Growth of Worldwide Healthcare Literature: A Scientometric Study

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Abstract:

The present paper is an attempt to map world literature on healthcare. It also describes the application of growth models as suggested by Egghe and Ravichandra Rao (Scientometrics 25:5-46, 1992). The scope of the paper is limited to study the growth and dynamics of worldwide literature of healthcare domain for the period of 1918-2013.

Keywords: *Healthcare, Scientometrics, Growth model, Health Sciences*

Introduction:

Healthcare domain has been a significant area ever since the birth of mankind. Developments in science and technology in general and healthcare field in specific have resulted in major developments due to variety of new health related solutions and techniques developed across the world in the Healthcare area. Healthcare as a field is contentiously witnessing the technological advancements in every aspect. As a result, healthcare has become a major interdisciplinary



subject in science & technology. Todays's healthcare domain involves understanding and applications of not only the medicinebut also various other fields like engineering, computer science, psychology, pharmacology, physiology.

This paper is an attempt to identify, analyze and report out growth of Healthcare Literature in the world.

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Methodology:

Scopus database is used as a source for the literature for this study. The Scopus database website (http://www.scopus.com) claims it to be world's largest abstracting and citation database of peer-reviewed literature: scientific journals, books and conference proceedings. Scopus covers 100% of MEDLINE.

A broad search has been conducted and retrieved d all the data from the Scopus database related healthcare. Search query used for the data retrieval is given below:

The present study aims to explore the efficiency of the freely available Input Method Editors (IMEs) for Urdu, which uses a Perso-Arabic script. Unlike other Indic languages, the Perso-Arabic scripts are rendered the right to left. As a matter of fact, Sindhi and Kashmiri also belong to the same category of language as that of Urdu as far as its script rendering is considered. Four IMEs were considered for testing purposes in this study.

((ALL(healthcare)) AND (healthcare) AND (EXCLUDE(PUBYEAR,2015) OR EXCLUDE(PUBYEAR,2014)) AND (EXCLUDE(DOCTYPE,"no") OR EXCLUDE(DOCTYPE,"ed") OR EXCLUDE(DOCTYPE,"le") OR EXCLUDE(DOCTYPE,"ch") OR EXCLUDE(DOCTYPE,"sh") OR EXCLUDE(DOCTYPE,"bk") OR EXCLUDE(DOCTYPE,"er")) AND (EXCLUDE(SUBJAREA,"Undefined")) AND (LIMIT-TO(DOCTYPE,"ar") OR LIMIT-TO(DOCTYPE,"re") OR LIMIT-TO(DOCTYPE,"cp")) AND (LIMIT-TO(SRCTYPE,"j") OR LIMIT-TO(SRCTYPE,"p")))

i. Excluded literature published in the years 2015 (found some articles) and 2014 as we need wait to get complete annual data

ii. Excluded the literature groped in 'un-defined' subject (found 22861 articles as on October 22nd, 2014) for the keyword Healthcare in Scopus database from inception to the year 2013)

iii. Document Type: considered only articles, reviews and conference papers and

excluded other document types such as article in press, conference review, report, business article, and undefined.

iv. Source Type: Included only Journals and conference proceedings.

Results and Discussion:

Relative Growth Rate and doubling time

Relative Growth Rate: is the growth rate relative to the size of population.It is also called as the exponential growth rate or continuous growth rate with reference to scientific literature publication time.

— P P

$$R(P) = \frac{Loge2 \quad Loge1}{T2 \quad T1}$$

Doubling Time (Dt): The doubling time is the given period required for quantity to double in size or value. This can be calculated by using the formula.

$$Dt(P) = \frac{Loge2}{R(P)} = \frac{0.693}{R(P)}$$

Here, Dt (P) = average doubling time of publications

YEAR	Total Articles	% of Articles	Cumulative articles	LN(p)	R(p)	Mean R(p)	Dt(p)	Mean dt(p)
1920	54	0.0095	98	4.5850	0.013545		0.51162	
1921	140	0.0246	238	5.4723	0.005415		1.27988	
1922	90	0.0158	328	5.7930	0.005434		1.27539	
1923	111	0.0195	439	6.0845	0.004192	0.005013	1.65316	1.402809
1924	125	0.0219	564	6.3351	0.003432		2.01911	
1925	184	0.0323	748	6.6174	0.002487		2.78689	
1926	247	0.0433	995	6.9027	0.001863	0.002594	3.72026	2.842085
1927	188	0.0330	1183	7.0758	0.001849		3.74876	
1928	154	0.0270	1337	7.1982	0.001827		3.79330	
1929	117	0.0205	1454	7.2821	0.001885	0.001853	3.67690	3.739652
1930	187	0.0328	1641	7.4031	0.001494		4.63925	
1931	182	0.0319	1823	7.5082	0.001404		4.93532	
1932	156	0.0274	1979	7.5903	0.001394	0.001431	4.97281	4.849128
1933	223	0.0391	2202	7.6971	0.001157		5.98898	
1934	301	0.0528	2503	7.8252	0.000962		7.20438	
1935	290	0.0509	2793	7.9349	0.000905	0.001008	7.65822	6.950528
1936	239	0.0419	3032	8.0170	0.000910		7.61873	
1937	258	0.0453	3290	8.0986	0.000840		8.25388	
1938	303	0.0532	3593	8.1867	0.000752	0.000834	9.21941	8.364007
1939	318	0.0558	3911	8.2715	0.000698		9.92210	
1940	189	0.0332	4100	8.3187	0.000787		8.80834	
1941	261	0.0458	4361	8.3805	0.000687	0.000724	10.09007	9.606840

Table-1- World Output, Relative Growth Rate (RGR) and Doubling Time (Dt) of Articles in Healthcare (11 subfields) from 1918-2013

YEAR	Total Articles	% of Articles	Cumulative articles	LN(p)	R(p)	Mean R(p)	Dt(p)	Mean dt(p)
1942	185	0.0325	4546	8.4220	0.000734		9.43943	
1943	260	0.0456	4806	8.4776	0.000642		10.80029	
1944	309	0.0542	5115	8.5399	0.000584	0.000653	11.86691	10.702212
1945	181	0.0318	5296	8.5747	0.000660		10.49904	
1946	256	0.0449	5552	8.6219	0.000581		11.92864	
1947	298	0.0523	5850	8.6742	0.000536	0.000592	12.92376	11.783811
1948	532	0.0933	6382	8.7612	0.000425		16.31675	
1949	491	0.0861	6873	8.8354	0.000413		16.75966	
1950	547	0.0960	7420	8.9119	0.000379	0.000406	18.26660	17.114337
1951	617	0.1082	8037	8.9918	0.000346		20.03185	
1952	700	0.1228	8737	9.0753	0.000314		22.06461	
1953	633	0.1110	9370	9.1453	0.000308	0.000323	22.46826	21.521572
1954	782	0.1372	10152	9.2254	0.000274		25.32955	
1955	588	0.1032	10740	9.2817	0.000286		24.21800	
1956	627	0.1100	11367	9.3385	0.000270	0.000277	25.68684	25.078126
1957	694	0.1217	12061	9.3977	0.000251		27.58884	
1958	756	0.1326	12817	9.4585	0.000235		29.52946	
1959	773	0.1356	13590	9.5171	0.000224	0.000237	30.98280	29.367031
1960	807	0.1416	14397	9.5748	0.000212		32.68447	
1961	861	0.1510	15258	9.6329	0.000200		34.70587	
1962	990	0.1737	16248	9.6957	0.000183	0.000198	37.79027	35.060202
1963	944	0.1656	17192	9.7522	0.000179		38.79938	
1964	963	0.1689	18155	9.8067	0.000171		40.57026	
1965	954	0.1674	19109	9.8579	0.000165	0.000172	41.97651	40.448717
1966	977	0.1714	20086	9.9078	0.000158		43.80172	
1967	1237	0.2170	21323	9.9675	0.000142		48.89049	
1968	1403	0.2461	22726	10.0313	0.000131	0.000144	53.06063	48.584281
1969	1303	0.2286	24029	10.0870	0.000128		54.03541	
1970	1314	0.2305	25343	10.1403	0.000123		56.26798	
1971	1533	0.2689	26876	10.1990	0.000113	0.000121	61.32212	57.208505
1972	1809	0.3173	28685	10.2641	0.000103		67.39422	
1973	1738	0.3049	30423	10.3230	0.000100		69.44613	
1974	1791	0.3142	32214	10.3802	0.000095	0.000099	72.96145	69.933937
1975	1996	0.3502	34210	10.4403	0.000088		78.56872	
1976	2118	0.3716	36328	10.5003	0.000083		83.41505	
1977	2372	0.4161	38700	10.5636	0.000077	0.000083	90.16600	84.049923
1978	2794	0.4901	41494	10.6333	0.000070		99.40088	
1979	3070	0.5386	44564	10.7047	0.000064		107.48661	
1980	3253	0.5707	47817	10.7751	0.000060	0.000065	114.89996	107.262484
1981	3549	0.6226	51366	10.8467	0.000056		124.00198	
1982	3750	0.6579	55116	10.9172	0.000052		132.44353	
1983	4367	0.7661	59483	10.9934	0.000047	0.000052	146.25203	134.232512
1984	4930	0.8649	64413	11.0731	0.000043		160.39726	
1985	5490	0.9631	69903	11.1549	0.000039		175.45222	
1986	5899	1.0348	75802	11.2359	0.000037	0.000040	189.72305	175.190843
1987	6659	1.1682	82461	11.3201	0.000033		208.75736	

Table-1- World Output, Relative Growth Rate (RGR) and Doubling Time (Dt) of Articles in Healthcare (11 subfields) from 1918-2013

YEAR	Total Articles	% of Articles	Cumulative articles	LN(p)	R(p)	Mean R(p)	Dt(p)	Mean dt(p)
1988	7356	1.2904	89817	11.4055	0.000030		228.37563	
1989	8051	1.4124	97868	11.4914	0.000028	0.000030	249.18969	228.774224
1990	7994	1.4024	105862	11.5699	0.000026		262.52744	
1991	9325	1.6359	115187	11.6543	0.000024		291.83179	
1992	9522	1.6704	124709	11.7337	0.000022	0.000024	310.31438	288.224537
1993	10712	1.8792	135421	11.8161	0.000020		340.64850	
1994	11207	1.9660	146628	11.8957	0.000019		364.96930	
1995	11579	2.0313	158207	11.9717	0.000018	0.000019	388.62114	364.746314
1996	2954	0.5182	161161	11.9902	0.000025		274.14546	
1997	3867	0.6784	165028	12.0139	0.000023		297.53702	
1998	4598	0.8066	169626	12.0414	0.000022	0.000023	316.97674	296.219744
1999	5450	0.9561	175076	12.0730	0.000020		338.80177	
2000	6322	1.1091	181398	12.1084	0.000019		361.45378	
2001	7592	1.3318	188990	12.1494	0.000018	0.000019	391.05597	363.770507
2002	8887	1.5590	197877	12.1954	0.000016		422.06801	
2003	10542	1.8494	208419	12.2473	0.000015		459.51857	
2004	13260	2.3262	221679	12.3090	0.000014	0.000015	512.81901	464.801864
2005	16826	2.9517	238505	12.3821	0.000012		579.39120	
2006	22588	3.9626	261093	12.4726	0.000010		675.32915	
2007	28139	4.9364	289232	12.5750	0.000009	0.000010	776.53137	677.083908
2008	33338	5.8484	322570	12.6841	0.000008		883.13275	
2009	35380	6.2066	357950	12.7881	0.000007		965.93426	
2010	41756	7.3252	399706	12.8985	0.000006	0.000007	1098.14898	982.405330
2011	49715	8.7214	449421	13.0157	0.000006		1258.12837	
2012	56734	9.9527	506155	13.1346	0.000005		1423.13515	
2013	63881	11.2065	570036	13.2535	0.000004	0.000005	1602.63634	1427.966615
1918 to 2013	**570036**							

The Table 1 indicates the world Healthcare output i.e. 570036 articles. The average relative growth rate of articles of worldwide distribution has come down from 0.013545 to 0.000004 over a period of ninety three years. The mean relative growth for the first three years block period (1920 to 1923) exhibits a growth of 0.005013. Similarly for the last block of three years (2011 to 2013) the growth is 0.000005.

At the same time, doubling time of publication of articles increased gradually from 0.51162% to 1602.63634% over a period of ninety three years. The mean Doubling time of the first block period is 1.402809 whereas it has increased to 1427.966615 in the final block period (2011-2013.

Year	Articles	% of Articles	Cumulative articles	LN(p)	R(p)	Mean R(p)	Dt(p)	Mean dt(p)
1937	1	0.0106	1	0.0000				
1939	1	0.0106	2	0.6931	0.693147		0.01000	
1946	2	0.0212	4	1.3863	0.346574		0.02000	
1947	1	0.0106	5	1.6094	0.402359	0.480693	0.01722	0.015739
1948	2	0.0212	7	1.9459	0.250553		0.02766	
1949	2	0.0212	9	2.1972	0.214868		0.03225	
1950	2	0.0212	11	2.3979	0.189416	0.218279	0.03659	0.032166
1951	3	0.0317	14	2.6391	0.140040		0.04949	
1952	2	0.0212	16	2.7726	0.148532		0.04666	
1953	4	0.0423	20	2.9957	0.100590	0.129721	0.06889	0.055012
1954	2	0.0212	22	3.0910	0.119895		0.05780	
1955	3	0.0317	25	3.2189	0.096376		0.07191	
1956	4	0.0423	29	3.3673	0.079240	0.098503	0.08746	0.072388
1957	5	0.0529	34	3.5264	0.066101		0.10484	
1958	1	0.0106	35	3.5553	0.104569		0.06627	
1959	3	0.0317	38	3.6376	0.072542	0.081071	0.09553	0.088881
1960	5	0.0529	43	3.7612	0.056625		0.12238	
1961	1	0.0106	44	3.7842	0.088004		0.07875	
1962	13	0.1375	57	4.0431	0.033593	0.059408	0.20629	0.135807
1963	14	0.1481	71	4.2627	0.028485		0.24329	
1964	11	0.1163	82	4.4067	0.028293		0.24493	
1965	8	0.0846	90	4.4998	0.029517	0.028765	0.23478	0.241002
1966	7	0.0740	97	4.5747	0.029209		0.23726	
1967	20	0.2115	117	4.7622	0.018211		0.38054	
1968	25	0.2644	142	4.9558	0.014846	0.020755	0.46680	0.361534
1969	25	0.2644	167	5.1180	0.013374		0.51817	
1970	26	0.2750	193	5.2627	0.012004		0.57733	
1971	23	0.2433	216	5.3753	0.011605	0.012328	0.59715	0.564216
1972	17	0.1798	233	5.4510	0.012120		0.57180	
1973	21	0.2221	254	5.5373	0.010699		0.64774	
1974	18	0.1904	272	5.6058	0.010691	0.011170	0.64823	0.622590
1975	33	0.3490	305	5.7203	0.008176		0.84763	
1976	26	0.2750	331	5.8021	0.008341		0.83083	
1977	49	0.5182	380	5.9402	0.006188	0.007568	1.11984	0.932767
1978	39	0.4125	419	6.0379	0.006248		1.10912	
1979	36	0.3808	455	6.1203	0.006054		1.14463	
1980	43	0.4548	498	6.2106	0.005383	0.005895	1.28732	1.180356
1981	51	0.5394	549	6.3081	0.004772		1.45233	
1982	58	0.6134	607	6.4085	0.004277		1.62029	
1983	48	0.5077	655	6.4846	0.004305	0.004451	1.60957	1.560730
1984	53	0.5605	708	6.5624	0.003957		1.75111	
1985	52	0.5500	760	6.6333	0.003788		1.82935	
1986	49	0.5182	809	6.6958	0.003689	0.003812	1.87833	1.819596
1987	60	0.6346	869	6.7673	0.003304		2.09741	
1988	88	0.9307	957	6.8638	0.002746		2.52347	
1989	100	1.0576	1057	6.9632	0.002464	0.002838	2.81253	2.477803

Table-2- Indian Output, Relative Growth Rate (RGR) and Doubling Time (Dt) of Articles in Healthcare (11 subfields)

Year	Articles	% of Articles	Cumulative articles	LN(p)	R(p)	Mean R(p)	Dt(p)	Mean dt(p)
1990	103	1.0894	1160	7.0562	0.002291		3.02506	
1991	125	1.3221	1285	7.1585	0.002009		3.44983	
1992	128	1.3538	1413	7.2535	0.001869	0.002056	3.70821	3.394367
1993	147	1.5547	1560	7.3524	0.001672		4.14566	
1994	156	1.6499	1716	7.4478	0.001537		4.50845	
1995	119	1.2586	1835	7.5148	0.001594	0.001601	4.34696	4.333693
1996	5	0.0529	1840	7.5175	0.003220		2.15240	
1997	10	0.1058	1850	7.5229	0.002837		2.44259	
1998	10	0.1058	1860	7.5283	0.002825	0.002961	2.45333	2.349441
1999	19	0.2010	1879	7.5385	0.002470		2.80576	
2000	19	0.2010	1898	7.5486	0.002450		2.82822	
2001	32	0.3384	1930	7.5653	0.002160	0.002360	3.20844	2.947474
2002	41	0.4336	1971	7.5863	0.002007		3.45362	
2003	74	0.7827	2045	7.6232	0.001684		4.11530	
2004	81	0.8567	2126	7.6620	0.001598	0.001763	4.33715	3.968687
2005	120	1.2692	2246	7.7169	0.001378		5.02939	
2006	234	2.4749	2480	7.8160	0.001051		6.59331	
2007	458	4.8440	2938	7.9855	0.000749	0.001059	9.24688	6.956530
2008	454	4.8017	3392	8.1292	0.000685		10.12409	
2009	518	5.4786	3910	8.2713	0.000596		11.62933	
2010	872	9.2226	4782	8.4726	0.000435	0.000572	15.92191	12.558443
2011	1238	13.0936	6020	8.7028	0.000331		20.95313	
2012	1575	16.6579	7595	8.9352	0.000261		26.51772	
2013	1860	19.6721	9455	9.1543	0.000214	0.000269	32.37049	26.613778
1937-2013	**9455**							

The Table 2 shows the Indian contribution in the field of healthcare i.e. 9455, the average Relative Growth rate of articles of Indian distribution has come down from 0.693147 to 0.000214 over a period of seventy eight years. The mean relative growth for the first block period (1937 to 1947) exhibits a growth of 0.480693. Similarly for the final block of three years (2011-2013) the growth is 0.000269.

The doubling time of publication of articles increased gradually from 0.01000 to 32.37049 over a period of seventy eight years. The mean doubling time of the first block period is 0.015739, whereas it has increased to 26.613778 in the final block period. It is similar to that of world literature.

The comparative study of world output(570036) as against Indian output (9455)shows that the Indian output is just 1.658% only.

Application of Growth Models

The various growth models are applied to assess the growth of literature in the 11 main subdisciplines of Healthcare domain. The study reveals that, exponential curve fitting is common for data analysis in the field of Healthcare

A broad search has been conducted and retrieved d all the data from the Scopus database related healthcare. Search query used for the data retrieval is given below:

The present study aims to explore the efficiency of the freely available Input Method Editors (IMEs) for Urdu, which uses a Perso-Arabic script. Unlike other Indic languages, the Perso-Arabic scripts are rendered the rig

Table-3 Application of Fit Statistics derived from application of various models to Cumulative Growth of Publications in disciplines of Healthcare

Subjects	Best Results Obtained in World Literature	
	Name of Model	R^2
Medicine	Exponential	0.9377
Biochemistry, Genetics and Molecular Biology	Exponential	0.8508
Nursing	Exponential	0.879
Health Professions	Exponential	0.8723
Social Sciences	Exponential	0.9544
Pharmacology, Toxicology and Pharmaceutics	Exponential	0.777
Engineering	Exponential	0.8192
Computer Science	Exponential	0.9786
Immunology and Microbiology	Exponential	0.9292
Neuroscience	Exponential	0.6931
Psychology	Exponential	0.9292

Findings and conclusion

The significant findings of the present study in the field of Healthcare are summarized below:

1. The World Healthcare output i.e570036, and the Indian output is 9455 during 1918-2013.
2. The mean relative growth rate shows a decreasing trend from 0.005013 to 0.000005.in the world literature and 0.480693.to 0.000269. in Indian literature.
3. The doubling time has increased from 1.40 to 1427.96 in the world literature and from 0.010to 32.370 in Indian literature. It is similar with the world literature.

.The study conducted on mapping of Healthcare literature has provided valuable results and are very much useful in understanding the relative position of different subfields of Healthcare. There is a need for collaborative research at individual and institutional level. Findings of the study are useful to the policy makers, healthcare professionals and Health Science Institutes.

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