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Exploring the track of Forensic Serology: A 23-Year Bibliometric Analysis

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Abstract: *this bibliometric evaluation reviewed forensic serology studies from 2000 to 2023, utilising Scopus records to song guide trends, key contributors, and impactful research. The subject showed significant growth, with 201 documents posted at a four.89% annual boom price. Major members consist of Virginia Commonwealth University and fantastic researchers like Hanson EK and Juusola J. The studies highlight diverse file kinds and influential papers, emphasizing ongoing advancements and the want for global collaboration. Limitations encompass reliance on Scopus and ability language bias. Overall, the study demonstrates the dynamic progress in forensic serology and the significance of continued research.*

Keywords: Serology; Bibliometric Analysis; Publication; Research; Information Science; impact, trend.

Introduction

Forensic serology, a crucial subject in forensic technological know-how, examines blood and different physical fluids to assist in criminal investigations. Over the beyond decades, studies on this area has expanded extensively, reflecting improvements in techniques and expanded scholarly hobby (1). This take a look at targets to provide a complete review of forensic serology research from 2000 to 2023 by way of studying e-book trends, key individuals, and the effect of seminal papers. By leveraging records from the Scopus database, this analysis gives insights into the growth, variety, and quotation styles of forensic serology literature. Using state-of-the-art bibliometric equipment and visualization techniques, we examine how this subject has advanced, pick out main establishments and authors, and assess the impact of pivotal research on the broader clinical community. Through this examination, we searching for to apprehend the improvement trajectory of forensic serology and highlight regions of widespread impact and collaboration (1).

Aim

Analyze Growth and Impact: Assess the expansion of forensic serology research from 2000 to 2023, focusing on publication numbers, growth rate, and citation impact.

Identify Key Contributors: Determine leading institutions and authors in forensic serology, evaluating their contributions and collaboration patterns.

Examine Publication Diversity: Investigate the range of document types within forensic serology research to understand the various formats and their contributions.

Materials and methods

Data for this study were carefully collected from the Scopus database, targeting publications

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from 2000 to 2023 that included the term «Forensic Serology» To prepare relevant records and retrieve accuracy, a Boolean search query was strategically handled by staff, ensuring that the search results included accurate context After retrieval, the data was exported in CSV (Comma-Separated Values) format. This framework was chosen for its simplicity and efficiency in dealing with large data sets, allowing simple data processing and analysis.

The next step was to use R programming to process the data. The Biblioshiny package, a robust tool in the R environment, was used to manage and analyze the bibliometric data. Biblioshiny provides advanced functionality for visualizing data development.

Results and discussion

In Table 1 (**Table 1: Study Information**), from 2000 to 2023, forensic serology research has significantly expanded, encompassing 201 documents across 115 sources, with an annual growth rate of 4.89% (2,3). The average age of these documents is 10.9 years, reflecting relatively recent contributions, and they have garnered an average of 15.21 citations per document, indicating a healthy impact within the academic community. With 2246 Keywords Plus and 595 Author's Keywords, the research topics are highly diverse. A total of 693 authors have contributed, with 34 authors producing single-authored documents. The average number of co-authors per document is 3.96, suggesting strong collaborative efforts, and international co-authorships account for 9.95% of the documents, showing growing global collaboration. The types of documents include 138 articles, 4 books, 18 book chapters, 8 conference papers, 5 editorials, 2 letters, 1 note, 24 reviews, and 1 short survey. This variety indicates a robust and multifaceted field with substantial reference material, totaling 7002 references, supporting the ongoing development and dissemination of forensic serology research (4).

The relevant institutions in the top ten based on the number of cases (**Graph 2: Key Affiliations in Forensic Serology Research**) are Virginia Commonwealth University (20 cases), University of Albany (15), University of Istanbul (14), Osaka City University School of Medicine (14); , Kenya Institute of Medical Research (10), Florida International University (9), Gujarat University of Forensic Sciences (9). Camino (9), Punjabi University (7), University of Modena and Reggio Emilia (7).

These institutions are notable for their significant contributions to the discussed articles, with Virginia Commonwealth University leading the list.

The **Table 2: Most Global Cited Documents** highlights ten influential papers in forensic serology, showcasing a range of citation metrics. Hanson EK's 2009 paper in Analytical Biochemi-

Table 1. Study Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2000:2023
Sources (Journals, Books, etc)	115
Documents	201
Annual Growth Rate %	4.89
Document Average Age	10.9
Average citations per doc	15.21
References	7002
DOCUMENT CONTENTS	
Keywords Plus (ID)	2246
Author's Keywords (DE)	595
AUTHORS	
Authors	693
Authors of single-authored docs	34
AUTHORS COLLABORATION	
Single-authored docs	39
Co-Authors per Doc	3.96
International co-authorships %	9.95
DOCUMENT TYPES	
article	138
book	4
book chapter	18
conference paper	8
editorial	5
letter	2
note	1
review	24
short survey	1

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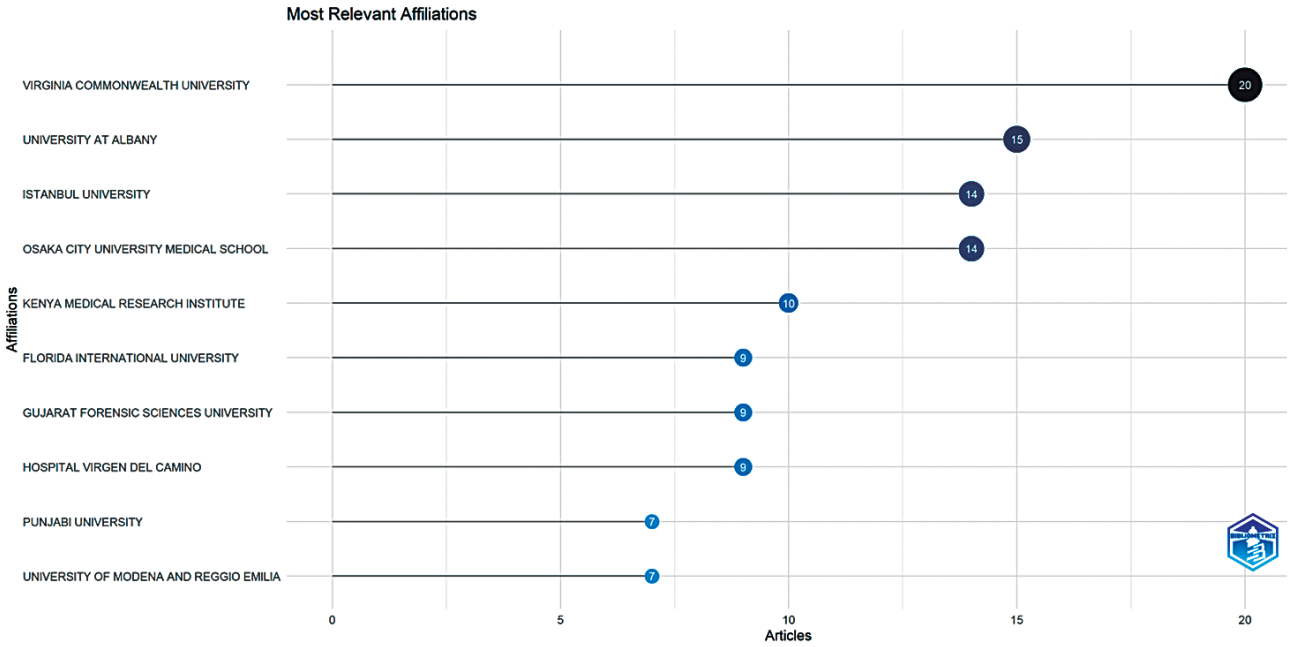

Graph 2. Key Affiliations in Forensic Serology Research

stry leads with 341 total citations, averaging 21.31 citations per year and a normalized TC of 8.67. Juusola J's 2005 paper in Forensic Science International follows with 296 citations, 14.80 per year, and a normalized TC of 5.99. Lee KW's 2005 study in Tissue Antigens has 181 citations (9.05/year, normalized TC 3.66). Silva SS's 2015 work in Forensic Science International Genetics,

Table 2. Most Global Cited Documents

Paper	DOI	Total Citations	TC per Year	Normalized TC
HANSON EK, 2009, ANAL BIOCHEM	10.1016/j.ab.2009.01.037	341	21.31	8.67
JUUSOLA J, 2005, FORENSIC SCI INT	10.1016/j.forsciint.2005.02.020	296	14.80	5.99
LEE KW, 2005, TISSUE ANTIGENS	10.1111/j.1399-0039.2005.00386.x	181	9.05	3.66
SILVA SS, 2015, FORENSIC SCI INT GENET	10.1016/j.fsigen.2014.09.002	103	10.30	5.42
MCLAUGHLIN G, 2014, FORENSIC SCI INT-a	10.1016/j.forsciint.2014.02.027	91	8.27	3.17
KOCAZEYBEK B, 2009, FORENSIC SCI INT	10.1016/j.forsciint.2009.03.007	71	4.44	1.81
SEASHOLS-WILLIAMS S, 2016, ELECTROPHORESIS	10.1002/elps.201600258	65	7.22	4.60
DOTY KC, 2018, FORENSIC SCI INT	10.1016/j.forsciint.2017.11.033	61	8.71	2.02
DOTY KC, 2018, TRAC TRENDS ANAL CHEM	10.1016/j.trac.2017.12.003	60	8.57	1.98
JABEEN R, 2006, ELECTROPHORESIS	10.1002/elps.200500948	60	3.16	3.14

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with 103 citations (10.30/year, normalized TC 5.42), and McLaughlin G's 2014 paper in Forensic Science International, with 91 citations (8.27/year, normalized TC 3.17), demonstrate mid-level impact. Kocazeybek B's 2009 study in Forensic Science International has 71 citations (4.44/year, normalized TC 1.81). Seashols-Williams S's 2016 paper in Electrophoresis has 65 citations (7.22/year, normalized TC 4.60). Doty KC has two 2018 papers: one in Forensic Science International with 61 citations (8.71/year, normalized TC 2.02) and another in TrAC Trends in Analytical Chemistry with 60 citations (8.57/year, normalized TC 1.98). Lastly, Jabeen R's 2006 paper in Electrophoresis has 60 citations (3.16/year, normalized TC 3.14). These metrics reflect each paper's yearly citation performance and their adjusted impact across the forensic serology landscape.

Result:

Analyze Growth and Impact: From 2000 to 2023, forensic serology studies exhibited large boom, with a complete of 201 documents posted across 115 sources. The subject has accelerated at an annual growth fee of four.89%, indicating a steady boom in scholarly output. The average age of the documents is 10.Nine years, suggesting that most studies is notably recent. Each file has completed a mean of 15.21 citations, reflecting a enormous impact in the educational network. This growth trajectory underscores the growing significance and development in forensic serology research over the past a long time (2).

Identify Key Contributors: Through this analysis, it was possible to identify a variety of leading institutions and authors contributing to research in forensic serology. Virginia Commonwealth University tops the list with 20 articles. This is followed by University at Albany (15), Istanbul University (14), Osaka City University Medical School (14) and Kenya Medical Research Institute (10). Clearly, these are some of the major contributors to this area of study. Among the well-known authors who wrote influential papers include Hanson EK, Juusola J and Lee KW- whose high number of citations shows their significant contributions to forensic serology research (5).

Examine Publication Diversity: The study revealed a diverse range of document types in forensic serology research. The majority of publications are articles (138), followed by reviews (24), book chapters (18), and conference papers (8). Other document types include books (4), editorials (5), and letters (2). This variety highlights the multifaceted nature of the field, encompassing different research formats and contributions. The presence of various document types indicates a robust and comprehensive body of literature supporting forensic serology research (6,7).

Evaluate Citation Metrics: The analysis of citation metrics for influential papers shows a range of impact within the forensic serology field. Key papers include Hanson EK's 2009 study with 341 total citations, averaging 21.31 citations per year, and Juusola J's 2005 paper with 296 citations, averaging 14.80 citations per year. Other notable papers, such as those by Lee KW (181 citations) and Silva SS (103 citations), also demonstrate significant influence. These metrics illustrate the prominence of seminal works and their contribution to shaping the research landscape in forensic serology (8).

Limitation:

Database Limitation: The analysis is based solely on the Scopus database, potentially missing relevant publications indexed in other databases such as Web of Science or PubMed.

Search Query Constraints: Boolean operators used in the search might have excluded relevant documents or included irrelevant ones due to limitations in search term specificity.

Citation Data Accuracy: The citation metrics may be affected by discrepancies or variations in citation practices across different journals, impacting the reliability of the results (9).

Analysis Tool Limitations: The Biblioshiny package, while comprehensive, may not fully capture nuances in publication quality or impact beyond basic citation metrics (1).

Language Bias: The study focuses on English-language publications, which could overlook significant research contributions published in other languages.

Guo et al. (2022) assessed the research status of infection detection methods in CNS disease

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from 2000 to 2021 by bibliometric analysis. A growing literature was observed, focusing on microbiology, infectious diseases, and bacteriology. They pointed to metagenomic next-generation sequencing (mNGS) as a major area of interest. Particular keywords include «pathogen», «pathogen», and «diagnosis». The United States, along with the CDC, and researchers Xin Wang and Jennifer Dien Bard were noted as major contributors. The study highlighted the critical importance of advanced diagnostic methods, particularly mNGS, in the diagnosis of CNS pathology [10].

Xia et al. (2022) conducted the first bibliometric analysis of COVID-19 and immune responses, providing an overview of recent research advances. Analyzing 2,200 publications from December 2019 to April 2022, they found that the United States, China, and Germany led in research output, with the United States being the most influential. Frontiers in Immunology published the most articles, and Alessandro Sette was the most productive author. The study highlighted vaccine development and evaluation as emerging hotspots. It concluded that while the U.S. led in impact, China needed to improve international cooperation and preclinical research. Future research might focus increasingly on vaccines [7].

Jiang et al. (2023) conducted a bibliometric analysis to evaluate the current research status on sepsis-related immunosuppression. Analyzing 4,132 articles from the SCI-E database in the Web of Science Core Collection, they found that publications and citations have increased annually, showing growing interest. Common keywords were sepsis, immunosuppression, and male. Monneret from Lyon, France, was the most prolific researcher, while Moldawer and Chaudry from the US had the most collaborations. Key journals included Shock, Critical Care, and Critical Care Medicine. The study concluded that most research is conducted in developed countries, highlighting the need for more collaborative research from Chinese researchers [9].

Conclusions

The study provides a comprehensive analysis of forensic serology research from 2000 to 2023, and reveals significant growth and impact in the field. The study shows a steady increase in publications, indicating continuous growth and scholarly interest in forensic serology. Major institutions and authors play key roles, with outstanding contributions from institutions such as Virginia Commonwealth University and influential papers reflecting the field's development The diverse literature and international collaboration emphasize the complex and multifaceted nature of the field (10). Citation metrics highlight the popularity of original texts, offering a detailed perspective on their impact on the research landscape. on the whole, this study demonstrates the dynamic development of forensic serology, and emphasizes the importance of continued research and collaboration to further the field's progress.

Authors' Contribution:

Dr, A.J. Pujari led the conceptualization, data analysis, and drafted the manuscript. Prof. Pujari supervised the study design, methodology, and provided critical revisions.

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Conflict of Interests

The authors declare no conflicts of interest.

Consent to Publication

All authors consent to the publication of this manuscript.

ORCID ID and authors' contribution

(A, B, C, D, E, F) Avinash J. Pujari

A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

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Дослідження розвитку судової серології: бібліометричний аналіз за 23 роки

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Анотація: *це бібліометричне дослідження аналізує публікації з судової серології за період 2000–2023 років, використовуючи базу Scopus для визначення тенденцій публікацій, ключових авторів і впливових досліджень. Галузь демонструє значне зростання, опубліковано 201 науковий документ зі середньорічним приростом 4,89%. Основними учасниками є Virginia Commonwealth University та видатні дослідники, такі як Hanson EK і Juusola J. Аналіз виявляє різноманітність типів публікацій та впливові наукові роботи, підкреслюючи безперервний розвиток і необхідність міжнародної співпраці. До обмежень дослідження належать залежність від Scopus та мовна упередженість. Загалом, дослідження демонструє динамічний розвиток судової серології та важливість подальших наукових розвідок.*

Ключовіслова: Серологія; Бібліометричний аналіз; Публікація; Дослідження; Інформаційна наука; Вплив; Тенденція.