Forensic Medicine Research Output: A Bibliometric Analysis

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Abstract – **This article focuses on the research output and growth of research on Forensic Medicine literature during 1981-2011. The data have been downloaded from the online published database of MEDLINE bibliographic format. The findings conclude that collaborative performance of authors compete single author contribution and the United States contribution is higher when compared to other countries contribution. The maximum outputs are articles published in journals.**

Keywords: **Bibliometrics, Forensic Medicine, Legal Medicine, Legal Pathology, Medical Jurisprudence**

I. Introduction

Forensic medicine is the science that deals with the application of medical knowledge to legal questions. It is the branch of medicine that interprets and establishes the medical facts in civil or criminal law cases. The use of medical testimony in law cases predates by more than 1,000 years the first systematic presentation of the subject by the Italian Fortunatus Fidelis in 1598. Forensic medicine was recognized as a specialty early in the 19th century. Also called legal medicine or medical jurisprudence, it applies medical knowledge to criminal and civil law. Areas of medicine that are commonly involved in forensic medicine are anatomy, pathology, and psychiatry.

Medical jurisprudence or forensic medicine, the application of medical science to legal problems. It is typically involved in cases concerning blood relationship, mental illness, injury, or death resulting from violence. Autopsy (see post-mortem examination) is often used to determine the cause of death, particularly in cases where foul play is suspected. Post-mortem examination can determine not only the immediate agent of death (e.g. gunshot wound, poison), but may also yield important contextual information, such as how long the person has been dead, which can help trace the killing. Forensic medicine has also become increasingly important in cases involving rape. Modern techniques use such specimens as semen, blood, and hair samples of the criminal found in the victim's bodies, which can be compared to the defendant's genetic makeup through a technique known as DNA fingerprinting; this technique may also be used to identify the body of a victim. The establishment of serious mental illness by a licensed psychologist can be used in demonstrating incompetency to stand trial, a technique which may be used in the insanity defense (see insanity), albeit infrequently. The synonym of forensic medicine is forensic pathology.

Forensic pathology is the legal branch of pathology concerned with determining cause of death (such as bullet wound to head, exsanguiation, strangulation, etc.) and manner of death (including murder, accident, natural, or suicide). Examination of some wounds and injuries due to crime or negligence. Examination of tissue specimens that may be relevant to rape, or other crimes. Forensic pathologists work closely with the coroner (England and Wales) or medical examiner (United States). The examination of dead bodies (autopsy or post mortem) is a subset of anatomical pathology. Often times, a coroner or medical examiner has a background in pathology.

Forensic medicine is often used in civil cases. The cause of death or injury is considered in settling insurance claims or medical malpractice suits, and blood tests often contribute to a court's decision in cases attempting to determine the paternity of a child.

II. Review of Literature

According to Burkhard Madea, Pekka Saukko and Frank Mubhoff [1] the research output of forensic medicine has sometimes been regarded as insufficient and as of poor quality, especially when parameters as impact factors and external funding were taken into account. However, forensic medicine has different tasks compared to clinical medicine. The main difference between basic subjects, clinical and forensic medicine is not a lack of scientific efficiency in forensic medicine but is a result of the questions asked, the available methods and specific aims. In contrast to natural-scientific research, forensic science has furthermore important intersections with arts and socio-scientific disciplines.

Etiologic and pathogenetic research is of only limited relevance in forensic medicine. Thus, forensic medicine is excluded from these research fields, which are mainly supported by external funding. In forensic medicine research mainly means applied research regarding findings, the probative value and reconstruction as well as examination at different points of intersection between medicine and law.

Clinical types of research such as controlled randomised, prospective cross-sectional, cohort or case–control studies can only rarely be applied in forensic medicine due to the area specific research fields (e.g. thantatology, violent death, vitality, traffic medicine, analytical toxicology, hemogenetics and stain analysis). The types of studies which are successfully established in forensic medicine are comparison of methods, sensitivity studies, validation of methods, kinetic examinations etc. Tasks of research in forensic medicine and study types, which may be applied will be addressed.

Nolte KB [2] made an attempt to characterize research efforts in forensic pathology. A questionnaire was sent to a representative of each of the 14 academic medical centers that employ full-time faculty forensic pathologists. Responses were received from all 14 (100%) of the institutions queried, representing a total of 39 forensic pathology faculty positions; 21 positions were tenure track and 18 positions were clinical or other tracks. Of the 39 positions, 25 positions (64%) at 10 institutions required some degree of research or scholarly output. Of the 25 forensic pathologists with a research imperative, only 3 (12%) were principal investigators or co-investigators on funded forensic pathology-based projects. The major limitation cited by respondents on the performance of forensic pathology research was the lack of protected time from service responsibilities. Fellowship training in forensic pathology was available at 6 of the 14 respondent institutions. Of these institutions, 4 (67%) had a research requirement for trainees, and 4 (67%) provided research training. In conclusion, very few US medical schools currently employ full-time faculty forensic pathologists. Of these, only a small number of institutions prioritize research by these faculty members. Scant federal funds are available to support research in forensic pathology. Few forensic pathology fellowship programs provide research training. To achieve a robust research agenda in forensic pathology that is sufficient to support the needs of the criminal justice and public health systems will require a paradigm shift in the medicolegal death investigative system and investment by federal agencies.

III. Methods

The number of published articles was considered as an index of quantity of research productivity. For the purposes of the study data was downloaded from Pubmed database using the key word "Forensic medicine" or "Legal medicine" or "Legal Pathology" or "Medical Jurisprudence" limiting the publications for the period from 1981 to 2011. The downloaded data was analysed to compute the growth rate of research in forensic medicine in three decades, authorship pattern and country of publication. The entire data is grouped into three blocks according to decades namely 1981-1990, 1991-2000 and 2001-2011.

IV. Analysis and Results

The research productivity in the field of forensic medicine shows a growing trend in the first decade from 1981 to 1990 except the years 1985 and 1986 where there is a slight decline and the average growth rate is 0.08. Similarly in the second and third blocks the average growth rate works out to 0.07 and 0.02 respectively (Table I). This indicated that much importance is not given to forensic medical research as predicted by Burkhard Madea, Pekka Saukko and Frank Mubhoff (2007).

Table I Growth of Literature in Forensic Medicine

Year	Count	Growth
1981	320	
1982	387	0.21
1983	408	0.05
1984	501	0.23
1985	395	-0.21
1986	387	-0.02
1987	407	0.05
1988	520	0.28
1989	580	0.12
1990	598	0.03
	4503	0.08

Year	Count	Growth
1991	589	
1992	647	0.10
1993	688	0.06
1994	618	-0.10
1995	667	0.08
1996	725	0.09
1997	855	0.18
1998	961	0.12
1999	961	0.00
2000	1027	0.07
	7738	0.07

Year	Count	Growth
2001	1147	
2002	1129	-0.02
2003	1309	0.16
2004	1257	-0.04
2005	1290	0.03
2006	1267	-0.02
2007	1286	0.01
2008	1195	-0.07
2009	1386	0.16
2010	1279	-0.08
2011	1349	0.05
	13894	0.02

The authorship pattern ranges from single authored publications to a maximum of more than 30 authors. Of the total publication count, nearly one fifty are results of solo research. When the number of authors increases above one there is gradual decrease in the number of papers. Many studies have proved that most of the scientific research is more collaborative in nature (Umut Al and Zehra Taşkın) [3]. The collaboration index also has increased from 1.14 in the year 1981 to 3.30 in the year 2011. Forensic medicine, though it sounds like a scientific discipline, it is an amalgamation of social science discipline-law on the scientific discipline-medicine. In spite of this fact, the analysis shows that the collaborative index has a growing trend in Forensic medicine and the team size increases from 1.14 to 3.3. (Table II)

Table II Authorship Pattern

Year	Coun	NOA	NOP	Coll In
1981	320	488	366	1.14
1982	387	677	543	1.40
1983	408	739	616	1.51
1984	501	818	670	1.34
1985	395	726	580	1.47
1986	387	651	510	1.32
1987	407	779	644	1.58
1988	520	1031	910	1.75
1989	580	1161	994	1.71
1990	598	1219	1097	1.83
	4503			1.51

Year	Coun	NOA	NOP	Coll In
1991	589	1316	1175	1.99
1992	647	1407	1264	1.95
1993	688	1540	1374	2.00
1994	618	1358	1235	2.00
1995	667	1475	1337	2.00
1996	725	1729	1592	2.20
1997	855	1978	1834	2.15
1998	961	2327	2176	2.26
1999	961	2379	2241	2.33
2000	1027	2683	2554	2.49
	7738			2.14

Year	Count	NOA	NOP	Coll In
2001	1147	3050	2907	2.53
2002	1129	2996	2853	2.53
2003	1309	3564	3422	2.61
2004	1257	3500	3372	2.68
2005	1290	3644	3503	2.72
2006	1267	3888	3768	2.97
2007	1286	3827	3738	2.91
2008	1195	3685	3597	3.01
2009	1386	4185	4078	2.94
2010	1279	4222	4127	3.23
2011	1349	4538	4453	3.30
	13894			2.86

NOA – No. of Authors;
NOP – No. of Papers

Research productivity in Forensic medicine is published in journals from various countries of the world among which USA ranks first forming 28.35% of the world output. China is in the 5th place while India is in the 26th Place. This evidences that the Indian scholars do not concentrate more on forensic medicine.

Table III Country-Wise Publications

Country	Count	Percent
United States	7410	28.35
Ireland	3219	12.32
England	3085	11.80
Germany	2013	7.70
China	1406	5.38
Japan	1168	4.47
Netherlands	874	3.34
Switzerland	761	2.91
Russia	571	2.18
USSR	538	2.06
Germany, West	512	1.96
Poland	446	1.71
Scotland	330	1.26
Austria	287	1.10
Italy	260	0.99
France	259	0.99
Denmark	248	0.95
Russia (Federation)	234	0.90
Australia	226	0.86
Belgium	183	0.70
South Africa	152	0.58
Czech Republic	142	0.54
Norway	126	0.48
Spain	121	0.46
NA	116	0.44
India	104	0.40
Sweden	101	0.39
Croatia	96	0.37
Brazil	96	0.37
Czechoslovakia	92	0.35
Hungary	92	0.35
Singapore	73	0.28
Canada	70	0.27
Germany, East	66	0.25
Yugoslavia	55	0.21
Turkey	44	0.17

Thailand	34	0.13
Malaysia	28	0.11
Greece	26	0.10
Finland	26	0.10
Israel	26	0.10
Romania	26	0.10
Saudi Arabia	26	0.10
Pakistan	26	0.10
New Zealand	26	0.10
Unknown	23	0.09
Serbia	18	0.07
Korea (South)	18	0.07
Nigeria	17	0.07
Chile	16	0.06
Bulgaria	15	0.06
Sri Lanka	14	0.05
Iran	13	0.05
Serbia and Montenegro	12	0.05
Slovakia	12	0.05
Kenya	12	0.05
Mexico	11	0.04
Bangladesh	11	0.04
United Arab Emirates	11	0.04
Portugal	10	0.04
Argentina	10	0.04
Nepal	9	0.03
Uganda	9	0.03
Egypt	9	0.03
Senegal	8	0.03
Tunisia	7	0.03
Macedonia	5	0.02
Bosnia and Hercegovina	5	0.02
Taiwan	4	0.02
Zimbabwe	4	0.02
Northern Ireland	3	0.01
Ukraine	3	0.01
China (Republic : 1949-)	3	0.01
Venezuela	3	0.01
Jamaica	3	0.01
Costa Rica	2	0.01
Georgia (Republic)	2	0.01
Lithuania	2	0.01
Puerto Rico	2	0.01
Cuba	1	0.00
Estonia	1	0.00
Ethiopia	1	0.00
Iceland	1	0.00
Korea	1	0.00
Morocco	1	0.00
Oman	1	0.00
Papua New Guinea	1	0.00
Lebanon	1	0.00
	26135	100

In the present study 2794 journals have contributed 26135 research papers. The Journals are arranged according to the publication count and they are divided into three zones each containing almost equal number of publications. The application of Bradford's law of scattering shows that the three zones are in the ratio 5:68:2721: :1:13.6:545 disproving Bradford's law.

In the very early 1900's, an Italian economist by the name of Vilfredo Pareto [4] created a mathematical formula describing the unequal distribution of wealth he observed and measured in his country: Pareto observed that roughly twenty percent of the people controlled or owned eighty percent of the wealth. In the late 1940s, Dr. Joseph M. Juran, a Quality Management pioneer, attributed the 80/20 Rule to Pareto, calling it Pareto's Principle. Applying this principle to the productivity of research articles in journals, it is found that, of the total of 2794 journals, 352 (12.78%) journals have contributed to 80% of the total output and thus deviating Paretos principle.

Table IV Bradford's Law

Zone	No. of Journals
Zone 1	5
Zone 2	68
Zone 3	2721

V. Conclusion

Forensic medicine is a discipline which is an application of legal practices to medical field. Hence it is a lamination of social science on science. Bibliometrics is a emerging subject in the field of information science that measures the growth or decline of a subject. Many bibliometric studies have proved that any subject that has a tremendous growth will naturally have its decline and at the time of declination a new branch will emerge. In the present study, though there is increase in the quantum of publications in the field of forensic medicine, the growth trend is very minimal. The reason may be due to the fact that this field is not purely scientific but an amalgamation of social science discipline on science.

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