ORIGINAL RESEARCH ARTICLE

MAPPING OF GLOBAL FORENSIC MEDICINE RESEARCH

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ABSTRACT:

Purpose: The development of research looking at forensic medicine was explored utilising a bibliometric approach and quantitative analytical methodologies. Using a visual analysis of research articles, this study also assessed the state of forensic medicine at the time it was conducted.

Design/methodology/approach: Bibliometrics indicators, such as annual research trends, pertinent journals, productive organisations, prolific authors, and author collaboration level, will be used to assess and display the results. Quality research papers totaling 11965 have been downloaded from Scopus. Biblioshiny (RStudio) and scientometric software, specifically, were used to analyse the data.

Findings: Analysis of 11965 original and review articles showed a steady increase in publications during the previous 11 years. The USA was the nation that produced the most articles in this field, followed by Germany and India. The three main categories of studies identified by a network analysis based on the cooccurrence of keywords are clinical studies, pain his management studies, and mechanism investigations. R.W. Byard is the most productive author, and association with the Turkish Ministry of Justice is the most productive.

Originality/value: The present study evaluated research on forensic medicine using bibliometric methods and revealed current trends in forensic medicine research and medicine treatment. Government policies, timely health care availability, and public awareness will largely contribute to the prevention of this new age mortality.

Keywords: Forensic Medicine; Authorship Pattern; Research Assessment; Authorship Network; keywords Co-occurrence; Bibliometrics analysis.

Introduction

As defined by the legal requirements of admissible evidence and criminal procedure, forensic science, often known as criminalistics(1), is the application of science to criminal and civil laws, primarily—on the criminal side—during criminal inquiry. DNA analysis, fingerprint analysis, blood stain pattern analysis,

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firearms examination and ballistics, tool mark analysis, serology, toxicology, hair and fibre analysis, entomology, questioned documents, anthropology, odontology, pathology, epidemiology, footwear and tyre tread analysis, drug chemistry, paint and glass analysis, and digital audio, video, and photo analysis are all included in the broad field of forensic science.

Applying forensic medical expertise, methods, and techniques to the care of live patients in the emergency room is known as clinical forensic emergency medicine (ED).(2) It is a crucial link that allows patients or victims of violence to seek redress from those who have wronged them. Emergency clinicians play a critical role in this process because they are frequently the first point of contact for most of these patients. They are also the clinicians that interact with law enforcement the most, making them ideal candidates to support evidence preservation.(3)

Forensic medicine is medicine used to solve legal issues. Both have buried histories that date back to the earliest days of family and tribal life. Human history has been documented for 6000 years. Egypt, Sumeria, and Babylon all made contributions to the growth of forensic medicine. Probably the first true medicolegal expert was Imhotep. Galen, a Roman, and Hippocrates, a Greek physician, both made significant contributions.(4) The millennium of the Dark Ages saw little progress. But throughout the seventeenth, eighteenth, and nineteenth centuries, Renaissance medicine gave this area of medicine a boost, and by the twentieth century, forensic medicine had gained international attention. Doctors, coroners, pathologists, medical specialists, and forensic labs all help in the investigation of crimes against people as well as the resolution of issues like identification, unexpected deaths, apparent drowning, and many others.(5,6)

With bibliometric analysis, the goal of this study was to provide a summary of forensic medicine research publications from 2010 to 2021. We also wanted to highlight keyword analysis and popular research topics, as well as the most widely cited effective papers, active journals, organisations, and writers. Using correlation and regression analysis, we also sought to ascertain the evolution of publications over time and the variables influencing the productivity of the publication.

While infrastructure and facilities expansion are crucial in every area of medicine, scientific research, breakthrough discoveries, and prominent publications are the ultimate markers of growth and evolution. The history of Forensic medicine research and development is complicated, involving discoveries in a variety of medical and social sciences fields. It is critical to map a field's research output in order to lead policymakers, researchers, and funding organisations toward areas where research activity should be restricted or increased. Several replicable statistical approaches have been developed under the umbrella of bibliometric in acknowledgement of its relevance. It is a "quantitative study of science, science communication, and science policy"(7) that aids in assessing the influence of journals, scientists, and institutions on the growth and innovation of a scientific discipline.

Using replicable bibliometric methodologies, the current study examines research trends in the area of Forensic medicine by the contribution. Despite the fact that various Bibliometric studies in general Forensic medicine and other disciplines medicine have been published, there are few studies mapping the research output of in the field of surgery, necessitating this investigation. From 2010 to 2021, the current research highlights key publications, groundbreaking ideas, authors, and major funding agencies that contributed to Forensic medicine.

STUDY DESIGN & METHODOLOGY

SOURCES OF DATA AND SEARCH STRATEGY

On the 22nd of October 2022, all data was downloaded from the Scopus database using the following search terms: Forensic medicine. The Scopus is a generally regarded and commonly used database for analyzing scientific papers that offers full publishing data. This research looked at publications published between 2010 to 2021 and found a total of Scopus articles.(8)

The Scopus database was used to collect the data of these Forensic medicine Research 2010 – 2021. The advanced search in Scopus using key words of : TITLE-ABS-KEY (forensic AND medicine) AND PUBYEAR > 2009 AND PUBYEAR < 2022 AND PUBYEAR > 2009 AND PUBYEAR < 2022

DATA ANALYSIS

Publications were categorized and scored methodically based on publication year, nation, journal, study field, authors, and connections with organizations. In addition, the frequency of keywords taken from the publications was evaluated and then used in a network analysis of the evolution of Forensic medicine Research.

The bibliographical information was entered into MS Excel in its entirety. The collaborative network of organisations, nations, keywords plus, and source growth was categorised using the VOSviewer(3)software and the Bibliometrix(4) R package, a popular tool for analyzing and visualizing links between authors, nations, co-citations, and article titles. The mapping approach was used to calculate similarity (affinity) based on association strength, with higher association strength indicating more similarity between words, and a greater number of publications in which two items co-occur indicating that the terms are more closely related. Depending on the threshold of similarity between nodes, the number of clusters may be changed.

RESULTS

Table (1): Summarises the studies in forensic medicine

This study's foundation is a 12-year retrieval of forensic medicine research publication data from the Medical and Health study's Scopus citation database (2010 – 2021). 11965 publications (2010–2021) on the topic of "forensic AND medical" were found in the Scopus database. The study uses both quantitative and qualitative factors to evaluate research publications that have been indexed in the Scopus database.

Description	Results
Timespan	2010:2021
Sources (Journals, Books, etc)	2458
Documents	11965
Average years from publication	6.46
Average citations per documents	8.015
Average citations per year per doc	1.047
References	330967
Document Types	
Article	9325
Article; proceedings paper	192
Biographical-item	87
Book review	306
Correction	192
Editorial material	14
Editorial material; retracted publication	250
Letter	58
Meeting abstract	215
Reprint	175
Retraction	1
Review	1248
short survey	89
Document Contents	
Keywords Plus (ID)	26335
Author's Keywords (DE)	20775
Authors	
Authors	29596
Author Appearances	48655
Authors of single-authored documents	1426
Authors of multi-authored documents	28170
Authors Collaboration	
Single-authored documents	1843
Documents per Author	0.404
Authors per Document	2.48
Co-Authors per Documents	4.07
Collaboration Index	2.79

The search results are summarised in Table 1. This demonstrates that the study took into account all types of materials and sources. Additionally, it lists the total number of authors, authors of single-authored and multi-authored publications, total keywords and author partnerships.

Forensic Medicine Research Annual Growth and Citation Count

Table (2): Literature growth in Forensic medicine research during 2010- 2021

Year	TP	% Scopus	MeanTCperArt	TC	ACP	h-index
2010	923	7.72	13.84	12772	13.33	54
2011	981	8.20	14.42	14152	14.77	56
2012	926	7.74	11.79	10920	11.40	46
2013	1181	9.88	9.61	11351	11.85	44
2014	1058	8.85	9.47	10026	10.46	42
2015	976	8.16	8.70	8494	8.86	40
2016	929	7.77	7.36	6843	7.14	38
2017	911	7.62	6.92	6308	6.58	33
2018	942	7.88	6.10	5754	6.00	28
2019	1006	8.41	4.69	4724	4.93	26
2020	1089	9.11	2.97	3241	3.38	23
2021	1029	8.61	1.19	1228	1.28	11

TP=Total papers, TC=Total citations, ACP=Average citations per papers

The year-by-year chronological distribution of the papers during the study period is shown in Table 2. Out of 11965 articles that were published between 2010 and 2021, the most papers—1181 (9.88%) were published in the year 2013. This was followed by 1089 (9.11%) papers in the year 2020, 1058 papers (8.85%) in the year 2014, and 1029 papers (8.61%) in the year 2021.

Top ten most relevant journals on Forensic medicine

Table (3): Top ten most relevant journals

Sources	TP	TC	Cite Score	Quartile	h_index	g_index	m_index
J. Forensic Leg. Med.	921	10060	2.9	Q1	39	49	3
Forensic Sci. Int.	664	10641	4.4	Q1	46	68	3.53
J. Forensic Med.	403	462	3.4	Q1	7	9	0.53
Int. J. Legal Med.	292	3566	4.6	Q1	29	40	2.23
J. Forensic Sci.	289	3158	3.4	Q2	27	40	2.07
Indian J. Forensic Med. Toxicol.	288	140	0.1	Q4	4	4	0.30
Sud. Med. Ekspert.	236	193	0.6	Q4	6	6	0.46
Rom. J. Leg. Med.	225	747	0.6	Q4	13	16	1
Rechtsmedizin	224	711	1.1	Q3	12	16	0.92
Legal Medicine	208	1803	2.5	Q2	21	18	1.53

The top 10 publications chosen by forensic medicine researchers to publish their findings are given in Table 3. These publications' rankings are based on prior research on the contributions of several disciplines, as well as the h, g, and m indices. These prestigious journals contained a sizable concentration of the diverse subject areas covered by forensic medicine research papers. As a result, the proportion of highly referenced papers differs depending on the journal. Journal of Forensic and Legal Medicine was the most widely used journal (TP=921; TC=10060; h index=39), followed by Forensic Science International (TP=664; TC=10641; h-index=46), Journal of Forensic Medicine (TP=403; TC=462; h-index=7), International Journal of Legal Medicine (TP=292; TC=3566; h-index=29), and the remaining.

Top ten most prolific authors on Forensic medicine Research during 2000-2021

Table (4): Prolific authors

Author	h_index	g_index	m_index	TC	NP	PY_start
Byard, R.W.	17	27	1.308	1150	96	2010
Thali, M.J.	21	34	1.615	1215	66	2010
Madea, B.	14	25	1.077	675	59	2010
Püschel, K.	11	18	0.846	425	58	2010
Kanchan, T.	16	28	1.231	861	54	2010
Verhoff, M.A.	9	15	0.692	279	44	2010
Cattaneo, C.	12	19	0.923	392	39	2010
Vrij, A.	19	32	1.462	1060	35	2010
Graw, M.	8	14	0.667	216	34	2011
Mangin, P.	15	23	1.154	554	34	2010

Table 4 shows, Interestingly, the majority of the authors that made the top 10 most influential list with 34 or more highly cited articles created more than 200 citations. Byard, R.W. (NP=96; TC=1150) was the author who was the most active, followed by Thali, M.J. (NP=66; TC=1215; h-index = 17), Badnjevic A (NP=25; TC=140; h-index =21), Madea, B. (NP=59; TC=675; h-index =14), and Püschel, K. (NP=58;TC=425; h-index =11) .

Pattern of authorship

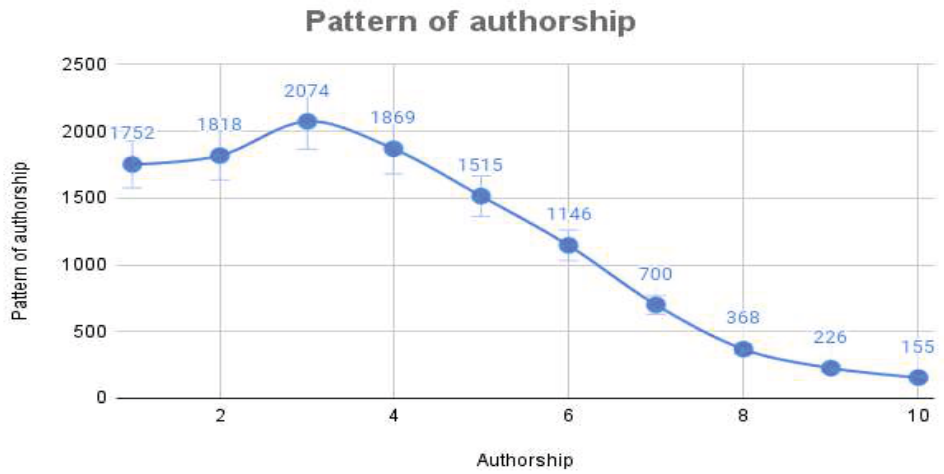

Figure (1): Pattern of authorship

Figure (1) portrays the authorship pattern in Forensic medicine Research. For 11965 publications, there are 1-10 types of authorship patterns identified for the Forensic medicine Research' research. Three authored publications (NP=2074) have the maximum number of research papers, followed by two authorship patterns, have a number of publications (NP=1818), four authorship (NP=1869), single authorship (NP=1752), five authorship (NP=1515) and more than 10 authorship is list of 17307.

Top 10 Organizations on the Forensic medicine research during 2000-2021

Table (5): Productive organization

Affiliations	NP	TC	h-index
Turkish Ministry of Justice	155	1003	17
University of Zurich	136	1846	24
University Medical Center Hamburg-Eppendorf	129	1621	19
Ministry of Justice, China	126	413	11
The University of Adelaide	112	1266	17
Universitaires de MédecineLégale	93	1304	21
Ministry of Health of Russian Federation	92	115	5
Monash University	90	1385	19
Ludwig Maximilian University of Munich	89	1347	15
Victorian Institute of Forensic Medicine	86	1311	18

Table 5 shows that contribution of top 10 institutions varied from 86 to 155 papers and together they contributed share of publications. On further analysis, it was observed that only 5 institutions are produced more than 100 publications. Turkish Ministry of Justice (NP=155;TC1003;h-index=17) papers followed by University of Zurich(NP=155; TC=1846; h-index=17), University Medical Center Hamburg (NP=129;TC =1621;h-index=19) publications, Ministry of Justice, China (NP=126;TC =413;h-index=11) publications, and The University of Adelaide publications (NP=112;TC =1266;h-index=17).

Highly cited papers

Table (6) Top ten most cited papers on the Forensic medicine research during 2010- 2021

Title	Authors	Source Title	TC	Year	NTC
Consensus Guidelines for Therapeutic Drug Monitoring in Neuropsycho - pharmacology: Update 2017	HiemkeC.,et. al	Pharmacopsychiatry	536	2018	337.50
Therapeutic and toxic blood concentrations of nearly 1,000 drugs and other xenobiotics	Schulz M., et. al.	Crit. Care	443	2012	198.56
Compositional Data Analysis: Theory and Applications	Pawlowsky-Glahn V.	Comp Data Ana: The & App	433	2011	160.94
On the overlap between victimization and offending: A review of the literature	Jennings W.G.	Aggress. Violent Behav	398	2012	74.86
Died of wounds on the battlefield: Causation and implications for improving combat casualty care	Eastridge B.J.,et. al.	J Trauma - Inj, Inf &Criti Car	365	2011	266.41
Mass spectrometry imaging under ambient conditions	Wu C.,	Mass Spectrom. Rev.	342	2013	91.52
Why do lie-catchers fail? A lens model meta-analysis of human lie judgments	Hartwig M., Bond C.F.	Psychol. Bull.	303	2011	50.99
Matching forensic sketches to mug shot photos	Klare B., Li Z., Jain A.K.	ITPIDJ	300	2011	121.73
Identifying personal microbiomes using metagenomic codes	FranzosaE.A.,et. al.	PNAS USA	264	2015	53.70
A kernel-based feature selection method for SVM with RBF kernel for hyperspectral image classification	Kuo B.-C.	IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens	261	2014	52.98

Country-wise Contributions

Table (7): Top 10 Contributing Countries.

Country	NP	TC	ACP	h-index
United States	1441	22447	15.58	66
India	1379	5052	3.66	31
Germany	1005	10835	10.78	46
China	924	4966	5.37	31
United Kingdom	812	10649	13.11	47
Italy	693	7228	10.43	35
Australia	521	6446	12.37	37
France	457	2951	6.45	24
Turkey	455	2730	6	22
Switzerland	414	7095	17.14	39

The contributions made by the top 10 countries and their world-share are enumerated and presented in Table 1.The USA is the top contributor of global Forensic medicine research literature with NP=1441; TC=22447; h-index=66 records during the past one decades. The 2nd highest contributor is India with NP=1379; TC=5052; h-index=31 records, followed by Germany with NP=1005; TC=10835; h-index=46 records. all these countries along with countries Chania, UK and Italy have been ranked in the top ten category.

Country collaboration on Forensic medicine research

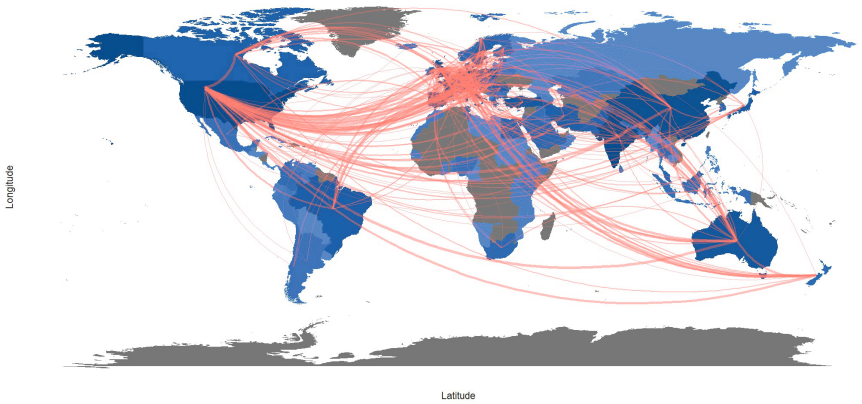

Figure (2): Country-wise collaboration

Coincidentally, USA Vs UK (89) and Germany VS Switzerland (72) are the top collaborating countries with106 collaborations (refer to figure 4), followed by Germany and Austria with 52 collaborations, Italy, and Switzerland with 52 collaborations, Germany and Italy with 47 collaborations, and USA and the Italy with 42 research collaboration, etc. India and Saudi Arabia (25 papers) are the least among the top ten collaborative countries.

Mapping co-occurrence of all keywords in Forensic medicine research

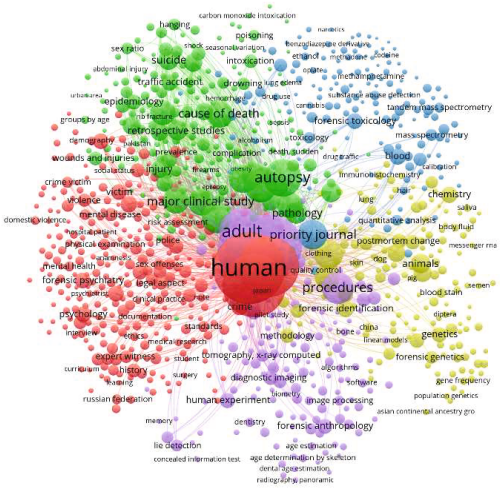

Figure (3): Mapping co-occurrence of the all Keywords

Figure 2 shows that the 20 significant keywords (with frequency of appearance varying from 179 to 1394) have been identified from the literature, which throw light on the trends of research on them. The largest frequency of occurrence (8934) of keywords to the main topic Human and "Forensic medicine" (6874), etc. The visualization map of co – occurrence of keywords is presented in Figure 2, where keywords have been presented in different clusters represented by various colors. Related keywords are found in the same cluster.

DISCUSSION

The article discusses a study analysing data from 2010 to 2021 that concentrates on the field of forensic medicine research. The data is retrieved from the Scopus citation database and contains various metrics pertaining to the research publications in this field.

The number of total publications (11.965) and the average number of years since publication (6.46). In addition, it provides information regarding the document classifications and their distribution, as well as the average number of citations per document.

The annual growth rate of citations in forensic medicine research publications from 2010 to 2021. There were the most papers published in 2013, followed by 2020. Over time, the average number of citations per article has decreased.

Table 3 lists the top ten forensic medicine journals according to indices such as total papers, total citations, and h-index. Forensic Science International and the Journal of Forensic and Legal Medicine are the two most extensively read journals in this field.

These are the ten most prolific authors in forensic medical research based on their h-index, g-index, and m-index. The table shows how many highly cited articles each author has published, with R.W. Byard having published the most and being the most cited.

Three-authored publications are the most common, followed by two and four-authored publications. There are also a substantial number of single-authored papers and publications with more than ten authors.

During the specified time period, the most cited forensic medicine paper was "Consensus Guidelines for Therapeutic Drug

Monitoring in Neuropsychopharmacology: Update 2017."

The USA contributes the most money, followed by India and Germany.

Overall, the study offers useful insights into the trends and patterns of forensic medical research, including contributions from many nations, prolific authors, and highly cited works. It provides a thorough analysis of the evolution of the discipline during the specified time period.

RESULTS AND SUMMARY

The Forensic medicineresearch during 2010 – 2021, publishing 11965 papers. The highest number of Forensic medicine research published in the year 2013 (NP=1181; TC=11351), a highly performed source is the Journal of Forensic And Legal Medicine,921 papers were produced. The Turkish Ministry of Justice is the most productive institution, with 155 (1.29%) papers. Byard, R.W. is the most prolific author with a total publication of 96 (TC=1150; h-index=17).Additionally, the current medical school system needs to be improved; it should promote research culture. A defined career structure in the field and effective incentives are necessary for those participating in research. Government initiatives should focus on providing academics and health professionals with access to modern biotechnology and information technology tools that are now unavailable to the majority of researchers. Forensic medicine research is woefully underfunded and needs strategic planning, financial support, and resource support.

CONFLICT OF INTEREST

This is non-funded original research, and there is not conflict of interest amongst the authors

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