A Bibliometric Analysis of the 100 Most Cited Articles on Nitrous Oxide Conscious Sedation

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Abstract

Background: A bibliometric analysis helps to analyze the affluence of research articles in a specific field. Citation analysis determines the popularity and impact of research articles, authors, and publications within a field. The aim of this study is to employ bibliometrics to purvey statistical analysis of publications on nitrous oxide conscious sedation published from 1972 to 2021.

Method: The titles and abstracts of the articles were taken from Elsevier's Scopus database. The articles were independently scrutinized by two authors and selected based on their citation and study characteristics. VOSviewer software was used to create a collaboration network amongst keywords, authors, affiliations, and countries.

Conclusion: A total of 729 articles were published on nitrous oxide conscious sedation, out of which 100 most cited articles were extracted and analyzed. Amid the papers with high levels of evidence, 2 were meta-analyses and 6 were randomized clinical trials. The topic most addressed was the systematic approach for safe sedation of children for procedures and comparison of different drugs used in sedation procedures.

The findings of this paper will help clinicians and students to refer appropriate articles for evidence-based clinical decision-making as well as to follow a methodical approach for sedation procedure.

Keywords: *Anxiolysis, Conscious sedation, Inhalational sedation, Nitrous oxide.*

Introduction

Patient management is basic premise for a successful dental treatment especially when children are considered.[2] Therefore,to instill positive attitude towards dental care in younger generation and for a successful outcome, behavioralmanagement is considered as a cornerstone in pediatric dentistry. There are substantial alternatives to manage them, however, proper selection of behavioral management technique is utmost important.[3]

Conscious sedation, a pharmacological technique of behavior management, has recently gained a lot of interest in medicine and dentistry due to its long history of safety for almost all patients routinely treated in the ambulatory dental setting.[2,8] In fact, it could be considered as the safest of all the modalities available for sedation in dentistry, nonetheless poses few limitations or may at least pose a relative contraindication.[8] Therefore, carefully inspecting the

medical history of a patient is an utmost important. For e.g.in inhalational sedation, the inability to use a nasal mask is an absolute contraindication to the use of nitrous oxide.[2]

A significant number of studies have been published regarding nitrous oxide conscious sedation. The scientific publications have grown progressively in terms of both the number of journals and their content in last decades. This makes it cumbersome for clinicians to find the most valuable article for evidence based clinical decision. Hence, the objective of this present study was to identify the top-cited articles published on nitrous oxide conscious sedation in the context of pharmacological behavior management technique to accentuate the influential papers and authors over time. Also, the characteristic features of the most cited articles have been discussed.

Procedure

1. Data Source

An electronic bibliometric search was conducted on Elsevier's Scopus database using the search strategy "Nitrous Oxide" AND "Conscious Sedation" on 14th March 2021 with no search restriction on the publication year. A total of 100 top-cited articles were extracted. The search included papers published in peer-reviewed journals in the English language. The top 100 highly cited articles were scrutinized and designated according to the descending order of the citation count. Citation count, if similar, was ranked according to a recent year of publication. For every article, data compilation for each article included the title of the paper, journal name, publication year, institution name country of origin, and the authors.

2. Data Extraction

An independent search was conducted by two authors (PP & NQ) in which journal name, publication year, affiliations, country of origin, and the authors were extracted from the selected article. Any, disagreement if present, was resolved by the third author (MP). Analysis and network visualization of the extracted data was done with the help of VOSviewer software (version 1.6.13; Leiden University Center for Science and Technology Studies, Netherlands).

Results

1. Citation count and publication year

The top-cited articles received 7911 total citations, with an h-index of 52. Total citations after removal of self-citations were 7409, with an h-index of 49. All the articles werepublished in English. The number of citations in the last five years varied between 95 and 495 (average number of citations = 385.6). The top 3 articles received more than 200 citations each. The guidelines are given by Coté et al, i.e., Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: An update published in American Academy of Pediatrics has been cited the maximum number of times (473). A review by Krauss et al in the New England Journal of Medicine has received 325 citations followed by an Audit given by Pandit et al was cited 214 times. The least number of citations (34) was received by four articles, and these were ranked in the list according to their citation density. The year 1996 had the highest number of publications of the top 100 articles (n = 8) followed by 2004 (n=7) and 2003 and 2004 (n=6). There was an increase in the prBoportion of articles on nitrous oxide conscious sedation from 1991. (Figure-1)

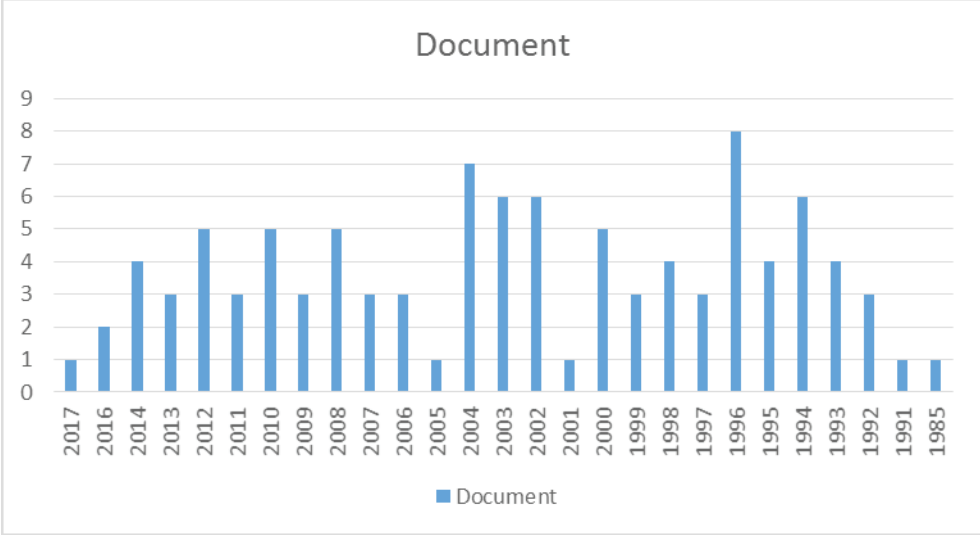

Figure-1 represents the documents based on the year of publication.

2. Authors

A total of 158 researchers contributed to the top-cited articles. Litman RS and Berkowitz RJ authored seven articles each (Figure 2). 82 articles had 1-5 authors contributing to the research, whereas the remaining 18 articles had 6 to 12 authors in collaboration. A collaboration network on Vosviewer softwarewas also developed and the analysis showed collaboration between authors who contributed to 2 or more articles of 100 highly cited article list. There was a strong association seen between authors in 7 clusters. The number of articles published by each author is denoted by nodes, and the number of publications between two researchers who have co-authored is represented by the joining lines.*(Figure 3)*

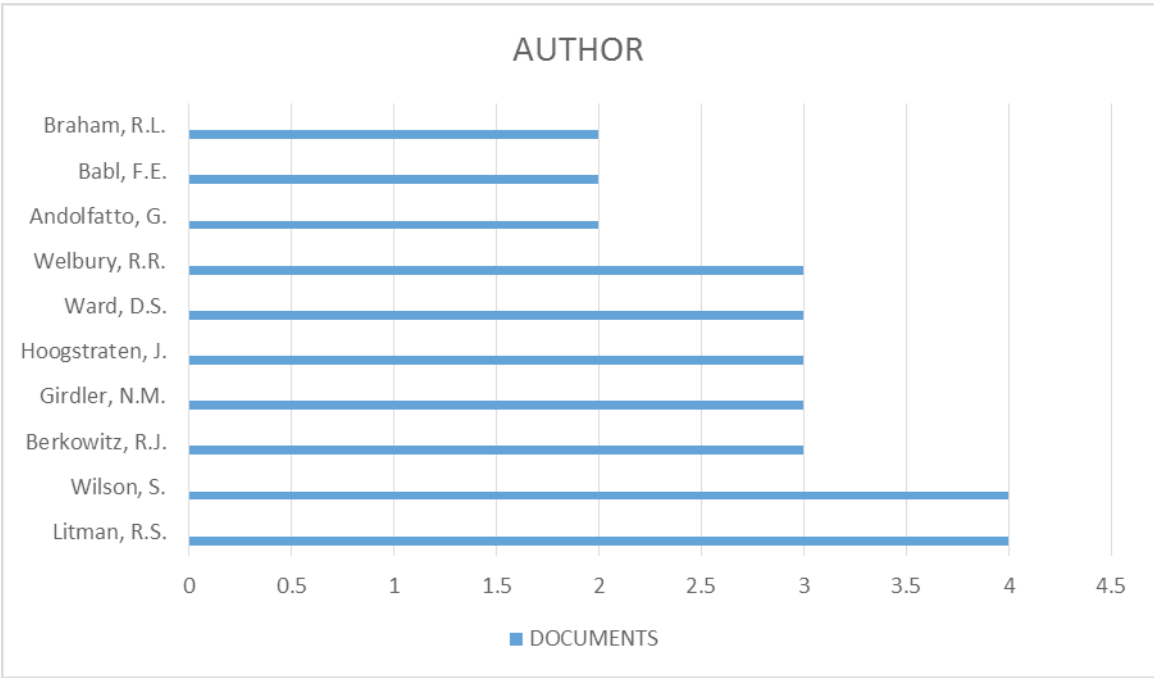

Figure 2 shows the number of documents per author.

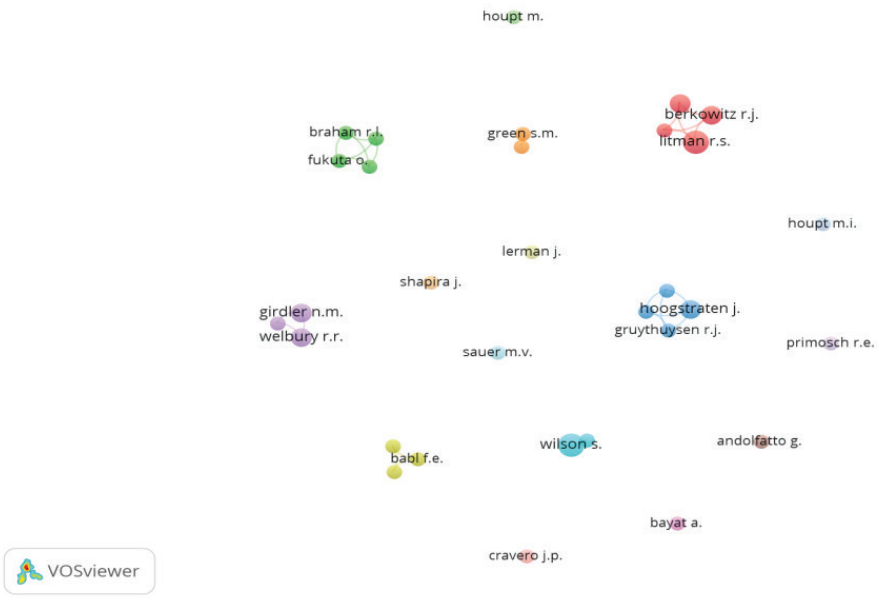

Figure 3represents the network collaboration between authors.

Table 1 represents the journals in which the 100 most cited articles were published.

Journal	Impact Factor	Subject Area and Category	Total number of Articles
1. Pediatric Dentistry	1.9	General Dentistry; Dentistry	12
2. Anaesthesia	8.3	Medicine: Anesthesiology and Pain Medicine	5
3. Anesthesia And Analgesia	5.8	Medicine: Anesthesiology and Pain Medicine	4
4. Archives Of Pediatrics And Adolescent Medicine	-	Medicine: Pediatrics, Perinatology and Child Health	4
5. PaediatricAnaesthesia	3.5	Medicine: Pediatrics, Perinatology and Child Health; Medicine: Anesthesiology and Pain Medicine	4
6. Pediatrics	9.6	Medicine: Pediatrics, Perinatology and Child Health	4
7. Anesthesiology	8.1	Medicine: Anesthesiology and Pain Medicine	3
8. Asdc Journal Of Dentistry For Children	-	Dentistry: General Dentistry	3
9. British Journal OfAnaesthesia	9.4	Medicine: Anesthesiology and Pain Medicine	3
10. Endoscopy	7.4	Medicine: Gastroenterology	3
11. International Journal OfPaediatric Dentistry	3.6	Dentistry: General Dentistry	3
12. Journal Of Oral And Maxillofacial Surgery	2.8	Dentistry: Oral Surgery; Medicine: Surgery; Medicine: Otorhinolaryngology	3
13. Anesthesia Progress	0.8	Medicine: Anesthesiology and Pain Medicine	2

***Cont...*Table 1 represents the journals in which the 100 most cited articles were published.**

14. Annals Of Emergency Medicine	7.4	Medicine: Emergency Medicine	2
15. Archives Of Disease In Childhood	4.7	Medicine: Pediatrics, Perinatology and Child Health	2
16. Current Opinion InAnaesthesiology	4.2	Medicine: Anesthesiology and Pain Medicine	2
17. Gastrointestinal Endoscopy	7.3	Medicine: Radiology, Nuclear Medicine and Imaging; Medicine: Gastroenterology	2
18. Journal Of Clinical Pediatric Dentistry	1.7	Dentistry: General Dentistry; Medicine: Pediatrics, Perinatology and Child Health	2
19. Academic Emergency Medicine	5	Medicine: Emergency Medicine	1
20. American Journal Of Dentistry	1.5	Dentistry: General Dentistry	1
21. Anesthesiology Clinics	3.5	Medicine: Anesthesiology and Pain Medicine	1
22. British Journal Of Radiology	3.7	Medicine: Radiology, Nuclear Medicine and Imaging	1
23. Canadian Journal OfAnaesthesia	5.3	Medicine: Anesthesiology and Pain Medicine	1
24. Chest	12.1	Medicine: Critical Care and Intensive Care Medicine; Medicine: Cardiology and Cardiovascular Medicine; Medicine: Pulmonary and Respiratory Medicine	1
25. Cochrane Database Of Systematic Reviews	7.4	Medicine: Pharmacology (medical)	1
26. Community Dentistry And Oral Epidemiology	4.1	Dentistry: General Dentistry; Medicine: Public Health, Environmental and Occupational Health	1
27. Contraception	5.1	Medicine: Obstetrics and Gynecology; Medicine: Reproductive Medicine	1
28. Current Opinion In Pediatrics	4.3	Medicine: Pediatrics, Perinatology and Child Health	1
29. Danish Medical Journal	2.2	Medicine: General Medicine	1
30. Digestive Diseases And Sciences	5.1	Medicine: Gastroenterology; Biochemistry, Genetics and Molecular Biology: Physiology	1
31. Drugs	9.6	Medicine: Pharmacology (medical)	1
32. EMA Emergency Medicine Australasia	2.0	Medicine: Emergency Medicine	1
33. Emergency Medicine Clinics Of North America	3.3	Medicine: Emergency Medicine	1

Cont... **.Table 1 represents the journals in which the 100 most cited articles were published.**

34.Emergency Medicine Journal	3.2	Medicine: Emergency Medicine; Medicine: Critical Care and Intensive Care Medicine	1
35. European Journal Of Gastroenterology And Hepatology	3.8	Medicine: Gastroenterology; Medicine: Hepatology	1
36. European Respiratory Journal	12.9	Medicine: Pulmonary and Respiratory Medicine	1
37. Expert Review Of Neurotherapeutics	6.2	Medicine: Pharmacology (medical); Medicine: Neurology (clinical); Neuroscience: General Neuroscience	1
38. Fertility And Sterility	9.8	Medicine: Obstetrics and Gynecology; Medicine: Reproductive Medicine	1
39. JAMA Ophthalmology	9	Medicine: Ophthalmology	1
40. JAMA The Journal Of The American Medical Association	26.3	Medicine: General Medicine	1
41. Journal Of Assisted Reproduction And Genetics	4.6	Medicine: Obstetrics and Gynecology;Medicine: Reproductive Medicine;Biochemistry, Genetics and Molecular Biology: Developmental Biology;Biochemistry, Genetics and Molecular Biology: Genetics;Medicine: Genetics (clinical)	1
42. Journal Of Neurointerventional Surgery	7.2	Medicine: Surgery;Medicine: Neurology (clinical)	1
43. Journal Of Neurosurgical Anesthesiology	4.4	Medicine: Surgery;Medicine: Anesthesiology and Pain Medicine;Medicine: Neurology (clinical)	1
44. Journal Of Pain And Symptom Management	5.1	Nursing: General Nursing;Medicine: Anesthesiology and Pain Medicine; Medicine: Neurology (clinical)	1
45. Journal Of Pediatric Surgery	3.5	Medicine: Surgery; Medicine: Pediatrics, Perinatology and Child Health	1
46. Journal Of The American Association Of Gynecologic Laparoscopists	-	Medicine: Obstetrics and Gynecology	1
47. Journal Of The American Dental Association	4.3	Dentistry: General Dentistry	1
48. Neurology	10.4	Medicine: Neurology (clinical)	1
49. New England Journal Of Medicine	66.1	Medicine: General Medicine	1
50. Pediatric Drugs	3.9	Medicine: Pediatrics, Perinatology and Child Health; Medicine: Pharmacology (medical)	1

Cont... **.Table 1 represents the journals in which the 100 most cited articles were published.**

51.	Pediatric Emergency Care	1.6	Medicine: Emergency Medicine; Medicine: Pediatrics, Perinatology and Child Health	1
52.	Pediatric Radiology	3.6	Medicine: Pediatrics, Perinatology and Child Health; Medicine: Radiology, Nuclear Medicine and Imaging	1
53.	Psychopharmacology	6.3	Pharmacology, Toxicology and Pharmaceutics: Pharmacology	1
54.	Thorax	13.3	Medicine: Pulmonary and Respiratory Medicine	1
55.	World Journal Of Gastroenterology	7.1	Medicine: Gastroenterology	1

c. Impact factor

Table 1 represents the impact factor(IF) of the list of journals. The articles identified in the search were published in 55. The maximum number of articles (n = 12) were contributed by the pediatric dentistryjournal, followed by the anesthesia journal (n=5), anesthesia and analgesia, archives of pediatrics, adolescent medicine, and pediatricanesthesia (n=4)). Rests of the six journals have contributed three, six journals contributed two and thirty- seven journals contributed only a single article, each in the top 100 list. The IF of the journals ranged from 0 to 66.1 (average 6.78). Impact factor 66.1 was the highest which was the New England journal of medicine, which contributed one article.

d. Institute, Countries of origin

The top-cited 100 most influential articles on nitrous oxide conscious sedation originated from 21 different countries. United States carried out a total of 50 studies, followed by 15 in Australia, Netherland.Figure 3 shows the collaboration network of countries formed applying a threshold of 2 or more collaborations. Most relatable articles were published by collaboration between Greece, Spain, Denmark and Germany. Greece, Spain and Denmark have more collaboration with Netherland and Switzerland. *(Figure 4)*

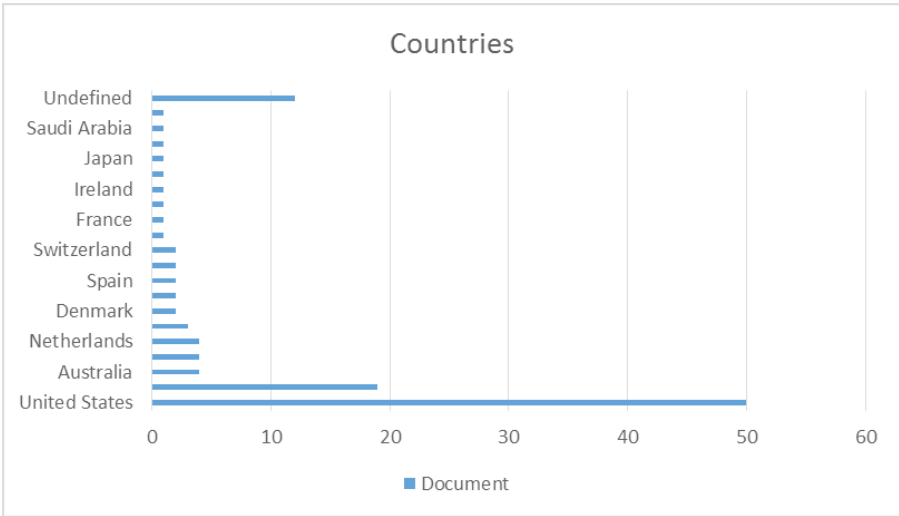

Figure 3 represents the number of documents per country.

Figure 4 represents the network collaboration between countries.

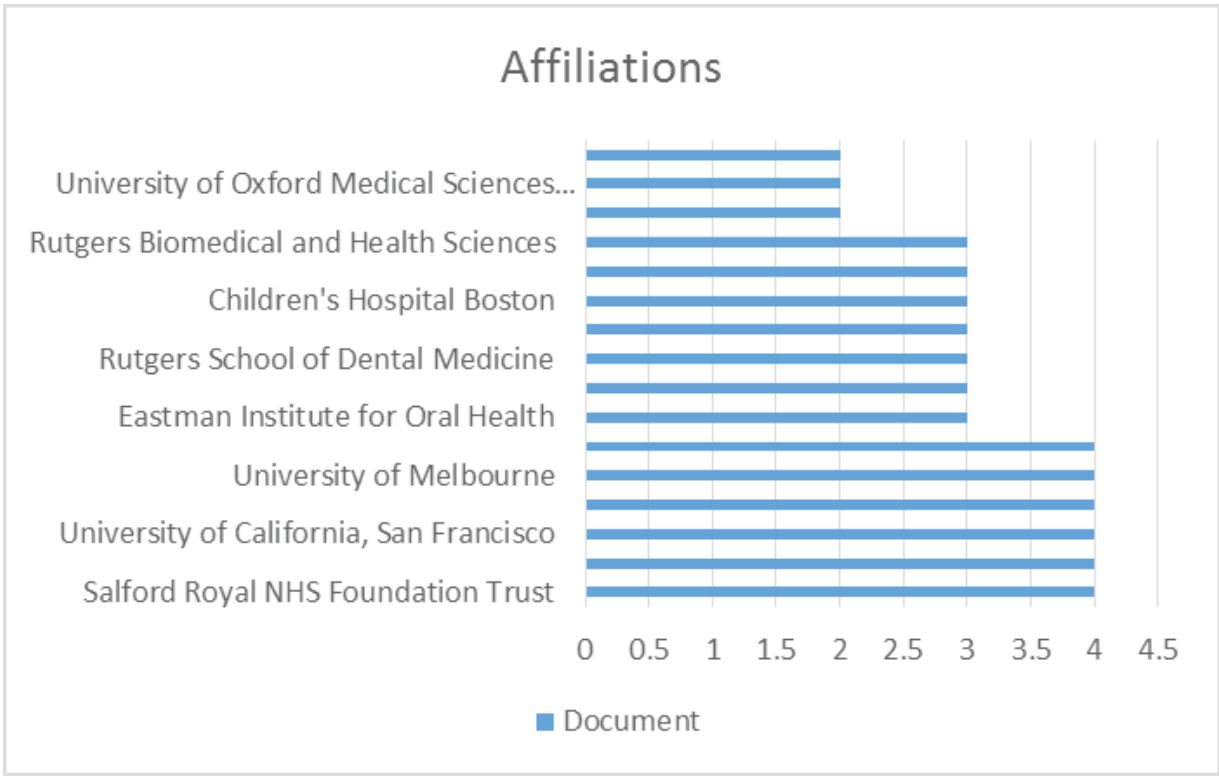

Figure 5 represents the number of documents per Institute/Affiliation

The Salford Royal NHS Foundation Trust, University of California(San Francisco), University of Melbourne published the most papers (n = 4), which is followed by Eastman Institute for Oral Health, Rutgers School of Dental Medicine, Children's Hospital Boston and Rutgers Biomedical and Health Sciences (n=3). *(Figure 5)*

e. Type of study and Topic addressed.

There were 45 original articles, 14 review papers, 6 guidelines, 2 curriculums and 2 conference papers. Cohort (n = 27) was a common study design, followed by expert opinion/narrative reviews (n = 22), questionnaire (n=4) and survey (n = 4). These study designs represented nearly 57% of all the articles. Amongst the studies with high levels of evidence, 2 were meta-analysis and 6 were randomized clinical trials. The topics commonly addressed were safety guidelines for administration of different drugs, preventive measures/treatment, and the comparison between different drugs. The subject area mostly covered is medicine followed by dentistry.

f. Keywords

Of the top-cited studies, a total of 157 keywords were identified with minimum occurrence of 5. *Figure 6*exhibits the keyword co-occurrence network analysis. The biggest node is "human" which appeared 99 times followed by "nitrous oxide" (90) and "conscious sedation" (86).

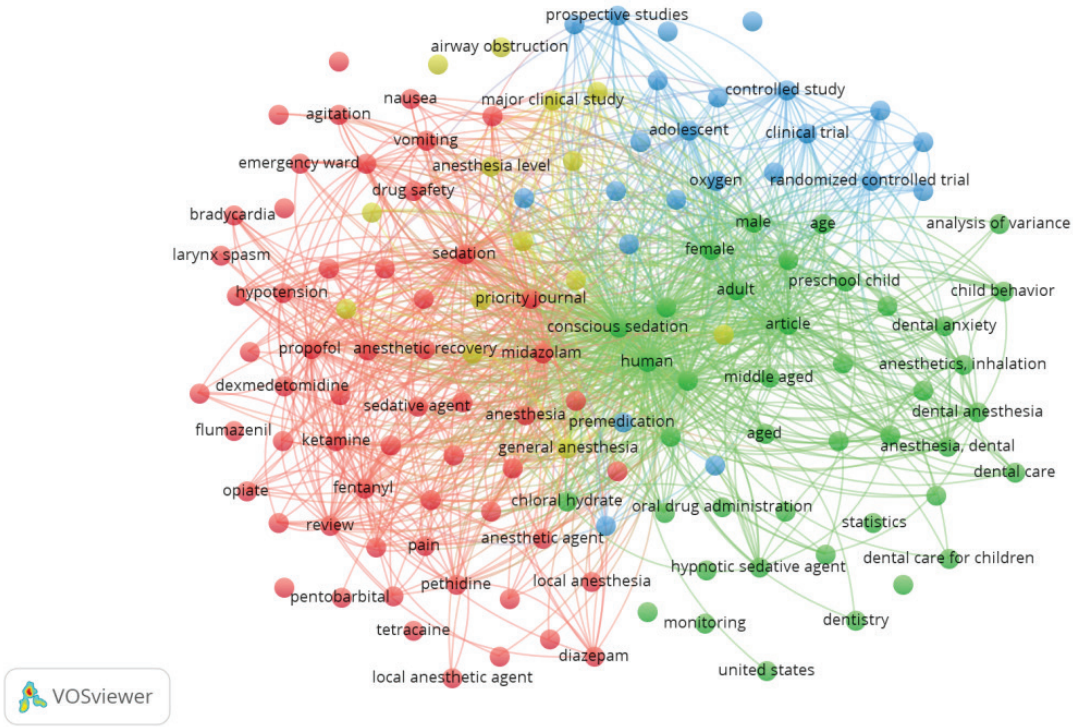

Figure 6 represents the keyword co-occurrence network of the 100 top-cited articles

Discussion

This article annals a bibliometric approach in terms of evidence-based decision making while using pharmacological behavior management of uncooperative children. With a huge number of articles published on nitrous oxide conscious sedation, it is difficult for researchers, students, and clinicians to narrow their search for attainable number of high-quality articles. Thequality of the publication by the scientific journal is solely appraised by the impact factor but does not usually commensurate correctly to the standard or popularity of the publication. Citation analysis is one of the statistical tools to assess the most remarkable articles in a specific field. The distinction of article is recognized based on the number of citations. Garfield stated that publications receiving 100 or greater citations are classified as classic papers.[2] This study identified 19 articles that have been cited more than 100 times, making them citation classics. There was an increasing trend of publication since 1991. The discrepancies in publication growth rates may partly be associated with advances in techniques and materials triggering scientific growth and research. The oldest and most recent publications were from the years 1985 and 2017, respectively. The top-cited articles on nitrous oxide conscious sedation have more than 300 citations, in agreement with different specialties.In respect of scientific articles by individual authors, Litman RS and Berkowitz RJ topped the list with 4 articles as the first author. The average number of authors per article were 1.58. There is a strong association seen between authors in 7 clusters, but they are located far apart showing less relatedness between them.

The h-index (Hirsch cited index), a metric that evaluates the cumulative impact of an author's proficiency and collates publications to citations, was estimated.25 An h-index of 50 of the most commended articles was found, which means that 50 papers, published on Nitrous oxide conscious sedation, have minimum of 50 citations. However, author's cumulative research contribution is not a comprehended by the h-index.[5] Twenty-five years ago, almost all the articles on nitrous oxide conscious sedation were from researchers in the United States. The findings show that higher economic countries are inclined towards biomedical research, conceivably due to better medical resources and funding. The findings of our study showed a vast number of scientific papers originated from universities in the United States. The United States, Australia, Netherlands, Spain, Switzerland and Denmark account for nearly 69% of the top-cited publications. The level of evidence of any paper is strongly linked to study design. Evidence-based practice, high-quality research, preferably systematic reviews, randomized clinical trials, and cohort studies are given primacy.

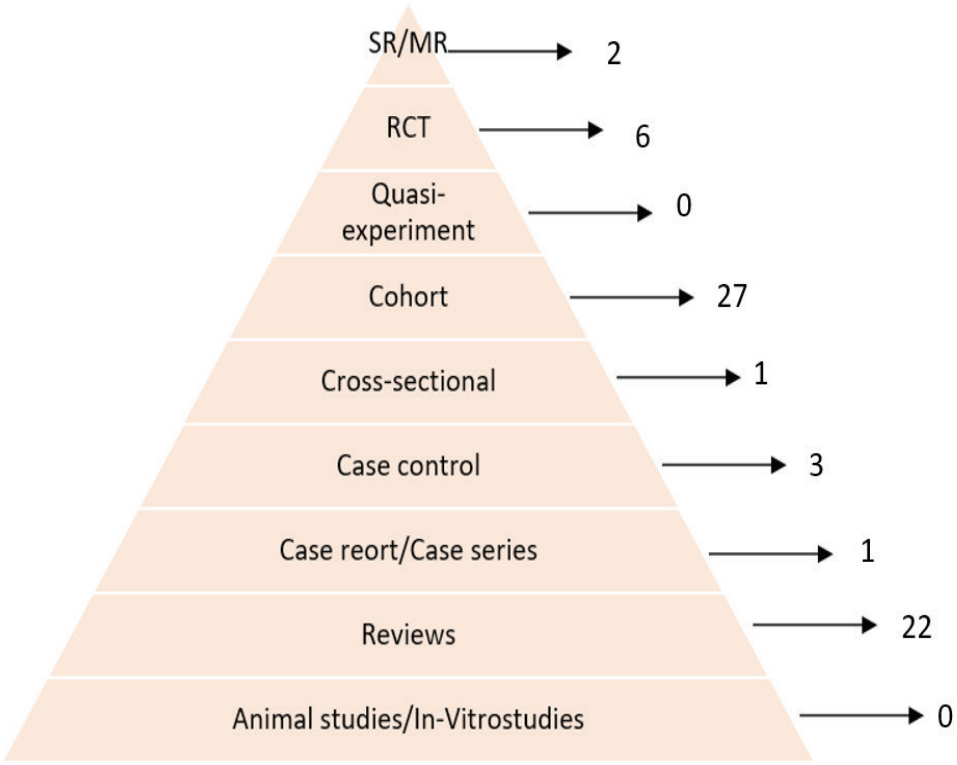

Figure 7Distribution of articles on early childhood caries according to study design

Regarding the topics addressed, a considerable number of articles consisted of cohort studies, mostly comparing different drugs used while sedation procedure. Reviews were mostly based on the systematic approach for the safe sedation of children for procedures. Out of the 3 topmost cited articles, the first paper mentioned the guideline given by collaborative effort of the American Academy of Pediatrics and the American Academy of Pediatric Dentistry to offer pediatric dentists an updated information and guidance to systematically deliver safe sedation in children.[6]An audit 5th National Audit Project (NAP5) which presented the main findings on accidental awareness during general anesthesia (AAGA)[20]was the second article followed by a review on systematic approach for pain management and anxiolysis, including education of the staff and protocol development, in emergency setting for children.[10] It is imperative to conduct more systematic reviews and meta-analysis on different field to acquire more knowledge about administration of different drugs and their pharmacokinetics and pharmacodynamics.

All the keywords by author and indexed in the publication were analyzed by VOSviewer software. The articles of the relevant topics are retrieved by using from various search engines keywords aid researchers to retrieve articles relevant to a topic keyword from various search engines, authors wisely select the keywords. The keyword 'Nitrous oxide' and 'Conscious sedation' appeared 99 and 86 times, respectively.

Although bibliometric analysis evaluates the importance and impact of the article in a specific field, it has few inherent limitations. The Scopus database was used in this study to retrieve the citation analysis information. Albeit Scopus is the most authentic and comprehensive database and provides about 20% more coverage than Web of Science[19]. It may not

be representative of the entire peer-reviewed paper; therefore the probability of exclusion of influential articles from other databases (PubMed and Web of Science) cannot be ruled out.

Citation analysis is usually belittled with the influence of time. Articles published earlier usually get enough time to get global circulation and hence stand a higher chance for receiving added citations than the recently published papers irrespective of the scientific value. Hence, the recent papers, although highly significant, would not reflect in such an analysis. Moreover, studies that have become landmark trials achieve fewer citations over time, because their findings are so universally accepted that their source or contributors are often forgotten. This is known as 'obliteration by incorporation' effect.[23]Thus, citation count does not remark the quality of an article but helps a quantitative evaluation of the scientific impact of a paper in a specific field. Similarly, no significant differences were reported in the h-index as well.

Conclusion

For pediatric patients with intellectual disability and fearful patients with low pain tolerance, conscious sedation can be considered as safe, practical and effective. When an inhalational anesthetic is considered, nitrous oxide as a single agent provides exemplary safety and is excellent for providing anxiolysis for apprehensive patients.

1. This is the first article to describe a bibliometric analysis of nitrous oxide conscious sedation in terms of evidence-based dentistry that gives a satisfactory scientometric view of Nitrous oxide conscious sedation research in the world.

2. The list of top-cited articles herein presented will serve as an important source of information for clinicians in making clinical decision making as well for planning systematic approach in procedural sedation.

3. Expanding international exchanges has encouraged academic collaborations. More such collaborations amongst researchers are required in the future to establish a systematic approach for safe sedation procedure.To achieve a complete appreciation during its clinical use, expansion of such international exchanges through academic collaborations is recommended.

4. The quality of the publication is not necessarily reflected by the number of citations. A further research and analysis are needed with other databases that could give a better apprehension about the dynamics of citations.

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Conflict of Interest - Nil

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