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Analyzing the Global Trend of Publications on Laryngeal Mask Airway

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Abstract

Background: Bibliometrics evaluates the scientific publications in different fields from different aspects. However, the bibliometric state of global research publications on Laryngeal Mask Airway (LMA), as a main progressive medical field, is unknown.

Aim: This study aimed to conduct a bibliometric analysis and scientific visualization for inspecting some main bibliometric indicators of the research publications in the field.

Methods: This study is a descriptive cross-sectional applied study that used bibliometric techniques. MeSH-retrieved synonyms for LMA were searched in Scopus and the bibliometric indicators of retrieved papers in the field were measured and visualized in Excel and VOSviewer.

Results: In total, 9,783 papers were published on LMA during 1952-2021, starting from one paper in 1952 and amounted to 255 in 2021. With ups and downs in the annual publication growth, steady trend was seen in the growth coefficient of publications (R^2=.1652). The first to third ranks in publishing countries belonged to the United States with 1,783 papers (18.22%), the United Kingdom with 1,632 papers (16.68%) and Japan with 729 papers (7.45%), respectively. Among active research institutes, Cairns Hospital from Australia ranked first with publishing 284 papers, followed by the University of Queensland again from Australia with publishing 141 papers and Royal United Hospital from England with 117 published papers, respectively. Anaesthesia ranked first highly-publishing journal with 1,049 published papers, followed by Anesthesia and Analgesia with 487 published papers and Pediatric Anaesthesia with 448 published documents. Anaesthesia was the main cited source, too. The top three highly-frequent keywords were laryngeal mask airway (N=223), equipment (N=132) and airway management (N=116), respectively. Co-occurred keywords were in four subject clusters.

Conclusion: This study is the first to give a relatively comprehensive bibliometric analysis and visualization of the global research publication and a guide for researchers and research policy-makers in LMA, as a progressive medical discipline.

Introduction

Many patients annually need the airway management due to accidents, surgeries, heart failures, strokes, etc. (1). Airway management is one of the key procedures in treating urgent patients and has a main role in patient cares (2). Airway management is the assessment,

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planning and conducting a series of medical procedures required to maintain or restore an individual's ventilation or breathing (3). A laryngeal mask airway (LMA) was confirmed as a new concept in airway management and has a firm placement in the anesthetic practice. It is a medical device that keeps a patient's airway open during anesthesia or while they are unconscious and most commonly used by anesthetists to channel oxygen or inhalational anesthetic to the lungs during surgery as well as in the pre-hospital setting for unconscious patients. Initially used primarily in the operating room setting, the LMA has more recently come into use in the emergency setting as an important accessory device for management of the difficult airway (4). Despite its wide application and use, no bibliometric studies have been conducted on research publication regarding LMA**.** Bibliometric studies are complementary to scientific activities in different disciplines (5) and make a depiction of scientific publication in different aggregate levels (6).

Bibliometric studies use different approaches for evaluating scientific output, such as citation analysis, collaboration matrix, co-authorship pattern, scientific visualization and so on (7, 8). In addition, bibliometrics studies monitor researchers' communication and interactions with investigating three variables: communication producers (authors), communication productions (published documents/papers) and communication concepts (such as topics and keywords) (9). Descriptive bibliometrics tends to study the features and characteristics of publications in a certain discipline. However, behavioral bibliometrics tries to trace citations and formal and informal communications among researchers (10).

Bibliometrics provides helpful information for research-policy decision-making and research grants in a professional field as well as detecting research gaps and hot topics (11).

As the bibliometric state of publications on LMA, as a main progressive medical field, is unknown in the international level, this study aimed to conduct a bibliometric analysis and visualization for inspecting some main bibliometric indicators in the field. The study can be helpful in guiding researchers, research policy-makers and research centers in different related aspects of the research on the field.

Methods

This applied research is a descriptive cross-sectional study that used bibliometric and scientific visualization approaches and techniques. Standardized and controlled vocabulary on Laryngeal mask airway (LMA) was searched and found in MeSH (Medical Subject Headings).

The searched terms were entered into the advanced search section of Scopus, as one of main abstracting / indexing scientific databases (https://www.scopus.com/search) on 3 September 2022. No limitation was made for searched phrases and retrieved publications. All bibliographic and bibliometric data on the retrieved papers were extracted and two reviewers overviewed the papers for their appropriateness for the study. Data analyses were done in Excel (as statistical software) and VOSviewer (as bibliometric visualization software).

Results

Publication frequencies and trend by their year of publication

In total, 9,783 papers were published on LMA during 1952-2021, starting from one paper in 1952, increased to 411 papers in 2006 and decreased to 255 in 2021 (Figure 1). This shows ups and downs in the overall publication trend with a steady trend as reflected in the growth coefficient (R^2 = .1652).

The first to third-ranked years in the number of published papers belonged to 2015 with 418 papers, 2009 with 417 papers and 2006 with 411 papers, respectively. The first indexed paper entitled as "the protection of the laryngeal

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airway during swallowing" and published by Ardran, G.M. and Kemp, F.H. in *The British journal of Radiology*. It received 91 citations.
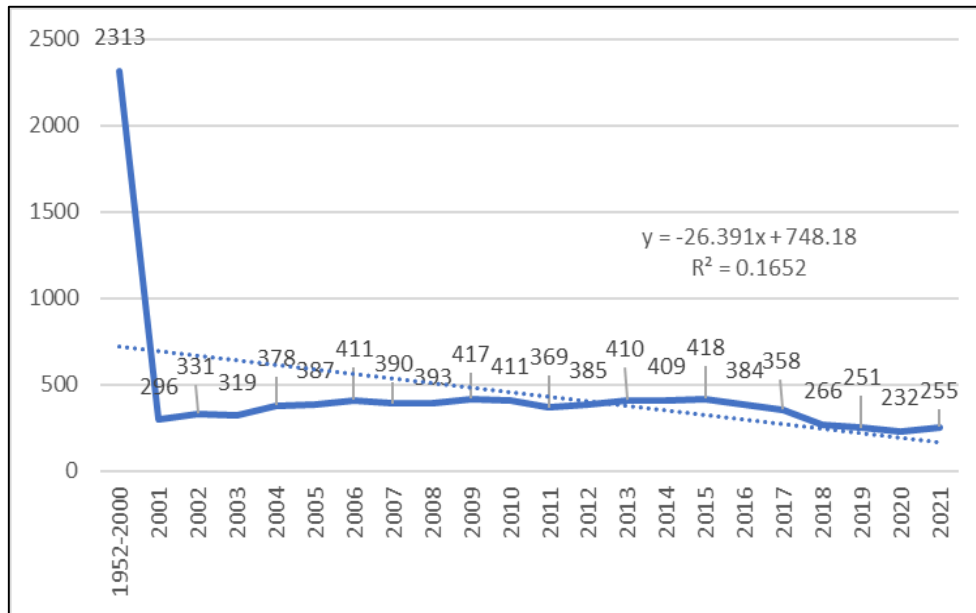

Figure 1. Publication trend in LMA by year of publication (1952-2021).

Top highly-publishing countries

103 worldwide countries contributed to LMA publications. Figure 2 shows the top ten contributing countries. The first to third ranks belonged to the United States with 1,783 papers (18.22%), United Kingdom with 1,632 papers (16.68%) and Japan with 729 papers (7.45%), respectively. About 42% of total publications belonged to these three top-ranked countries.
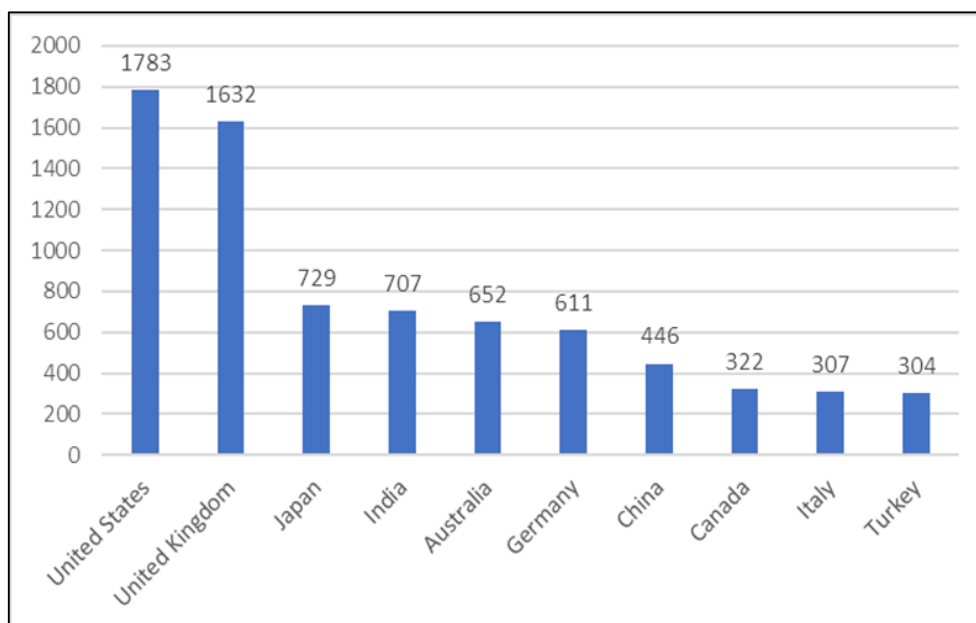

Figure 2. Top ten countries active in publishing on LMA (1952-2021).

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Table1. Top 20 highly-contributing research institutes in LMA publications (1952-2021)

Rank	Research Institute	Country	Document Count
1	Cairns Hospital	Australia	284
2	The University of Queensland	Australia	141
3	Royal United Hospital	England	117
4	Universität Innsbruck	Austria	116
5	All India Institute of Medical Sciences, New Delhi	India	114
6	Kansai Medical University	Japan	99
7	University of Toronto	Canada	87
8	James Cook University	Australia	85
9	Postgraduate Institute of Medical Education & Research, Chandigarh	India	75
10	Harvard Medical School	United States	64
11	Royal Berkshire Hospital	England	64
12	Cardiff University	United Kingdom	61
13	Plastic Surgery Institute & Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College	China	53
14	Royal Perth Hospital	Australia	52
15	Università degli Studi di Padova	Italy	50
16	University of Oxford Medical Sciences Division	United Kingdom	49
17	Ann & Robert H. Lurie Children's Hospital of Chicago	United States	47
18	Toronto Western Hospital University of Toronto	Canada	46
19	Medizinische Universitat Innsbruck	Austria	46
20	Northwestern University Feinberg School of Medicine	United States	45

Top highly-active research institutes

Table 1 shows the top 20 highly-contributing research institutes being active in LMA publications. As can be seen, Cairns Hospital from Australia ranked first with publishing 284 papers, followed by the University of Queensland again from Australia with publishing 141 papers and Royal United Hospital from England with having 117 published papers, respectively.

Top highly-productive authors

The bibliometric indicators of the top 20 highly-active authors authoring LMA papers were shown in Table 2. The highest-productive author was Brimacombe, Joseph R., affiliated to James Cook University from Australia with publishing 297 LMA papers (3.03% of total papers; received citations amounted to 7,573 with mean rate of 25.49 citations per document), followed by Keller, Christian H., affiliated to Schulthess Klinik Society from Switzerland with 160 published papers (1.63% of total papers; received citations amounted to 4,930 with mean rate of 30.81 citations per document) and Asai, Takashi, affiliated to Saitama University from Japan with 147 published papers (1.50% of total papers; received citations amounted to 2,890 with mean rate of 19.65 citations per document).

Core (highly-publishing) journals

Table 3 shows the bibliometric characteristics of the top ten highly-publishing (core) journals on LMA. *Anaesthesia* from the United Kingdom ranked first with 1,049 published papers (h-index=124).

Anesthesia and Analgesia from the United States ranked second with 487 published papers (h-index=208). The third rank belonged to

Pediatric Anaesthesia from the United Kingdom with 448 published documents (h-index= 86). All of these journals were in anesthesia field and eight journals published in the United States or United Kingdom.

Table 2. Bibliometric indicators of top 20 highly-active authors in LMA (1952-2021)

Rank	Author name	Affiliation/Country	h-index	Documents Count	% of 9783	Times Cited	citations per document
1	Brimacombe Joseph R.	James Cook University/Australia	56	297	3.03	7573	**25.49**
2	Keller, Christian H.	Schulthess Klinik/Switzerland	47	160	1.63	4930	**30.81**
3	Asai, Takashi	Saitama University/Japan	37	147	1.50	2890	**19.65**
4	Cook, Timothy M.	Royal United Hospitals Bath NHS Foundation Trust/United Kingdom	61	95	0.97	3408	**35.87**
5	Berry, Alison M.	University of Wisconsin-Madison/United States	23	84	0.85	1576	**18.76**
6	Brimacombe, Joseph R.	James Cook University/Australia	56	66	0.67	2413	**36.56**
7	Shingu, Koh	Japanese Red Cross Osaka Hospital/Japan	33	52	0.53	725	**13.94**
8	Verghese, Chandy	Royal Berkshire Hospital, Reading/United Kingdom	25	46	0.47	2413	**52.45**
9	Xue, Fushan	Beijing Friendship Hospital, Capital Medical University/China	24	45	0.45	165	**3.66**
10	Brain, Archibald I.J.	UCL Ear Institute/United Kingdom	18	41	0.41	1506	**36.73**
10	Trevisanuto, Daniele D.	Università degli Studi di Padova/Italy	36	41	0.41	1405	**34.26**
11	Brimacombe, Joseph C.	Cairns Hospital/Australia	14	39	0.39	482	**12.35**
11	Jagannathan, Narasimhan 'Sim'	Northwestern University Feinberg School of Medicine/United States	24	39	0.39	817	**20.94**
12	Komasawa, Nobuyasu	Osaka Medical and Pharmaceutical University/Japan	18	34	0.34	189	**5.55**
12	Micaglio, Massimo	Università degli Studi di Firenze/Italy	14	34	0.34	433	**12.73**

13	Voyagis, Gregorios S.	University General Hospital of Patras/Greece	13	33	0.33	294	**8.90**
14	Nolan, J. P.	Warwick Medical School/United Kingdom	79	31	0.31	3620	**116.77**
15	Liao, Xu	Plastic Surgery Institute & Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College/China	18	29	0.29	91	**3.13**
15	Timmermann, Arnd	Pain Therapy/Germany	27	29	0.29	901	**31.06**
16	Hagberg, Carin A.	University of Texas MD Anderson Cancer Center/United States	30	28	0.28	1948	**69.57**

Table 3. Bibliometric indicators of top ten highly-publishing journals in LMA (1952-2021)

Rank	Source Title	H-Index	Country	Documents Count
1	Anaesthesia	124	United Kingdom	1049
2	Anesthesia and Analgesia	208	United States	487
3	Paediatric Anaesthesia	86	United Kingdom	448
4	British Journal of Anaesthesia	189	United States	405
5	Anaesthesia and Intensive Care	65	Australia	280
6	Journal of Clinical Anesthesia	72	United States	270
7	Canadian Journal of Anesthesia	102	United States	269
8	Anesthesiology	245	United States	262
9	European Journal of Anaesthesiology	80	United Kingdom	252
10	Japanese Journal of Anesthesiology	17	Japan	203

Key-word co-occurrence map

Figure 3 depicts the co-occurrence map of highly-frequent keywords of LMA papers (with minimum occurrence of 20). Therefore, only 23 keywords out of all 2,377 author-assigned keywords included in the map. The top three highly-frequent keywords were laryngeal mask airway (N=223), equipment (N=132) and airway management (N=116), respectively. Co-occurred keywords were in four clusters. The first cluster (in red) included 7 keywords (including among others, airway management, laryngeal masks and resuscitation). The second cluster (in green) covered 6 keywords (such as children, anaesthesia and propofol). The third cluster (in blue) consisted of 5 keywords (such as endotracheal intubation and difficult airway). The fourth cluster (in yellow) had 5 keywords (such as equipment and complications).

Source co-citation analysis

In highly cited LMA papers, 6,523 sources were used as references. 21 sources were cited 400 times or more. These sources were used for

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depicting the co-citation network (Figure 4). *Anaesthesia* was the main cited source. Three clusters were formed with the first cluster in red, including 10 journals such as *Anaesthesia, Anesthesia and Analgesia*, *Acta Anaesthesiologica Scandinavica* and *European Journal of Anaesthesiology*. Among 9 sources in the second cluster (in green) were *JAMA*, *Annals of Emergency Medicine*, *Chest*, and *Circulation*. The third cluster (in blue) included two journals: *Anaesthesia* and *British Journal of Aneasthesia*.
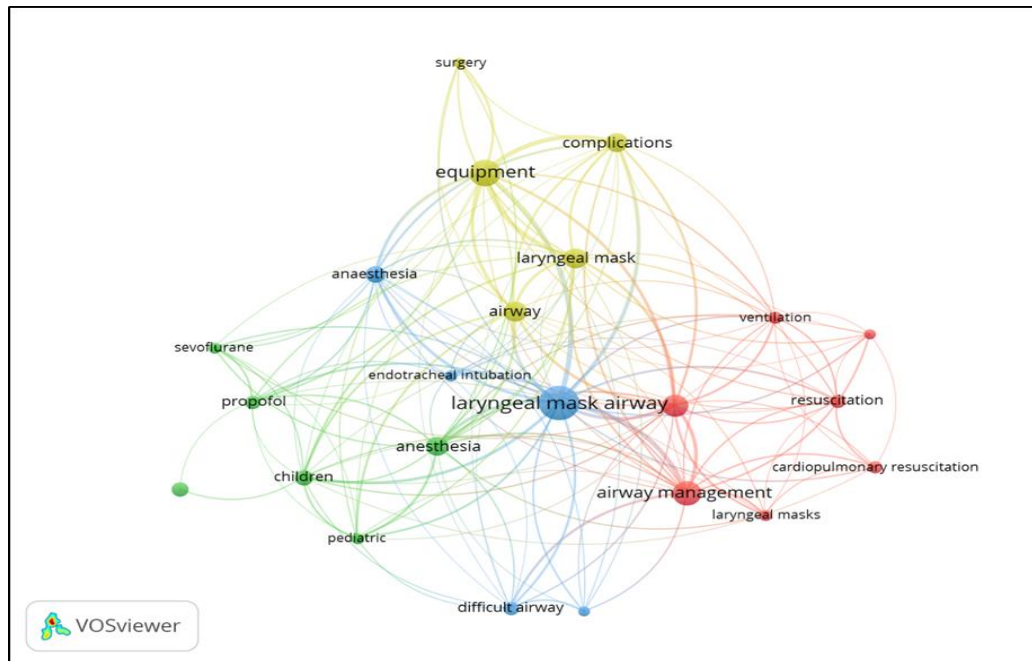
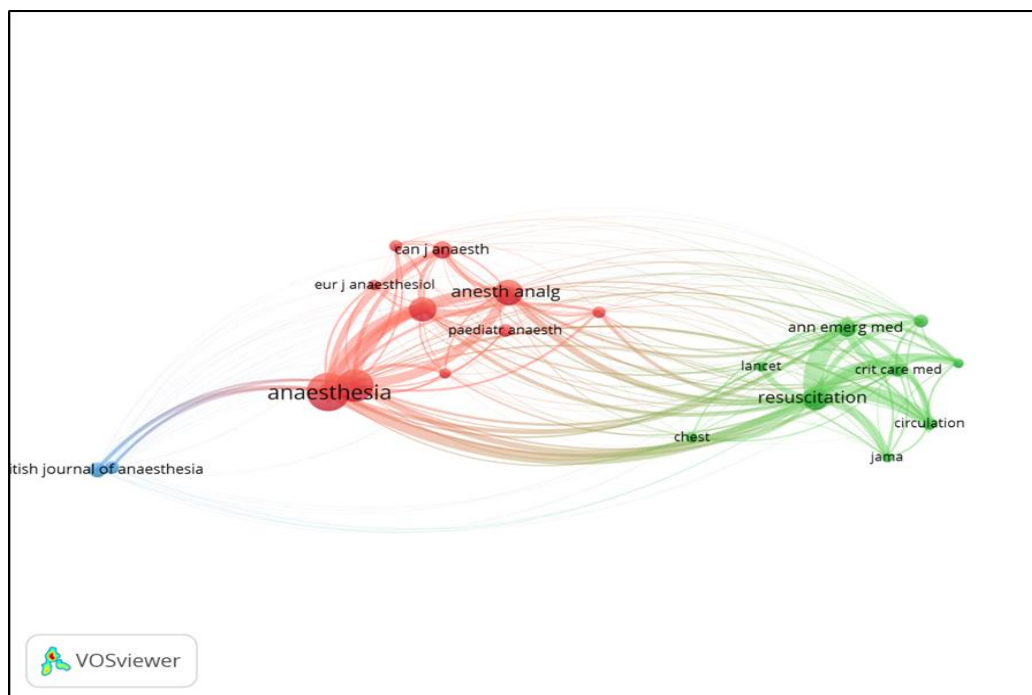**Figure 3.** Keyword co-occurrence network of papers published on LMA (1952-2021)

Figure 4. Source co-citation network of highly-cited papers published on LMA (1952-2021)

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Author co-citation analysis

60,337 individual authors were cited in LMA papers. Brimacombe, J. was the most highly-cited author with 2,627 received citations, followed by Keller, C. with 1,461 received citations and Cook, T.M. with 817 received citations, respectively.

Authors with at least 200 received citations were included in the author co-citation map (Figure 5). Four clusters were formed. As authors in a certain cluster are more co-cited, Brimacombe, J. and Keller, C. were the most co-cited author couple.
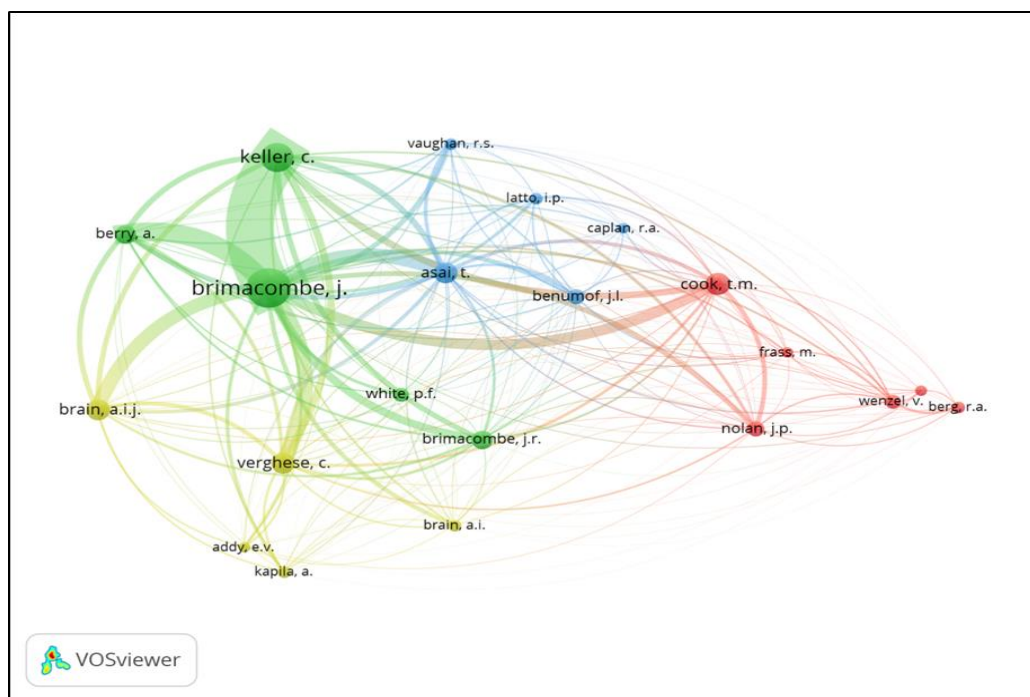

Figure 5. Author co-citation network of highly-cited authors cited in LMA (1952-2021)

Discussion

Laryngeal Mask Airway (LMA) is one of active research fields in anesthesia as the document co-citation analysis of the anesthetic literature showed in a recent study (12). It is one of highly-considered research subjects as reporetd in a systematic review (13). The field is a newly-emerged one that found its way in airway management, too (14). However, the global publications on the field have not been evaluated yet by applying bibliometrics, as a wide-used scientific evaluative technique. Therefore, this bibliometric survey aimed at analyzing the bibliometric indicators of the global research publication on LMA from its beginning in 1952 to 2021. Despite its ups and downs during the studied time span, the publication trend in LMA has been relatively steady during the studied years. This steady growth trend is a symbol of scientific progression in the field as to publishing research output. Active publishing countries in the field were mainly from American and European countries. as well as some Asian countries. Collaboration of other countries with these pioneering countries can potentially increase their contribution to the field and may be influential in developing its theory and practice worldwide. This is true regarding top productive authors and most-active research institutions as most were with American-European origin. No African author or research institute can be seen among top active authors and research institutes, too.

Most core journals in the field were from American and European countries (the USA and the UK). These journals are also highly-influential known ones in anesthesia as their h-index rates show. When considering the source co-citation network of the field, it interesting that some highly-cited journals are ones in other fields of medicine (such as *JAMA* and *Circulation*) that reflects the interdisciplinary and importance of research on LMA. Researchers' publishing in these highly-published/highly-cited journals can further reach their visibility and influence. Keyword co-occurrence analysis showed highly-considered topics and subject clusters in LMA as hot topics with a heavy research focus (such as difficult airway (15)). Co-occurred keywords and their clustering show the interrelated topics and helpful in finding different interests for potential co-authorship. Researchers in LMA can considered these topics as ones that are under recent study and argumentation.

Conclusion

This research found that the global publications on LMA have increased. Recently, topics such as "surgery", "management", "propofol" and "complications" appeared most frequently, which were active areas of research in this field. In the future research, research on these topics in combination with others may form the hotspot and mainstream research trend. The bibliometric depiction of LMA could inform strategy on the future directions of LMA research. The findings show that countries with high income are effective in the field of anesthesia. Undeveloped and developing countries (especially African regions) should be encouraged to conduct research in the field.Despite some limitations related to data extraction, selected indexing database and other natural constrains of bibliometric studies, this study is the first to give a relatively comprehensive bibliometric analysis and visualization of global research publication in LMA.

Conflicts of Interest

The authors declare no conflicts of interest.

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