence network map based on the top 20,000 most-cited documents in Scopus. Colors denote distinct thematic clusters: *Tumor Microenvironment & Biomarkers* (Cluster 1), *Inflammatory Mechanisms* (Cluster 2), and *Clinical Checkpoint Blockade* (Cluster 3).

(A)

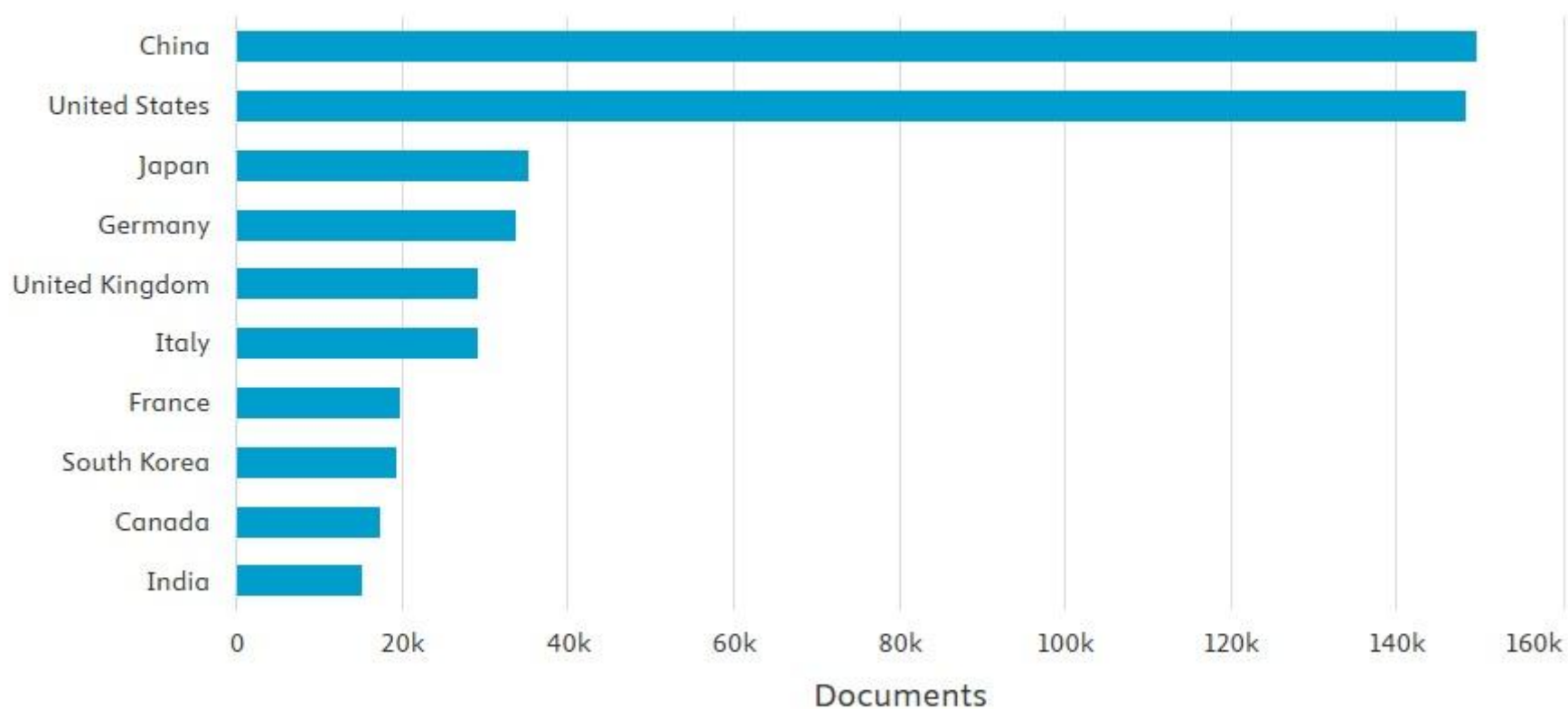
Documents by year



(B)

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

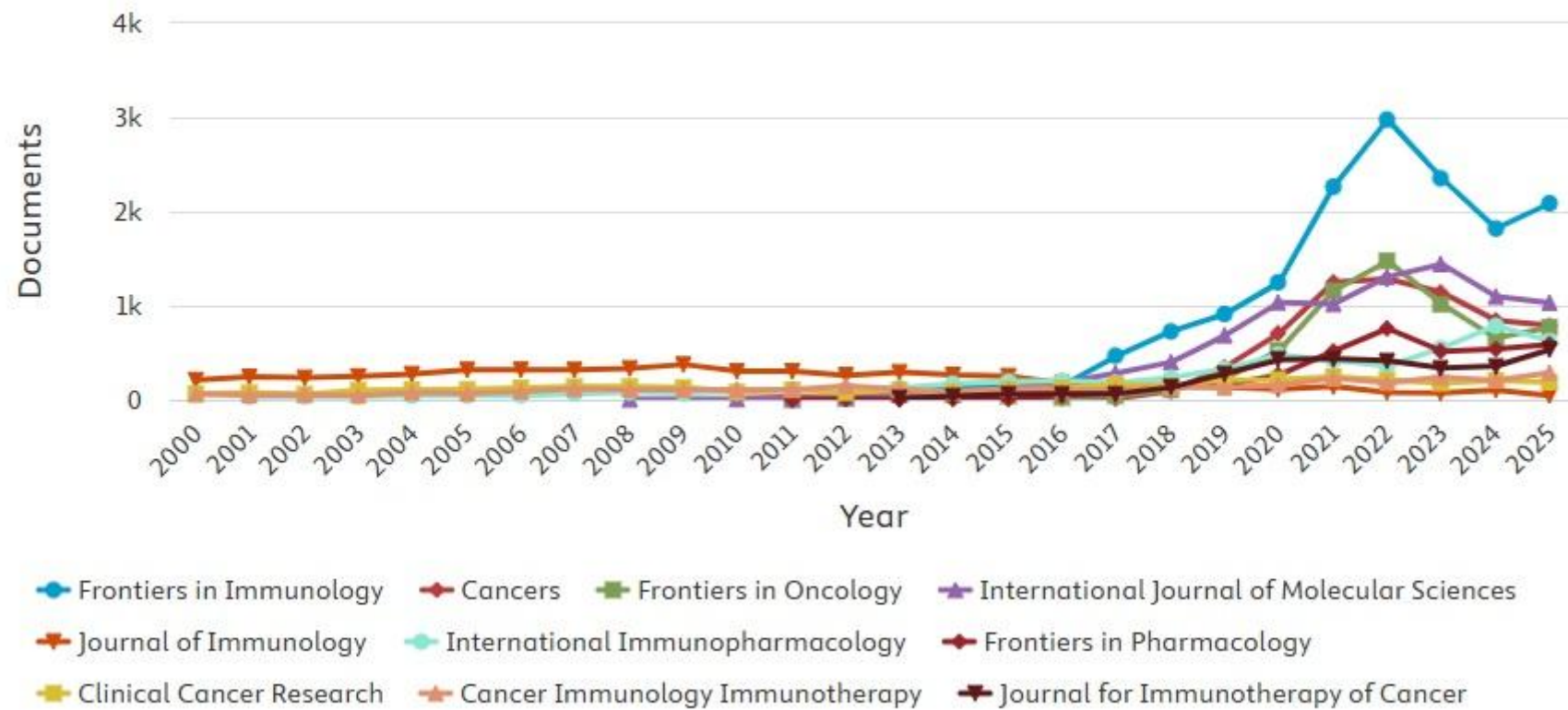


(C)

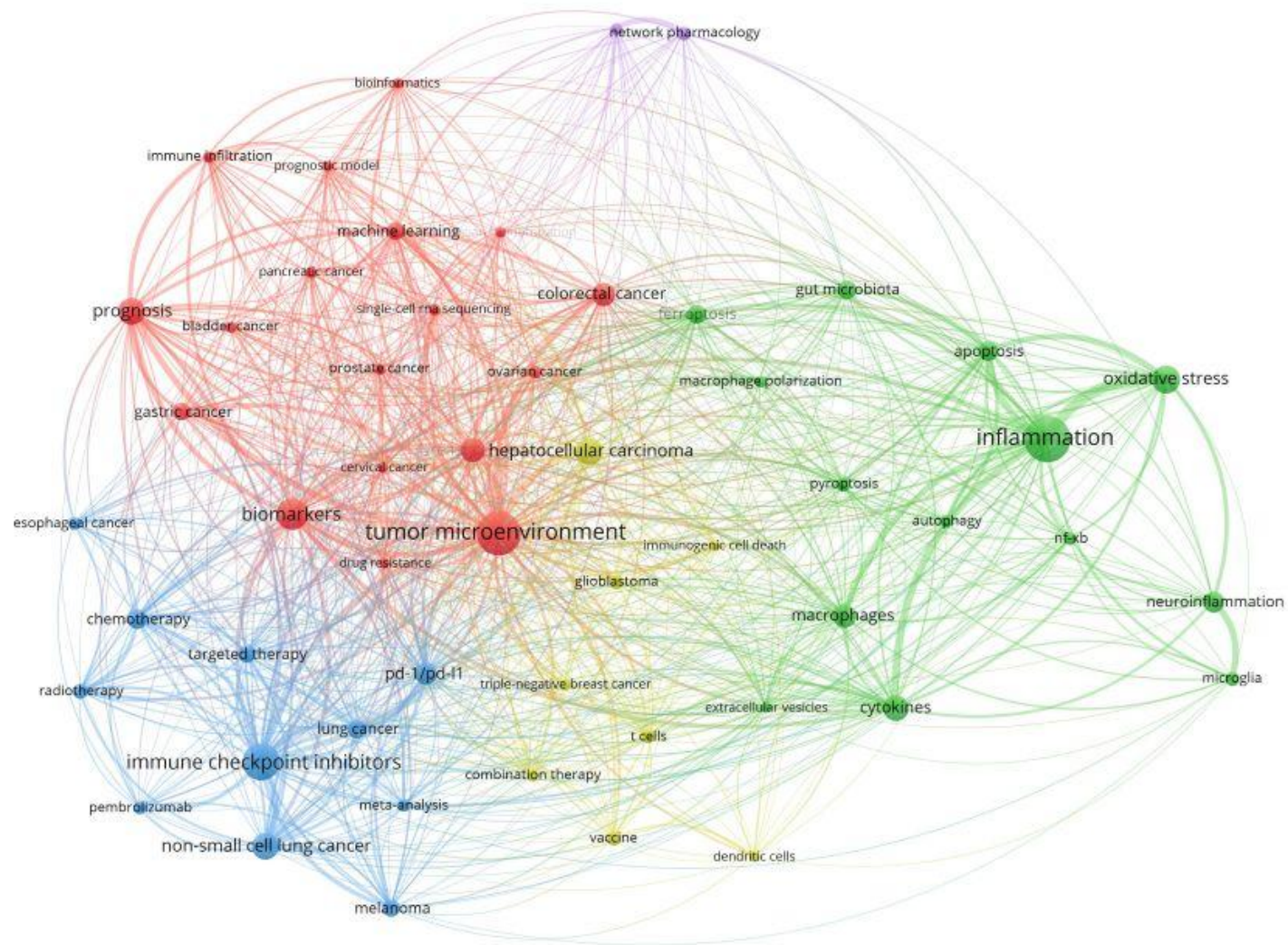
Documents per year by source

Compare the document counts for up to 10 sources.

[Compare sources and view CiteScore, SJR, and SNIP data](#)



(D)



Thesaurus

Replace by, Label

biomarkers, biomarker

vaccine, vaccines

vaccine, cancer vaccines

vaccine, cancer vaccine

vaccine, vaccination

tumor microenvironment, tumor microenvironment - tme

tumor microenvironment, tumor immune microenvironment

tumor microenvironment, immune microenvironment

tumor microenvironment, immune microenvironment

immune checkpoint inhibitors, immune checkpoint inhibitors (icis)

immune checkpoint inhibitors, immune checkpoint inhibitor

immune checkpoint inhibitors, immune checkpoint inhibitors

immune checkpoint inhibitors, immune checkpoint inhibitor

immune checkpoint inhibitors, immune checkpoint blockade

immune checkpoint inhibitors, checkpoint inhibitors

immune checkpoint inhibitors, checkpoint inhibitor

immune checkpoint inhibitors, pd-1 inhibitor

melanoma, metastatic melanoma

pd-1/pd-l1, pd-1

pd-1/pd-l1, pd-l1

immune checkpoint inhibitors, anti-pd-1

immune checkpoint inhibitors, anti-pd-l1

immune checkpoint inhibitors, anti pd-1

immune checkpoint inhibitors, anti pd-l1

non-small cell lung cancer, nsclc

non-small cell lung cancer, non-small-cell lung cancer

non-small cell lung cancer, non-small cell lung cancer (nsclc)

hepatocellular carcinoma, hcc

esophageal cancer, esophageal squamous cell carcinoma

il-6, interleukin-6

tnf-alpha, tumor necrosis factor alpha

tnf-alpha, tumor necrosis factor-alpha

il-18, interleukin-18

il-2, interleukin-2

il-12, interleukin-12

il-12, interleukin 12

il-10, interleukin-10

il-10, interleukin 10

il-8, interleukin-8

ifn-gamma, interferon-gamma

ifn-gamma, interferon gamma

ifn-alpha, interferon-alpha

ifn-alpha, interferon alpha

chimeric antigen receptor, chimeric antigen receptor - car

t cells, regulatory t cells

t cells, t cell

cytokines, cytokine

ipilimumab, ipilimumab

dendritic cells, dendritic cell

inflammation, inflammation

immune infiltration, immune infiltration

immunogenic cell death, immunogenic cell death

macrophages, macrophage