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RESEARCH ARTICLE

Mapping of patient safety and service quality: Bibliometric analysis by using R package

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ABSTRACT

The current study aims at exploring the themes – patient safety and service quality from 2005 to 2021. It intends to identify the most prominent sources, authors, affiliations, countries, documents, words and trend topics. Total 566 records have been extracted from Scopus after applying inclusion and exclusion criteria, and analysed by using *biblioshiny* software of R-package. Results of bibliometric analysis reveal the increasing trend of publications in 'patient safety and service quality' research. International Journal of Environmental Research and Public Health, Franklin B.D, Imperial College London and United Kingdom are found to be the most productive and prominent among different sources, authors, affiliations and countries. Health worker, drug safety, nursing care, public hospital, qualitative analysis and controlled study are found to be the current trending topics. This study presents the deep analytics regarding patient safety and service quality and it also suggests valuable future research avenues and insights for researchers and practitioners.

Keywords: patient safety; service quality; bibliometric analysis; R studio; biblioshiny

1. Introduction

Patient safety has its roots in the document, *To Err is Human: Building a Safer Health System*, work of the Institute of Medicine (IOM)[1]. It was reported that error in healthcare delivery was the eighth leading cause of death in the United States. Further, the report estimated 98000 patients who were hospitalized died from medical mistakes and errors. It clarified that the blame was not on the shoulders of providers but the systems of bad care. The report paved the way to include patient safety in the global agenda for all WHO-member countries which was aiming at initiating the global efforts to improve patient safety. Subsequently, the same institute issued another report, named Crossing the Quality Chasm: A New Health System for the 21st Century,[2] which identified six aims for healthcare reforms and placed safety at the first mentioning that healthcare systems should be safe, and hospitals must be responsible for that.

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Patient safety is the absence of preventable harm which is the result of errors caused by different domains of healthcare services. By keeping this notion of patient safety, The World Health Organization (WHO, 2021) initiates the framework for patient safety and mentions the domains of error. These are diagnostic errors, administrative errors, medication errors and care transition errors. Similarly, wrong diagnosis, error in clinical procedures, side-effects of drugs, injuries due to falls, infections and staying at the hospital for a longer period determine the concerns of overall service quality of healthcare organization that ultimately reflect the notion of patient safety.

Considering that healthcare facilities have fatalities due to neglecting safety, it is considered one of the most significant aspects of any organization. Within the arena of health, the safety of patients is defined as giving them a health-care service that reduces the risks of harming them (WHO, 2017). Additionally, it can also be described as preventing patients from getting injured when they were being helped (WHO, 2017). Health service providers who adopt safety precautions boost patients' confidence, calming their fears of worsening conditions and the prospect of death[5, 6]. The level of safety net measures practiced by health service providers has an impact on the perceptions of satisfaction, utilization of services, and referrals to other providers from patients via word-of-mouth (WoM).

The bibliometric analysis is a quantitative technique to visualize and synthesize the literature of a particular piece of research work (Khudzari et al., 2018). Different bibliometric studies have been performed on different themes related to safety and service quality e.g., Safety climate[10], Patient safety from IOM reports[11], Food safety[12], Patient safety and public health[13], Safety in home care[14], Patient safety and coronavirus infection[15], Service quality in healthcare (Ali et al., 2021), electronic service quality (Ali et al., 2021), mobile healthcare (Ali et al., 2021b) and SERVQUAL & Healthcare (Ali et al., 2021). The focus of the current study is on mapping the literature of 'patient safety and service quality' and it intends to achieve following research objectives:

RO 1. To identify the publication output of 'patient safety and service quality' research till 2021.

RO 2. To identify the most prominent and relevant sources, their productivity and impact of publications related to 'patient safety and service quality' research.

RO 3. To identify the most prolific and relevant authors, their productivity and impact related to 'patient safety and service quality' research.

RO 4. To identify the most productive and relevant affiliations and countries related to 'patient safety and service quality' research.

RO 4. To identify the most frequent and relevant words and the trending topics related to 'patient safety and service quality' research

2. Materials and methods

The current study presents the bibliometrix analysis of two main themes; Patient Safety and Service Quality from 2005 to 2021. Mapping of literature regarding these two themes are based on 566 records extracted from Scopus. Scopus is the largest database and it offers comprehensive coverage of the subjects than MedLine, Web of Sciences and other databases (Abbas et al., 2022; Ali et al., 2021; Ali et al., 2021; Alsharif et al., 2021; Khudzari et al., 2018; Wan et al., 2021).

Search Strategy

Search is based on inclusion and exclusion criteria to screen the records and it started in March 2022. Two main keywords have been used; *Patient Safety and Service Quality*. Documents are limited to articles,

journals and English language only. The year 2022 has been excluded from the search. Total 566 records have been screened for analysis. Complete search strategy flowchart and search string are mentioned in **Figure 1** and Appendix-I respectively.

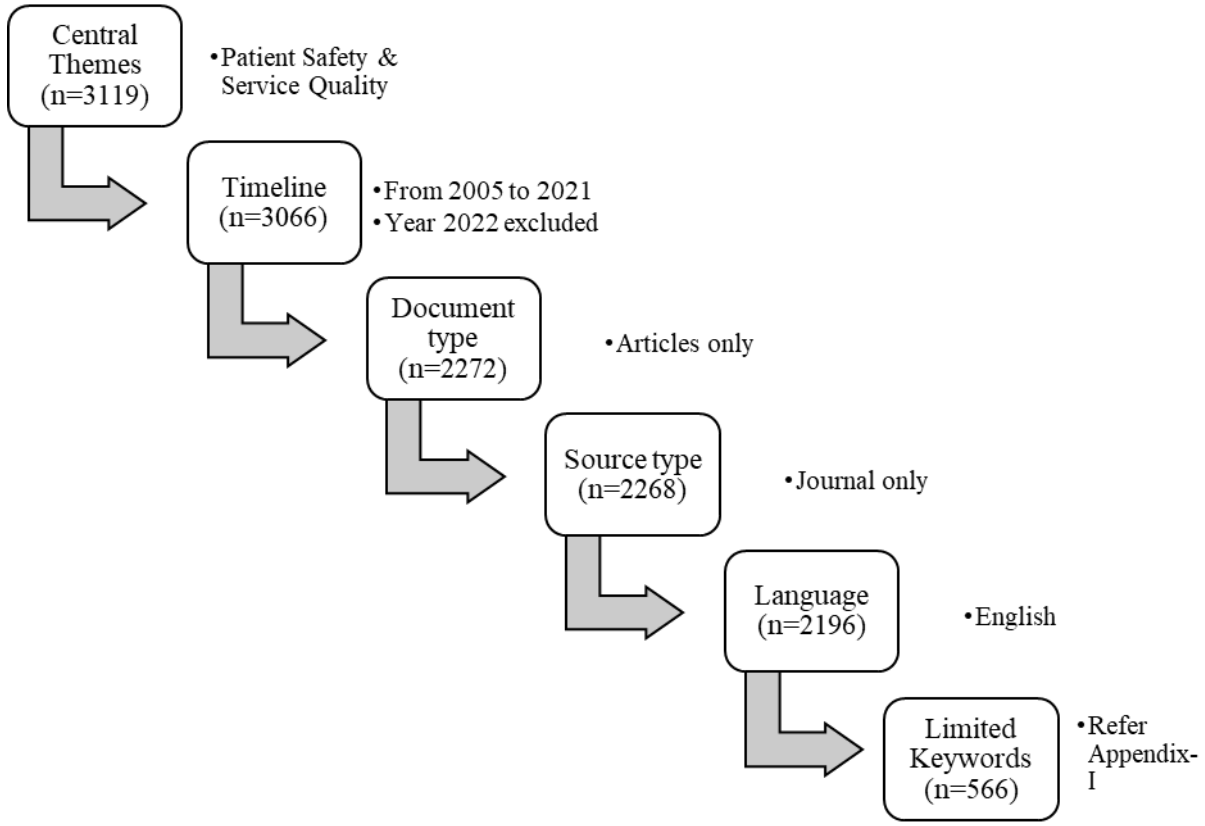

Figure 1. Search flow chart.

3. Results

To analyze the screened records *biblioshiny* software of *R-package* has been used because this software gives more options of analysis than others such as VOSviewer. The main information of the current search contains 266 documents, 1356 author's keywords, 2244 authors, 4.21 collaboration index and other facts mentioned in **Table 1**. Next sections describe the findings of the current study.

Table 1. Main information of screened records.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2005:2021
Sources (Journals, Books, etc)	307
Documents	566
Average years from publication	6.02
Average citations per documents	17.51
Average citations per year per doc	2.09
References	27189
DOCUMENT TYPES	
Article	566
DOCUMENT CONTENTS	

Table 1. (*Continued*)

Description	Results
Keywords Plus (ID)	2867
Author's Keywords (DE)	1356
AUTHORS	
Authors	2244
Author Appearances	2651
Authors of single-authored documents	40
Authors of multi-authored documents	2204
AUTHORS COLLABORATION	
Single-authored documents	43
Documents per Author	0.252
Authors per Document	3.96
Co-Authors per Documents	4.68
Collaboration Index	4.21

3.1. Annual scientific production

Annual scientific production of articles containing themes of 'patient safety and service quality' is growing rapidly throughout the years. It reflects the increasing trend of publication in the searched themes in future (**Figure 2** and **Table 2**). Data shows the increasing trend of publication from 2005 till 2013, then it reveals ups and downs in publications till 2017. There is rapid increase in the number of studies published from 2017 till date showing the increasing concern in central themes of the search.

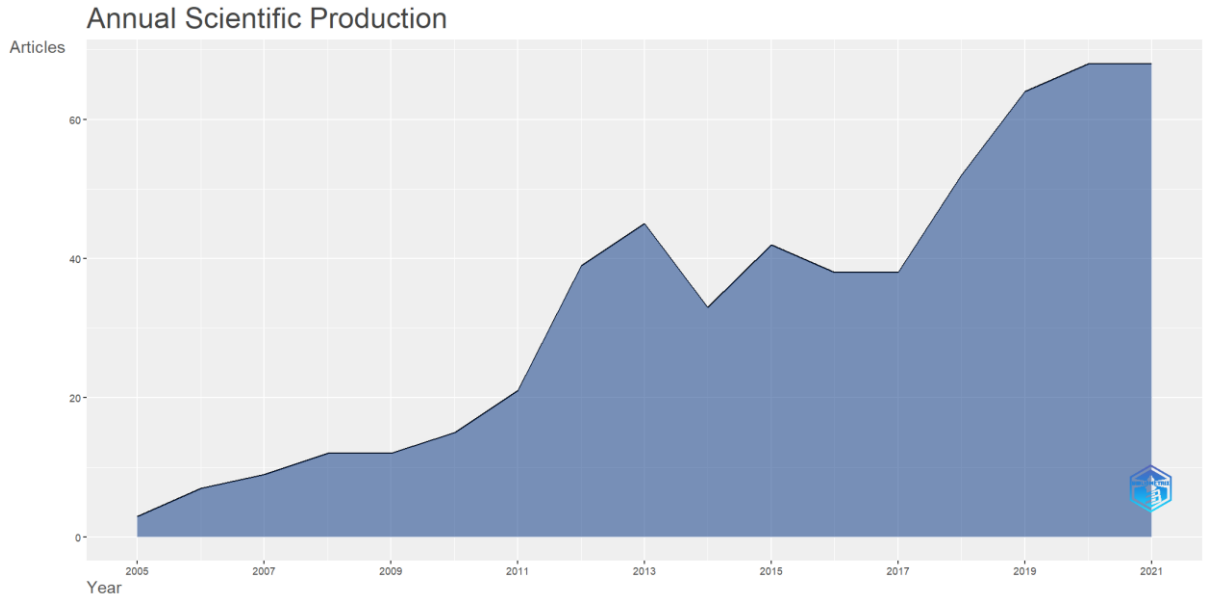

Figure 2. Annual scientific production from 2005 to 2021.

Table 2. Annual production data.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Articles	3	7	9	12	12	15	21	39	45	33	42	38	38	52	64	68	68

3.2. Article Citations per Year

Annual trend of citations has also been identified from 2005 to 2021 (**Figure 3**). Data shows that the year 2007 has received the highest number citations among all other years with mean of 129.67 total citations per article and 8.64 total citations per year, it is followed by the year 2009, 2005 and others mentioned in **Table 3**.

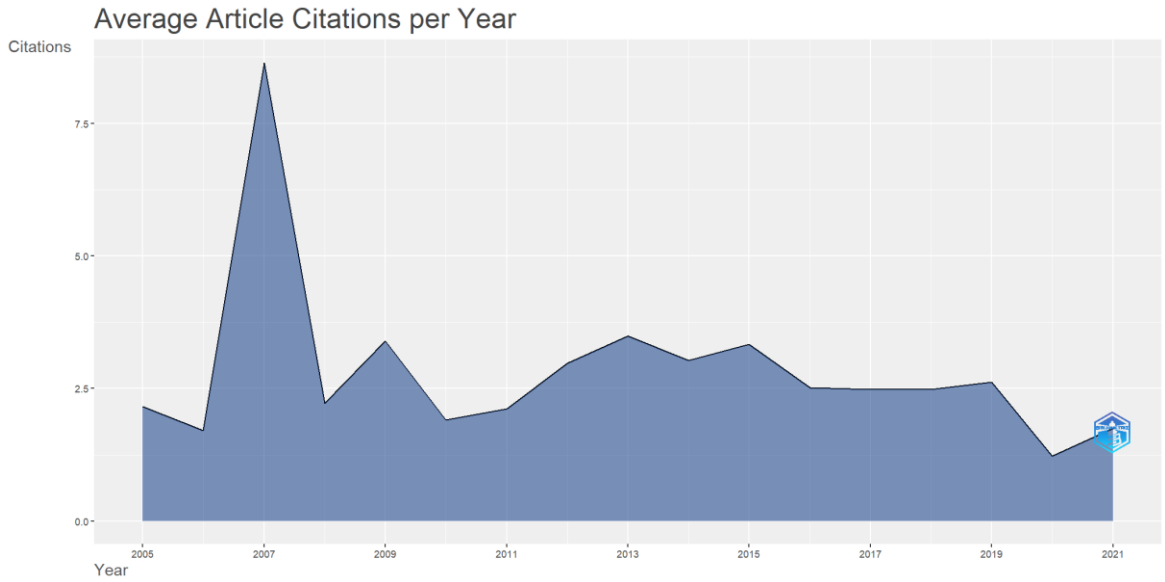

Figure 3. Average article citations per year.

Table 3. Article citations per year.

Year	N	MeanTCperArt	MeanTCperYear	CitableYears
2005	3	36.67	2.16	17
2006	7	27.29	1.71	16
2007	9	129.67	8.64	15
2008	12	31.17	2.23	14
2009	12	44.17	3.40	13
2010	15	22.87	1.91	12
2011	21	23.33	2.12	11
2012	39	29.82	2.98	10
2013	45	31.40	3.49	9
2014	33	24.27	3.03	8
2015	42	23.33	3.33	7
2016	38	15.08	2.51	6
2017	38	12.39	2.48	5
2018	52	9.92	2.48	4
2019	64	7.86	2.62	3
2020	68	2.44	1.22	2
2021	68	1.75	1.75	1

3.3. Prominent sources

This section contains the identifications of the most relevant sources, Bradford's law and source local impact.

3.3.1. Most relevant sources

Results show top 20 relevant sources that have published most of the studies containing the themes of patient safety and service quality. International Journal of Environmental Research and Public Health is leading with 32 publications followed by International Journal of Health Care Quality Assurance (26), BMJ Quality and Safety (16), International Journal for Quality in Health Care (14) and others are mentioned in **Figure 4.**

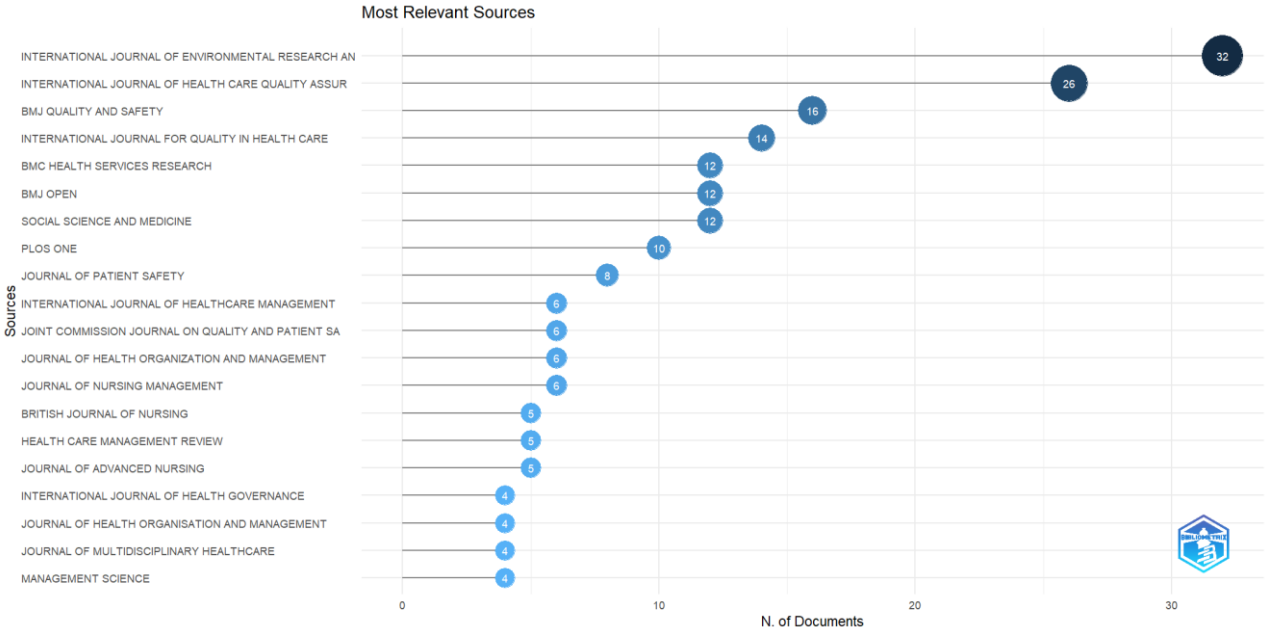

Figure 4. Most relevant sources.

3.3.2. Bradford's law

Bradford's Law shows the most significant sources in which first 50 relevant articles can be revealed. It splits the sources in different zones. First zone is considered as core sources where most of the relevant articles fall and it is for first 50 articles of the search. Among top 20 sources, International Journal of Environmental Research and Public Health till Journal of Health, Organisation and Management are those sources that fall in zone 1 reflect the core sources where the relevant searches can be executed (**Figure 5** and **Table 4**).

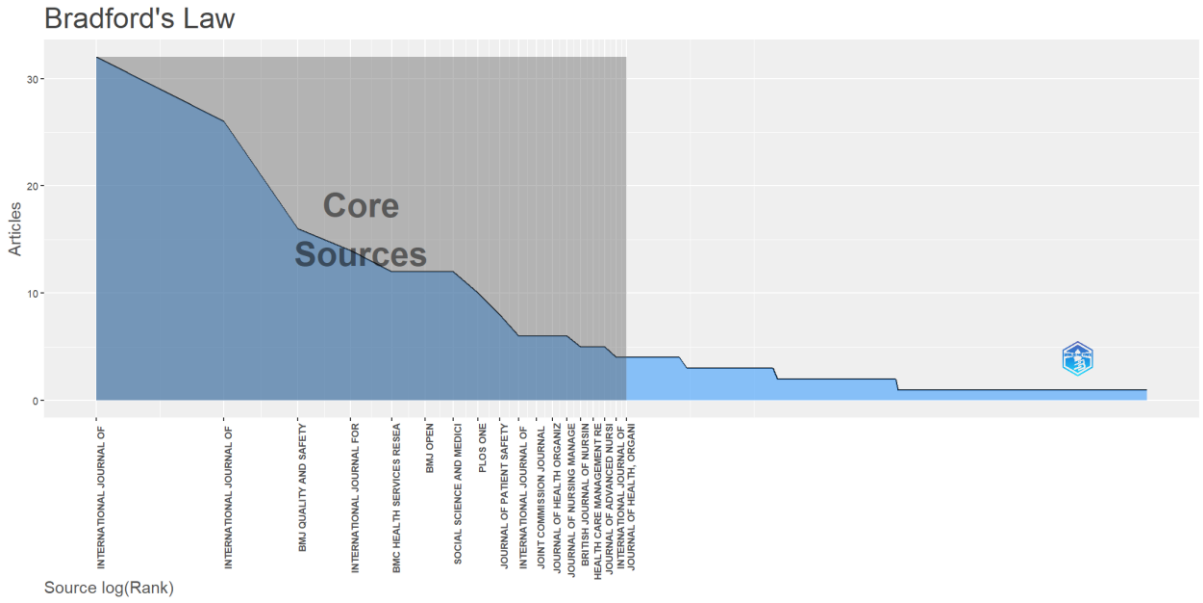

Figure 5. Most reliable sources by Bradford's Law.

Table 4. List of most reliable sources by Bradford's Law.

Sources	Rank	Freq	C.Freq	Zone
International Journal of Environmental Research and Public Health	1	32	32	Zone 1
International Journal of Health Care Quality Assurance	2	26	58	Zone 1
BMJ Quality and Safety	3	16	74	Zone 1
International Journal for Quality in Health Care	4	14	88	Zone 1
BMC Health Services Research	5	12	100	Zone 1
BMJ Open	6	12	112	Zone 1
Social Science and Medicine	7	12	124	Zone 1
PLOS One	8	10	134	Zone 1
Journal of Patient Safety	9	8	142	Zone 1
International Journal of Healthcare Management	10	6	148	Zone 1
Joint Commission Journal on Quality and Patient Safety	11	6	154	Zone 1
Journal of Health Organization and Management	12	6	160	Zone 1
Journal of Nursing Management	13	6	166	Zone 1
British Journal of Nursing	14	5	171	Zone 1
Health Care Management Review	15	5	176	Zone 1
Journal of Advanced Nursing	16	5	181	Zone 1
International Journal of Health Governance	17	4	185	Zone 1
Journal of Health, Organisation and Management	18	4	189	Zone 1
Journal of Multidisciplinary Healthcare	19	4	193	Zone 2
Management Science	20	4	197	Zone 2

3.3.3. Source Local Impact

Source local impact states the impact of sources (journals) because of their ranking in weightage of respective h-index, g-index and m-index. H-index represents the ranking given to the journals on their productivity, G-index reflects that highly cited journals are given more weightage than others and M-index represents the weightage on the time span of a journal; the older the journal is, the higher weightage it will get. Results reveal that most of the impact has been created from BMJ Quality and Safety (H-index), International Journal of Health Care Quality Assurance (G-index) and International Journal of Environmental Research and Public Health (M-index). These journals are followed by different other sources of high impact and are shown in (**Figure 6**, **Figure 7** and **Figure 8**).

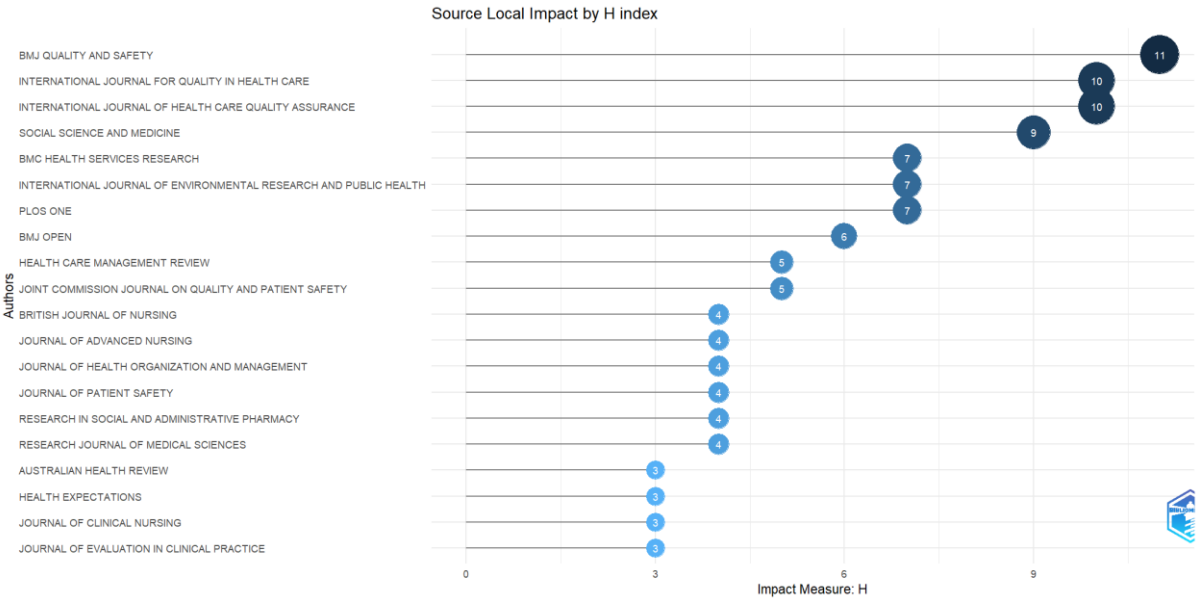

Figure 6. Source local impact by H-index.

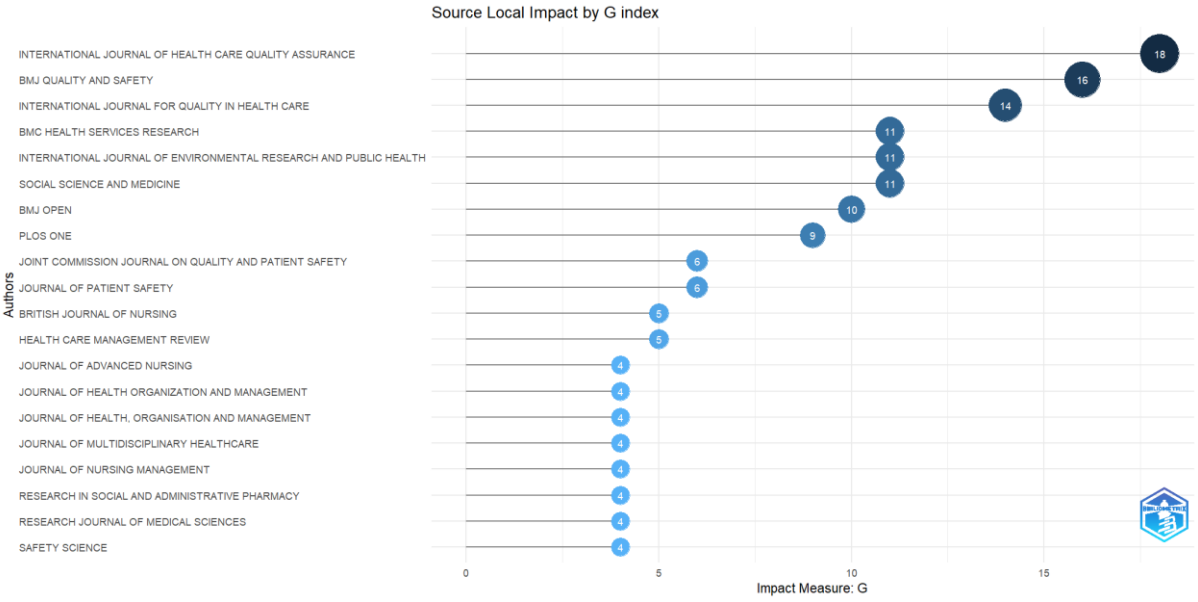

Figure 7. Source local impact by G-index

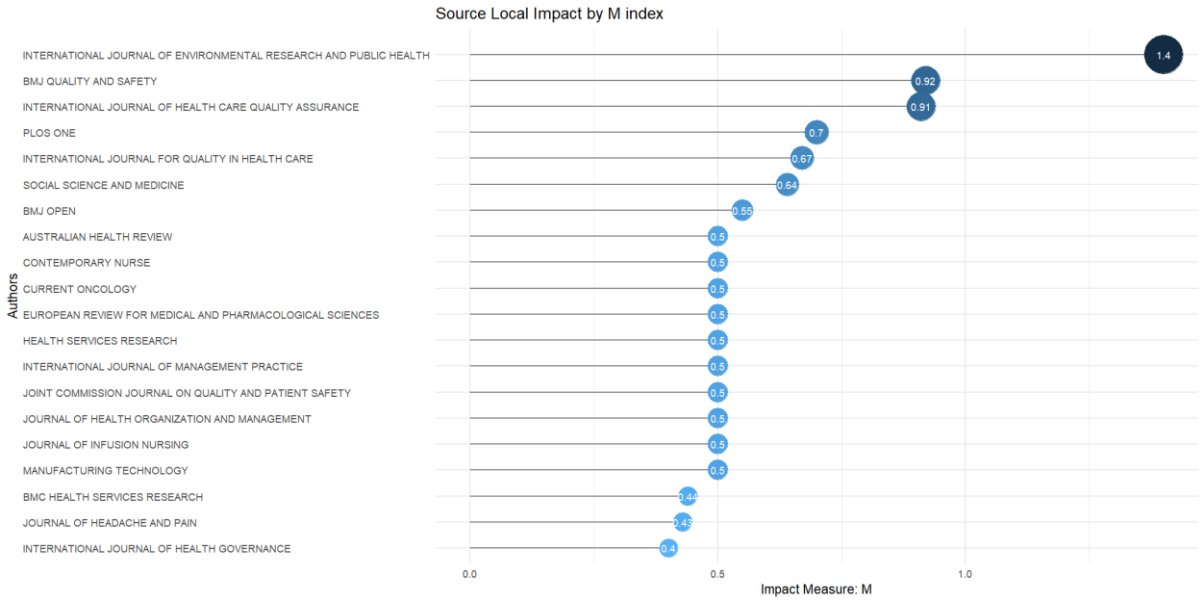

Figure 8. Source local impact by M-index.

3.4. Prolific authors

Different prolific authors as per their relevance, productivity and impact have been identified in this study.

3.4.1. Most relevant authors

Top 20 relevant authors who have contributed the most in 'Patient Safety and Service Quality' area of search have been identified. Franklin B.D is at the top with 31 articles followed by Vincent C. (22), Sevdalis N. (11) and others mentioned in **Table 5**.

Table 5. Most relevant authors.

Authors	Articles	Articles Fractionalized
Franklin Bd	31	6.24
Vincent C	22	5.21
Sevdalis N	11	1.80
Blandford A	9	1.34
Lee Y-C	9	1.95
Wu H-H	9	1.95
Arora S	8	1.40
Huang C-H	8	1.75
Furniss D	7	1.01
Waring J	7	3.83
Jacklin A	6	1.27
Bates Dw	5	0.49
Dixon-Woods M	5	0.95
Iacovides I	5	0.68
Moorthy K	5	0.77
Sandall J	5	1.63
Vincent Ca	5	0.83
Wei L	5	0.78

Table 5. (*Continued*)

Authors	Articles	Articles Fractionalized
Barber N	4	1.03
Bishop S	4	1.58

3.4.2. Authors' Productivity

This section comprises of top 20 authors' productivity in the searched area and it contains production of top authors over time, and productivity trend by Lotka's law. The most consistent production of documents and citations have come from Franklin BD, Vincent C., Sevdalis N., Arora S., Waring J., Jacklin A and Bates DW. There is increasing trend of production after the year 2011 in the 'patient safety and service quality' area of research (**Figure 9**). Productivity of authors is also identified by Lotka's Law. This law advocates that as number of articles written increases, the productivity of authors decreases. It is shown in

Figure 10 & **Table 6** that 01 document has been produced by 2023 authors, then 02 documents have been produced by 158 authors and this productivity decreases when number of articles written increases.

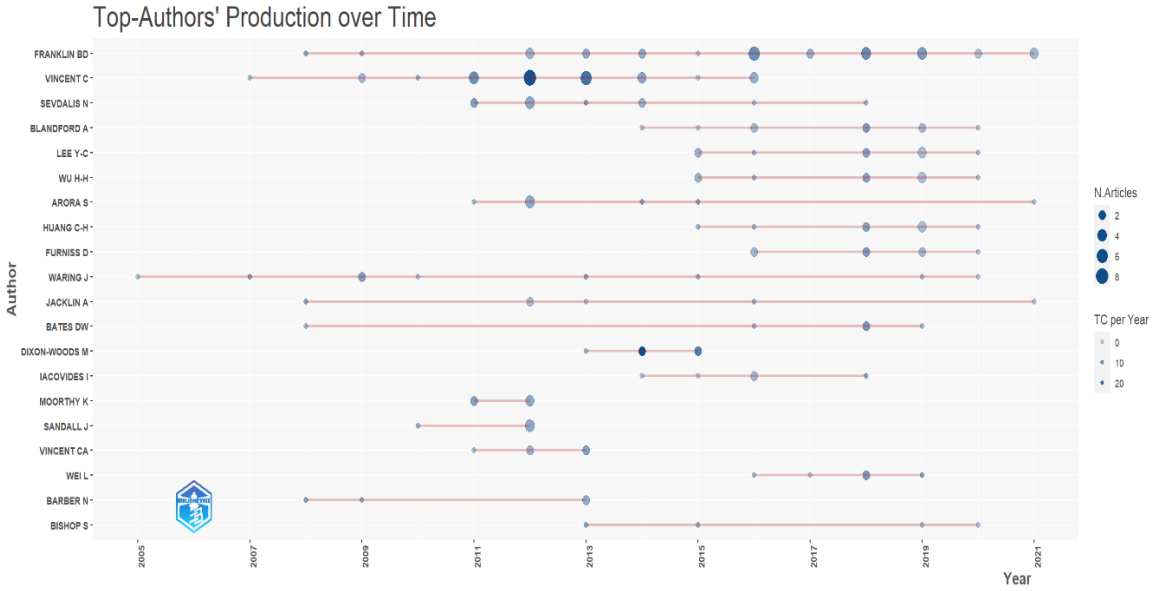

Figure 9. Authors' production over time.

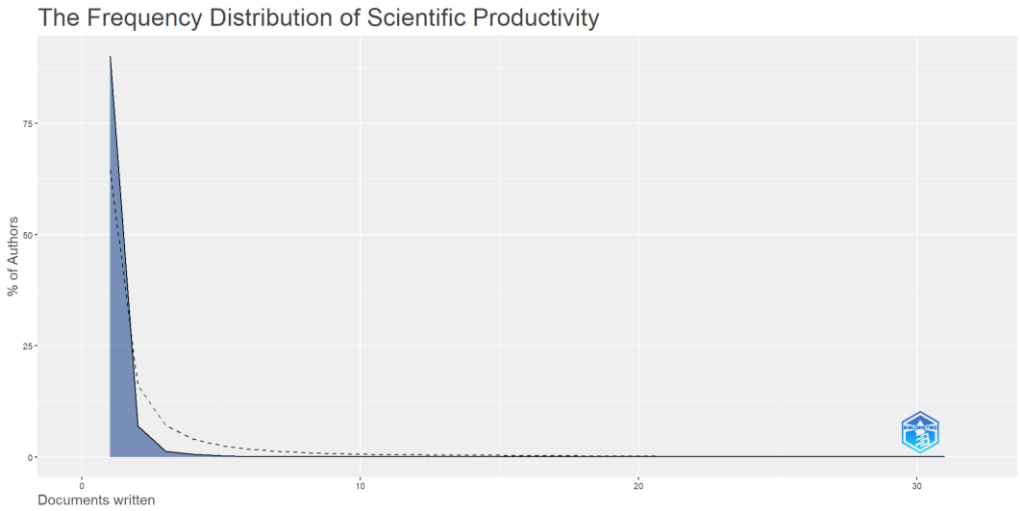

Figure 10. Authors' scientific productivity through Lotka's Law.

Table 6. Authors' scientific productivity by Lotka's Law.

Documents written	N. of Authors	Proportion of Authors
1	2023	0.902
2	158	0.07
3	30	0.013
4	15	0.007
5	7	0.003
6	1	0
7	2	0.001
8	2	0.001
9	3	0.001
11	1	0
22	1	0
31	1	0

3.4.3. Authors' local impact

Similar to journal's local impact, authors' local impact has also been identified in this study with respect to their h-index, g-index and m-index. Findings reveal that Franklin BD, Vincent C., and Sevdalis N. are leading with respect to their h-index, g-index and m-index score (**Table 7**). Their total citations (TC), net production (NP) and beginning year of production (PY start) are also highlighted.

Table 7. Author's local impact.

Element	h_index	g_index	M_index	TC	NP	PY_start
Franklin BD	15	23	1	566	29	2008
Vincent C	15	22	0.938	657	22	2007
Sevdalis N	10	11	0.833	298	11	2011
Arora S	7	7	0.583	192	7	2011
Blandford A	6	9	0.667	102	9	2014
Bates DW	5	5	0.333	124	5	2008
Dixon-Woods M	5	5	0.5	411	5	2013
Furniss D	5	7	0.714	85	7	2016
Huang C-H	5	8	0.625	99	8	2015
Jacklin A	5	5	0.333	166	5	2008
Lee Y-C	5	9	0.625	110	9	2015
Moorthy K	5	5	0.417	165	5	2011
Vincent CA	5	5	0.417	168	5	2011
Wei L	5	5	0.714	107	5	2016
Wu H-H	5	9	0.625	110	9	2015
Barber N	4	4	0.267	241	4	2008
Devreux I	4	4	0.308	56	4	2010

Table 7. (*Continued*)

Element	h_index	g_index	M_index	TC	NP	PY_start
Garfield S	4	4	0.444	88	4	2014
Mayer A	4	4	0.571	73	4	2016
Mckee L	4	4	0.4	374	4	2013

3.5. Affiliation and country analysis

This study also contains the identification of relevant affiliations associated with documents, corresponding authors' countries and country's scientific production in 'patient safety and service quality'.

3.5.1. Most relevant affiliations

Top 20 most relevant affiliations reflecting the contributions of renowned institutions in the search topic of the current study have been identified. Imperial College London is leading all other institutions with 89 documents, followed by Imperial College Healthcare NHS Trust (55) and others mentioned in **Figure 11**.

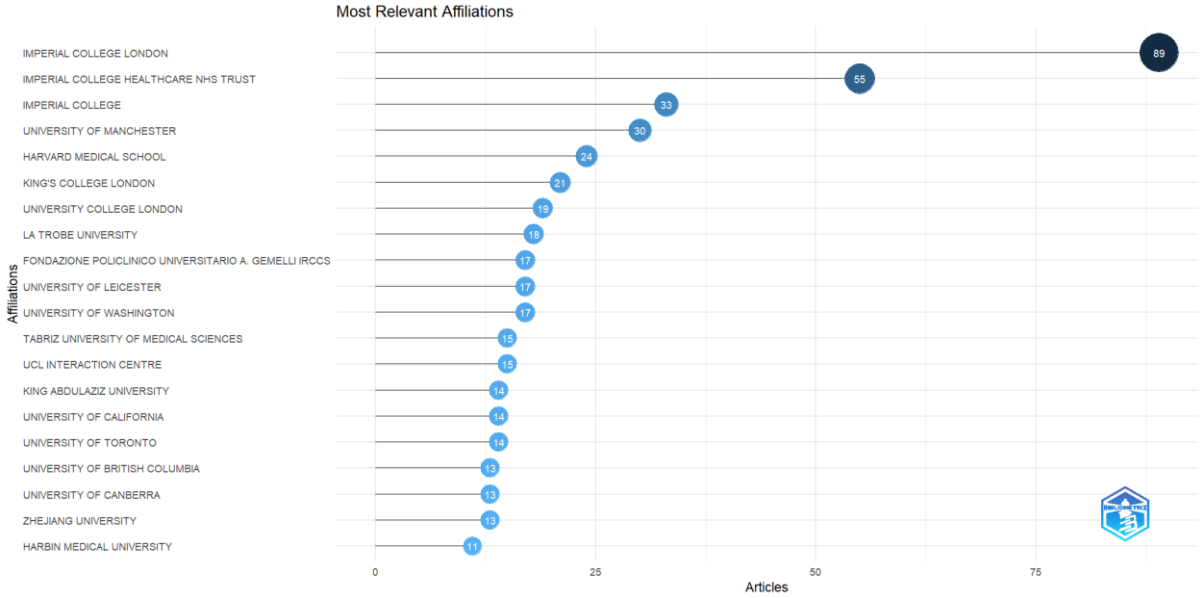

Figure 11. Most relevant affiliations.

Most Relevant Countries by Corresponding Author & Country's Scientific Production

Contributions in 'Patient safety and Service quality' research from different countries around the world have been identified. Top 20 most relevant countries have been highlighted with their single country publications (SCP) and multiple country publications (MCP). United Kingdom is leading with 125 total articles including 100 SCP and 25 MCP representing more collaborative studies in searched area. It is followed by USA (79 SCP, 10 MCP), China (25 SCP, 05 MCP), Australia (21 SCP, 07 MCP) and others mentioned in **Figure 12** and **Table 8**.

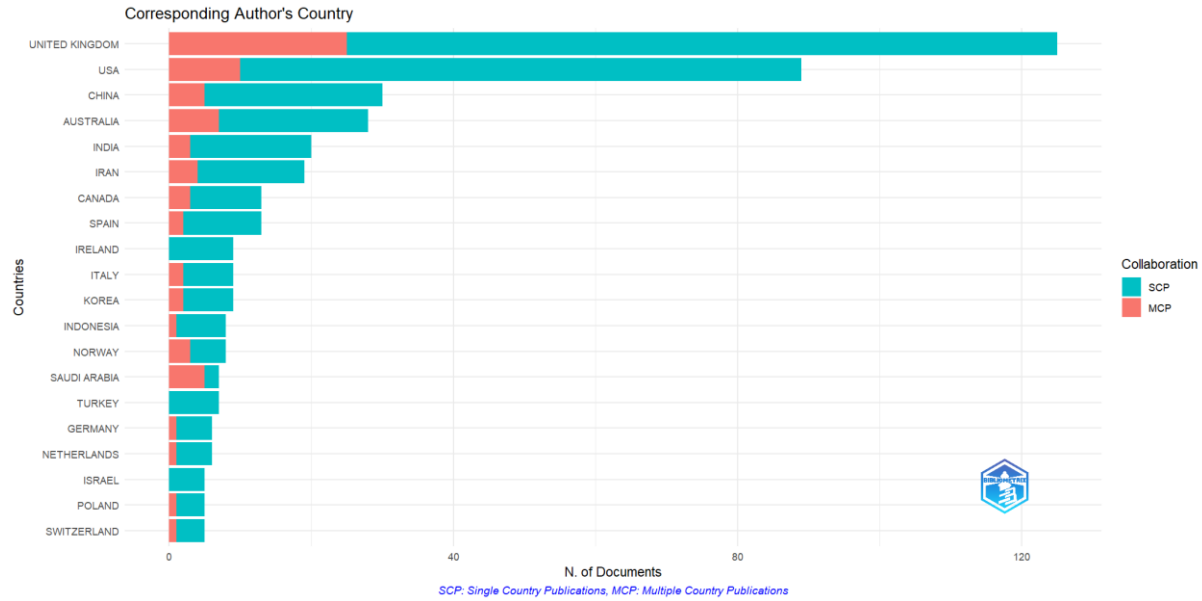

Figure 12. Corresponding authors' countries.

Table 8. List of corresponding authors' countries.

Country	Articles	Freq	SCP	MCP	MCP_Ratio
United Kingdom	125	0.25826	100	25	0.2
USA	89	0.18388	79	10	0.112
China	30	0.06198	25	5	0.167
Australia	28	0.05785	21	7	0.25
India	20	0.04132	17	3	0.15
Iran	19	0.03926	15	4	0.211
Canada	13	0.02686	10	3	0.231
Spain	13	0.02686	11	2	0.154
Ireland	9	0.0186	9	0	0
Italy	9	0.0186	7	2	0.222
Korea	9	0.0186	7	2	0.222
Indonesia	8	0.01653	7	1	0.125
Norway	8	0.01653	5	3	0.375
Saudi Arabia	7	0.01446	2	5	0.714
Turkey	7	0.01446	7	0	0
Germany	6	0.0124	5	1	0.167
Netherlands	6	0.0124	5	1	0.167
Israel	5	0.01033	5	0	0
Poland	5	0.01033	4	1	0.2
Switzerland	5	0.01033	4	1	0.2

3.6. Documents and words analysis

We have analyzed documents and words containing the identification of the most global cited documents, most local cited documents, the most frequent words, wordcloud, tree map and trend topics.

3.6.1. Most global and local cited documents

Most global cited documents represent all documents related to the central theme of the search whereas local cited documents reflect the specific documents provided in the software for analysis. Top 20 global and local cited documents have been identified with their local and global citations (LC & GC), total citations per year (TC/Y), normalized total citations (N.TC) and DOI (**Table 9** and **Table 10**). Results show PRATT RJ, 2007, J HOSP INFECT is the most cited document globally with 533 total citation till 2021 and TAYLOR BB, 2008, MED CARE is the most local cited document provided in the data set with 15 local citations till 2021.

Table 9. List of most global cited documents with DOI and TC.

Paper	DOI	TC	TC/ Y	N.TC
PRATT RJ, 2007, J HOSP INFECT	10.1016/S0195-6701(07)60002-4	533	33.312	4.110
BERRY LL, 2007, J SERV RES	10.1177/1094670507306682	370	23.125	2.853
DIXON-WOODS M, 2014, BMJ QUAL SAF	10.1136/bmjqs-2013-001947	236	26.222	9.722
BOSSAERT LL, 2015, RESUSCITATION	10.1016/j.resuscitation.2015.07.033	231	28.875	9.9
KOUFTEROS X, 2009, INT J PROD ECON	10.1016/j.ijpe.2009.04.010	168	12	3.803
GALLAN AS, 2013, J ACAD MARK SCI	10.1007/s11747-012-0307-4	166	16.6	5.286
WILSON RM, 2012, BMJ (ONLINE)	10.1136/bmj.e832	163	14.818	5.466
LYU H, 2013, JAMA SURG	10.1001/2013.jamasurg.270	138	13.8	4.394
WEINGART SN, 2011, INT J QUAL HEALTH CARE	10.1093/intqhc/mzr002	131	10.916	5.614
PANAGIOTI M, 2019, BMJ	10.1136/bmj.l4185	125	31.25	15.90
DONYAI P, 2008, BR J CLIN PHARMACOL	10.1111/j.1365-2125.2007.02995.x	115	7.6667	3.689
WARING J, 2007, SOCIOL HEALTH ILLN	10.1111/j.1467-9566.2007.00527.x	106	6.625	0.817
LEE SM, 2012, SERV IND J	10.1080/02642069.2010.545397	95	8.6364	3.185
NAVEH E, 2005, MANAGE SCI	10.1287/mnsc.1050.0372	95	5.2778	2.590
MARTIN GP, 2015, SOC SCI MED	10.1016/j.socscimed.2015.07.027	94	11.75	4.028
WEST MA, 2013, J HEALTH ORGAN MANAGE	10.1108/14777261311311843	94	9.4	2.993
WARING JJ, 2009, SOC SCI MED	10.1016/j.socscimed.2009.09.052	94	6.7143	2.128
SINGER SJ, 2008, MED CARE	10.1097/MLR.0b013e31817925c1	92	6.1333	2.951
AL-BORIE HM, 2013, INT J HEALTH CARE QUAL ASSUR	10.1108/09526861311288613	91	9.1	2.898
NAGPAL K, 2011, ANN SURG	10.1097/SLA.0b013e318211d849	87	7.25	3.728

Table 10. List of most local cited documents with DOI and TC.

Document	DOI	Year	LC	GC	LC/GC (%)	NLC	NGC
TAYLOR BB, 2008, MED CARE	10.1097/MLR.0b013e3181589ba4	2008	15	47	31.91	8.57	1.51
BLANDFORD A, 2016, BMJ OPEN	10.1136/bmjopen-2015-009777	2016	6	19	31.58	7.86	1.26
LEE Y-C, 2015, INT J HEALTH CARE QUAL ASSUR	10.1108/IJHCQA-03-2015-0039	2015	6	26	23.08	10.96	1.11
WARING J, 2007, SOCIOL HEALTH ILLN	10.1111/j.1467-9566.2007.00527.x	2007	6	106	5.66	5.40	0.82
WARING JJ, 2005, POLICY POLIT	10.1332/030557305774329145	2005	6	15	40.00	1.80	0.41
HUANG C-H, 2018, APPL NURS RES	10.1016/j.apnr.2017.12.010	2018	5	29	17.24	13.68	2.92
FURNISS D, 2018, BMC HEALTH SERV RES	10.1186/s12913-018-3025-x	2018	4	12	33.33	10.95	1.21
GILLESPIE A, 2016, BMJ QUAL SAF	10.1136/bmjqs-2015-004596	2016	4	40	10.00	5.24	2.65
LEE Y-C, 2015, J MED IMAGING HEALTH INFORMATICS	10.1166/jmihi.2015.1482	2015	4	11	36.36	7.30	0.47
OCLOO JE, 2010, SOC SCI MED	10.1016/j.socscimed.2010.03.050	2010	4	38	10.53	6.00	1.66
NAVEH E, 2005, MANAGE SCI	10.1287/mnsc.1050.0372	2005	4	95	4.21	1.20	2.59
LYONS I, 2018, BMJ QUAL SAF	10.1136/bmjqs-2017-007476	2018	3	36	8.33	8.21	3.63
KAMRA V, 2016, TOTAL QUAL MANAGE BUS EXCELLENCE	10.1080/14783363.2015.1057488	2016	3	32	9.38	3.93	2.12
GARFIELD S, 2016, PLOS ONE	10.1371/journal.pone.0153721	2016	3	22	13.64	3.93	1.46
VOGUS TJ, 2016, HUM RESOUR MANAGE REV	10.1016/j.hrmr.2015.09.005	2016	3	65	4.62	3.93	4.31
DIXON-WOODS M, 2014, BMJ QUAL SAF	10.1136/bmjqs-2013-001947	2014	3	236	1.27	7.07	9.72
WARING J, 2013, SOC SCI MED	10.1016/j.socscimed.2013.08.037	2013	3	64	4.69	6.43	2.04
HOWARD M, 2013, J PATIENT SAF	10.1097/PTS.0b013e3182913837	2013	3	14	21.43	6.43	0.45
AL-BORIE HM, 2013, INT J HEALTH CARE QUAL ASSUR	10.1108/09526861311288613	2013	3	91	3.30	6.43	2.90
WILSON RM, 2012, BMJ (ONLINE)	10.1136/bmj.e832	2012	3	163	1.84	8.36	5.47

3.6.2. Most frequent words

Results show various frequently occurred words in the literature of 'patient safety and service quality'. Biblioshiny software enables researchers to generate overall keywords used in the literature of particular searched area (Keyword Plus) and author keywords provided in the data set extracted from database. We

have identified the occurrence of top 20 frequently used words in terms of Keyword Plus and Author Keywords (**Table 11**). Occurrence of Keywords Plus reveal that 'patient safety' has occurred most of the times with 606 occurrences (central theme of the study) followed by 'human' (445), 'article' (384), 'humans' (357), 'female' (333) and others mentioned in TABLE. The most frequent author keywords are 'patient safety' with 175 occurrences, followed by 'service quality' (83), 'patient satisfaction' (40), 'quality improvement' (23) and others mentioned in **Table 11**.

Table 11. Most frequent words (Keyword plus and author keywords).

Keyword Plus		**Author Keywords**	
Words	**Occurrences**	**Words**	**Occurrences**
Patient Safety	606	Patient Safety	175
Human	445	Service Quality	83
Article	384	Patient Satisfaction	40
Humans	357	Quality Improvement	23
Female	333	Healthcare	20
Male	314	Quality	20
Adult	305	Hospital	19
Health Care Quality	210	Accreditation	16
Patient Satisfaction	171	Risk Management	16
Middle Aged	156	Hospitals	15
Aged	126	Patient Experience	15
Questionnaire	110	Safety	14
Qualitative Research	108	Quality of Care	13
Patient Care	104	Adverse Events	11
Organization and Management	103	Health Care	11
Total Quality Management	102	Patient Safety Culture	11
Major Clinical Study	89	Nurses	10
Priority Journal	89	Clinical Governance	9
Controlled Study	87	Patient Participation	9
Quality of Health Care	83	Qualitative Research	9

Biblioshiny software also enables researchers to obtain the frequency of words in unigrams (single-word keyword), bigrams (double-word keyword) or trigrams (three-word keyword) used in titles and abstracts. Results show the frequency of Keyword Plus and Author Keywords as unigrams, bigrams and trigrams used in titles only. The most frequent unigrams in Keyword Plus are patient (1310), quality (1199), safety (1180), care (1056) and others, bigrams are patient safety (668), service quality (253), health care (231), safety culture (130), patient satisfaction (128) and others (table), and trigrams are patient safety culture (81), improve patient safety (35), national health service (28), Health Care Providers (20) and others (**Table 12**).

Top 20 frequent unigrams in Author Keyword used in titles are safety (178), patient (175), quality (170), care (137), study (114) and others, bigrams are patient safety (112), service quality (50), health care (35), safety culture (28), patient satisfaction (21) and others, and trigrams are patient safety culture (23), mixed methods study (5), patient safety climate (5), health care quality (4), hospital service quality (4) and others (**Table 13**).

Table 12. Most frequent unigrams, bigrams and trigrams (keyword plus).

Keyword Plus					
Unigrams		**Bigrams**		**Trigrams**	
Words	**Occ**	**Words**	**Occ**	**Words**	**Occ**
Patient	1310	Patient Safety	668	Patient Safety Culture	81
Quality	1199	Service Quality	253	Improve Patient Safety	35
Safety	1180	Health Care	231	National Health Service	28
Care	1056	Safety Culture	130	Health Care Providers	20
Patients	788	Patient Satisfaction	128	Hospital Service Quality	19
Study	688	Quality Improvement	89	Lippincott Williams Wilkins	18
Health	684	Adverse Events	72	Main Outcome Measures	18
Hospital	607	Patient Care	60	Patient Safety Climate	17
Service	516	Publishing Limited	59	Confirmatory Factor Analysis	16
Healthcare	476	Health Service	57	Health Care System	13
Hospitals	452	Health Services	54	Health Care Quality	12
Data	432	Improve Patient	46	Health Service NHS	12
Results	424	Medication Errors	42	Healthcare Service Quality	12
Services	347	Safety Climate	41	Intensive Care Unit	12
Medical	344	Healthcare Quality	39	Oxford University Press	12
Clinical	313	Primary Care	38	Enhance Patient Safety	11
Satisfaction	308	Quality Management	38	Informa UK Limited	11
Research	306	National Health	37	Palliative Symptom Control	11
Management	300	Healthcare Professionals	36	Preventable Patient Harm	11
Analysis	282	Patient Experience	36	UK Limited Trading	11

Table 13. Most frequent unigrams, bigrams and trigrams (author keyword)

Author Keywords					
Unigrams		**Bigrams**		**Trigrams**	
Words	**Occ**	**Words**	**Occ**	**Words**	**Occ**
Safety	178	Patient Safety	112	Patient Safety Culture	23
Patient	175	Service Quality	50	Mixed Methods Study	5
Quality	170	Health Care	35	Patient Safety Climate	5
Care	137	Safety Culture	28	Health Care Quality	4
Study	114	Patient Satisfaction	21	Hospital Service Quality	4
Service	80	Quality Improvement	19	Health Care Providers	3
Hospital	76	Qualitative Study	16	Improve Patient Safety	3
Health	65	Systematic Review	11	Intensive Care Unit	3
Hospitals	58	Emergency Department	9	Medication Administration Errors	3
Patients	58	Observational Study	9	National Health Service	3
Healthcare	56	Care Quality	8	Patient Safety Management	3

Table 13. (*Continued*)

Author Keywords					
Unigrams		**Bigrams**		**Trigrams**	
Words	**Occ**	**Words**	**Occ**	**Words**	**Occ**
Medical	47	Mixed Methods	8	Safety Culture Based	3
Satisfaction	44	Public Hospitals	8	Service Quality Improvement	3
Analysis	34	Adverse Events	7	Abdulaziz University Hospital	2
Improvement	34	Cross-Sectional Study	7	Academic Medical Center	2
Services	32	Health Service	7	Acutely Ill Patient	2
Culture	30	Healthcare Quality	7	Adverse Event Reporting	2
Management	29	Medication Administration	7	Affecting Patient Satisfaction	2
Factors	28	Primary Care	7	Carers Medication Administration	2
Impact	28	Exploratory Study	6	Continuous Quality Improvement	2

3.6.3. Wordcloud and tree map

Wordcloud and Tree maps visualize the prominence of keywords as per their occurrences generated in the search. This section comprises of these maps showing the mapping of Keyword Plus and Author Keywords. The most prominent themes in wordclouds (**Figure 13** and **Figure 14**) and tree maps (**Figure 15** and **Figure 16**) are patient safety, human, article, female, adult, male, health care quality, patient satisfaction, service quality, and quality improvement.

Figure 13. Wordcloud showing author keyword.

Figure 14. Wordcloud showing keyword plus.

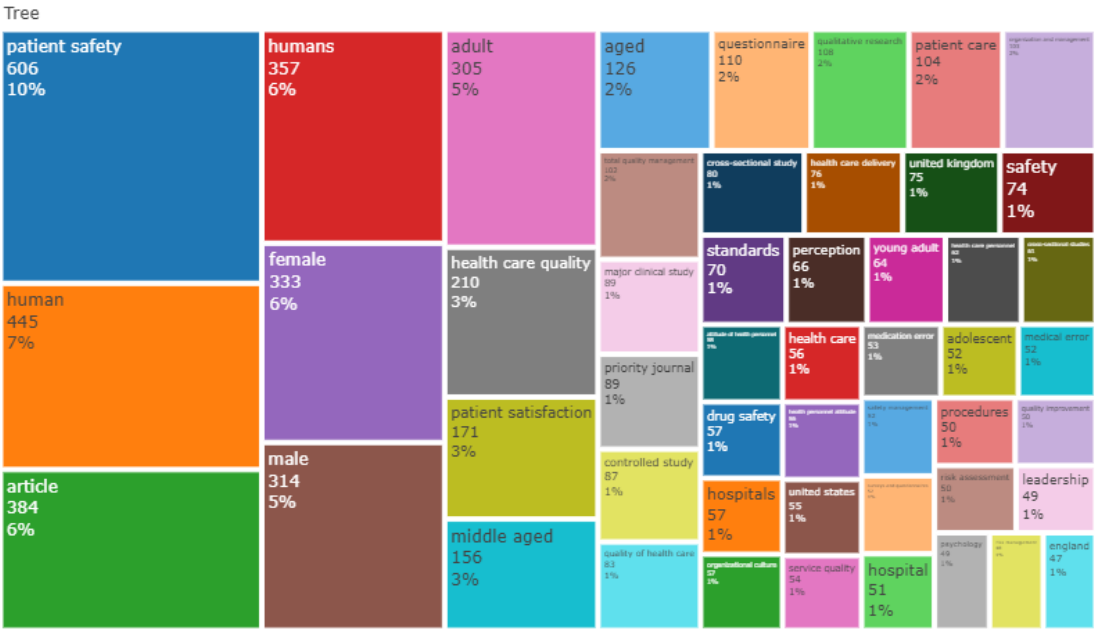

Figure 15. Tree map showing keyword plus.

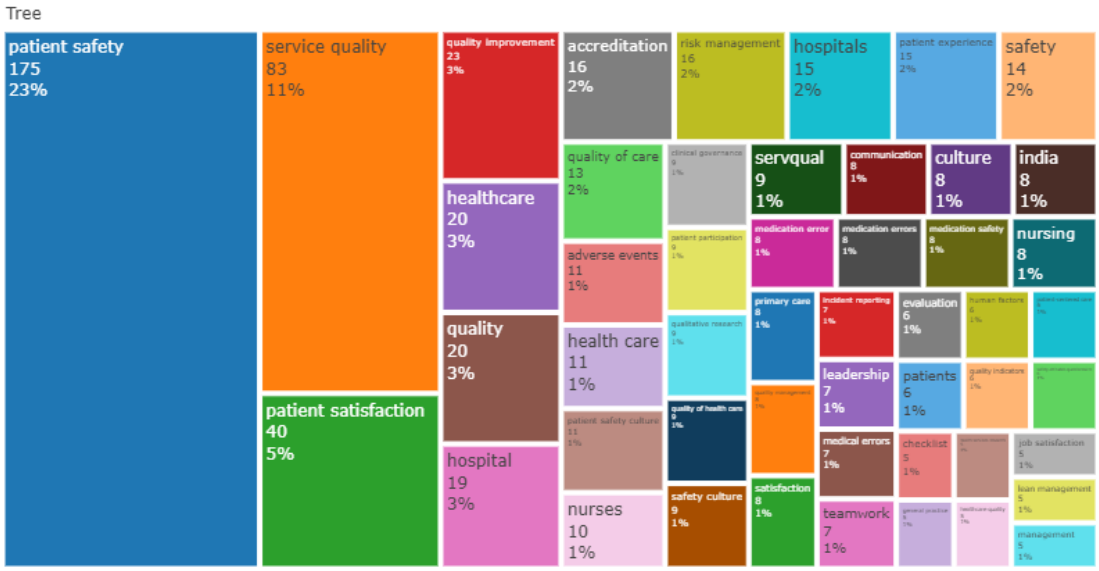

Figure 16. Tree map showing author keywords.

3.6.4. Trend topics

Analysis of trend topics exhibits the pattern of different themes are being studied and used in different timelines. Different themes have emerged in our analysis that may be considered as avenues for future research. Health worker, drug safety, nursing care, public hospital, qualitative analysis and controlled study are few themes that are being streamlined after 2019 (**Figure 17**).

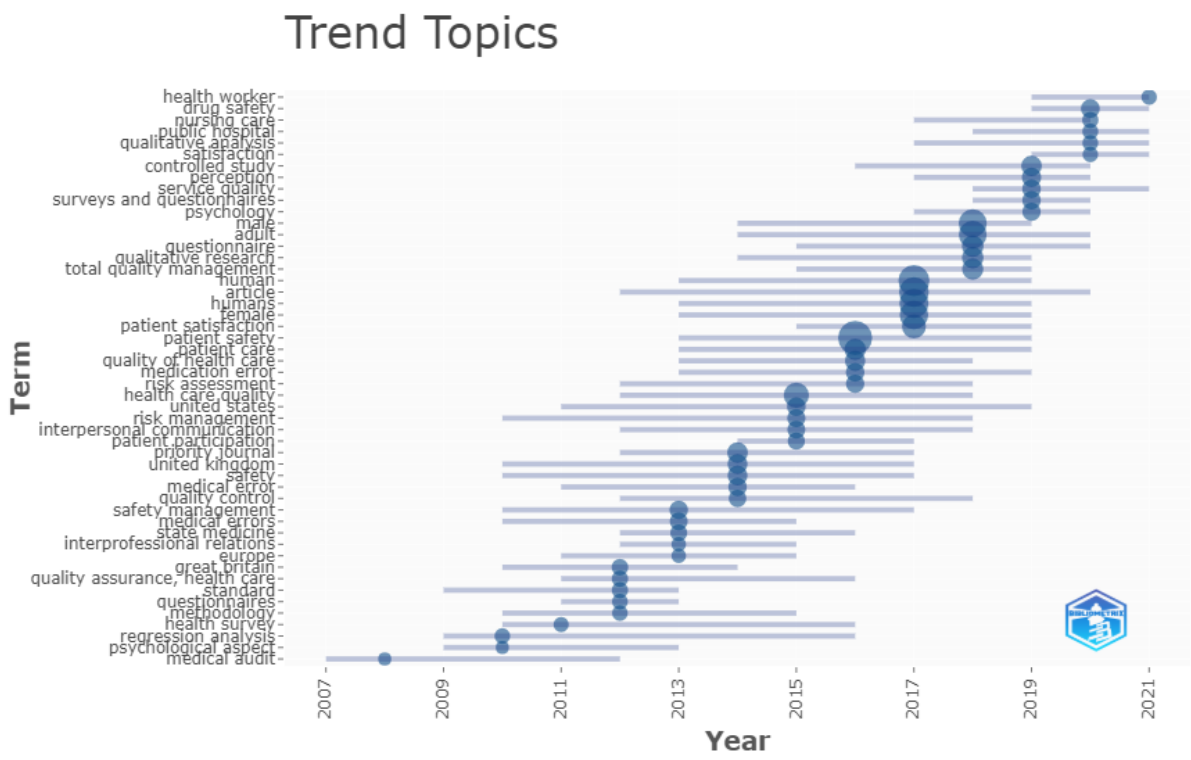

Figure 17. Map showing the trending topics across years.

4. Limitations and future research directions

Future research directions may also be highlighted. The current study is limited to only two themes e.g., 'patient safety and service quality'; different groupings of words can be used instead. One of the limitations of using 'R package biblioshiny' is that it does not have the option of replacing the duplicate or similar themes into one theme or keyword as it can be done in VOSviewer by creating thesaurus file e.g., human and humans are similar words, similarly, hospital and hospitals, national health services and NHS and others. Only Scopus database has been used to extract data, other databases e.g., Web of Science, MedLine and so on can be utilized to compare the findings.

There is rapid increase in publications about patient safety and service quality specifically after 2017 showing the increasing interest of researchers, therefore more studies are suggested. Researchers and practitioners are suggested to look into the sources e.g., International Journal of Environmental Research and Public Health, International Journal of Health Care Quality Assurance, BMJ Quality and Safety, International Journal for Quality in Health Care and other top journals and works of Franklin B.D, Vincent C., Sevdalis N. and other top authors to check the current developments, trends, discoveries and discussions in 'patient safety and service quality' research. Most of the publications and collaborations have been generated from United Kingdom, USA, China or other developed countries, therefore, more studies and collaborations are needed from developing or under-developed countries e.g., Asian, South Asian, Middlle East and African countries.

5. Conclusion

This study is designed to present the mapping of 'patient safety and service quality' literature from 2005 to 2021. Bibliometric analysis by using biblioshiny of R-package is performed on 566 documents after screening process of inclusion and exclusion criteria. Different analyses have been established in identifying publication output, prominent sources and their impact, prolific authors their productivity and impact, prominent affiliations and countries, most relevant and frequent documents and words and their visualizations.

Author contributions

Conceptualization, Mohd Amran Mohd Daril and Javed Ali; methodology, Mohd Amran Mohd Daril and Javed Ali; software, Javed Ali and Awais Gul Airij; validation, Mohd Amran Mohd Daril; formal analysis, Mohd Amran Mohd Daril and Javed Ali.; resources, Mohd Amran Mohd Daril, Javed Ali, Sarfaraz Ahmed Dakhan and Awais Gul Airij; data curation, Javed Ali and Sarfaraz Ahmed Dakhan; writing—original draft preparation, Mohd Amran Mohd Daril and Javed Ali; writing—review and editing, Sarfaraz Ahmed Dakhan and Awais Gul Airij; visualization, Javed Ali and Awais Gul Airij; supervision, Mohd Amran Mohd Daril and Sarfaraz Ahmed Dakhan; project administration, Javed Ali and Awais Gul Airij. All authors have read and agreed to the published version of the manuscript."

Conflict of interest

The authors declare no conflict of interest.

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