



## Bibliometric and visual analysis of global research: Enhanced Recovery After Caesarean Surgery (ERACS)

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### ABSTRACT

**Background:** ERACS (Enhanced Recovery after Caesarean Surgery) is a method developed in obstetric services. Its global popularity has grown in recent years. The purpose of this article is to find out the extent to which ERACS has been researched and published in the world over the past ten years. Researchers also want to know an overview of the scope of research related to ERACS. **Methods:** This research is a quantitative study by analyzing bibliographic data using the VOS viewer program. Bibliographic data on ERACS was searched through Scopus ([www.scopus.com](http://www.scopus.com)) and processed with the VOS viewer program. **Results:** 123 publications with ERACS-related papers over the previous 10 years were found in the search results. The most is in the United States. Nelson, G is the researcher who has the greatest productivity. In the analysis of terms in the research abstract, there are 5 clusters. The most widely used term in the article is "caesarean section" with 109 occurrences. Based on the keyword analysis used, cluster 1 theme is about "Postoperative care", cluster 2 theme is about "obstetric anesthesia", cluster 3 theme is about "preoperative and perioperative care", cluster 4 theme is about "postoperative pain" and cluster 5 theme is about "enhanced recovery after surgery". **Conclusion:** This bibliometric analysis presents the current state of ERACS programs from a variety of angles and serves as a resource and pointer for scholars conducting additional research. Postoperative care, obstetric anesthesia, preoperative and perioperative care, postoperative pain, and enhanced recovery after surgery are the themes that appear in this bibliometric analysis.

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### INTRODUCTION

Enhanced recovery after cesarean surgery, or ERACS, has been widely implemented to improve hospital productivity, mother recovery, patient happiness, and obstetric services (Sultan et al., 2022). It has recently gained popularity. 40% of British women return home the next day after an elective cesarean section (Adshead et al., 2020).

In recent years, enhanced recovery following surgery (ERAS) has been used in obstetrics and thoroughly researched for cesarean section. Cesarean deliveries can successfully use ERAS principles with great protocol compliance (Shinnick et al., 2021). The analgesia and recovery outcomes following cesarean section have significantly improved since the ERAS regimen was

implemented. This increase in healthcare quality indicates that the ERAS technique may be used for elective cesarean surgery (Kleiman et al., 2020). In clinical settings, ERACS is demonstrating promising effects. The information that is now available indicates that ERACS dramatically lowers postoperative complications, lowers postoperative pain scores and opioid use, lowers hospital stays and maybe lowers hospital expenditures without impacting remission rates. Consequently, the ERACS implementation protocol is created (Meng et al., 2021).

Other studies have demonstrated that ERACS can decrease hospital expenses, decrease the occurrence of problems, and shorten the length of stay (LOS). The study strengthens the case for the viability, efficacy, and safety of ERACS. The results should be confirmed by larger,

randomized controlled investigations, however this is constrained by the size and quality of the study and its possible heterogeneity (Meng et al., 2021). The neonate is not adversely affected by the ERACS protocol's application, and it may even be advantageous for the mother and her child (Chiao et al., 2022).

ERACS is a pre-, intra-, and postoperative multidisciplinary, evidence-based strategy. Accelerating recovery and enhancing mother and newborn outcomes are the main objectives of ERACS. The development of pregnancy-specific optimal procedures is only getting started with ERACS. In the future, all new mothers may be given priority for a swift recovery to help them quickly regain their physical and mental functioning level while minimizing hospital expenses and medical resource waste (Liu et al., 2020). Other ERACS investigations were able to demonstrate a significantly shorter postoperative stay and a significantly higher rate of exclusive breastfeeding (Teigen et al., 2020).

The millions of women who will undergo a cesarean delivery each year have less focus on improving perioperative outcomes despite ongoing worries about high cesarean delivery rates globally. Over the past few years, preliminary ERACS research has been conducted in a number of countries (Peahl et al., 2019). By using bibliometric analysis, researchers can determine the scope of ERACS research advancement globally over the previous ten years. Bibliometric analysis is a quantitative technique for examining bibliographic information in articles and journals. This analysis is typically used to investigate the references of scientific articles cited in a journal, to map scientific articles in a journal, and to categorize scientific articles based on their field of research. Scopus is used to search for a bibliography as the source of the database to be used. The choice to use Scopus because Scopus is one of the largest databases providing *literature and peer-reviewed publications* (Herawati et al., 2022).

VOS viewer is a program designed for creating and viewing bibliometric maps. The program is freely available to the bibliometric research community ([www.vosviewer.com](http://www.vosviewer.com)). VOS viewer can be used to create author or journal maps based on correlation data, as well as data-driven keyword maps. The program allows you to customize the appearance of bibliometric maps. Maps can be displayed in a variety of ways, each emphasizing a different aspect of the map. VOS viewer's viewing capability is ideal for maps with a large number of items (at least 100 items). VOS viewer employs VOS mapping techniques to generate a map. Vos is an abbreviation for Visualization of Similarities. VOS viewer can display maps that have been created using appropriate mapping techniques. VOS viewer can create and display co-citation maps from over 5,000 scientific journals (van Eck & Waltman, 2010).

There are two kinds of bibliometric maps. Distance-based maps and graphs. The distance between two items on a distance-based map represents the strength of their relationship. Shorter distances generally signify better partnerships. Items are commonly placed irregularly on a distance-based map. The distance between two things on a graph-based map does not have to indicate the intensity of their relationship. A line is created between the elements to illustrate the link. Items are usually distributed in a relatively consistent manner in graph-based maps (van Eck & Waltman, 2010).

The purpose of this article is to find out the extent to which ERACS has been researched and published in the

world over the past ten years. Researchers also want to know an overview of the scope of research related to ERACS.

## METHODS

**Research Specifications:** this research is a quantitative study by analyzing bibliographic data using the VOS viewer program.

**Research Material:** bibliographic data on ERACS research from 2012 to 2022 taken through Scopus ([www.scopus.com](http://www.scopus.com)).

**Data Collection Techniques:** researchers use data from international publications sourced from Scopus data. Data collection through search with *keywords* "(TITLE-ABS-KEY (enhanced AND recovery AND after AND caesarean AND surgery) OR TITLE-ABS-KEY (enhanced AND recovery AND after AND cesarian AND delivery)) AND PUBYEAR > 2012 AND ( LIMIT-TO ( SUBJAREA , "MEDI" ) OR LIMIT-TO ( SUBJAREA , "NURS" ) OR LIMIT-TO ( SUBJAREA , "PHAR" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )".

**Data Processing Techniques:** data exported from Scopus and VOS viewer programs.

**Data Analysis:** data obtained through searching on Scopus, then analyzed using four steps. namely the search stage, filtering stage, bibliometric attribute check, and bibliometric analysis.

## RESULT AND DISCUSSION

On search using Scopus, with keywords "(TITLE-ABS-KEY (enhanced AND recovery AND after AND caesarean AND surgery ) OR TITLE-ABS-KEY ( enhanced AND recovery AND after AND cesarian AND delivery ) ) AND PUBYEAR > 2012 AND ( LIMIT-TO ( SUBJAREA , "MEDI" ) OR LIMIT-TO ( SUBJAREA , "NURS" ) OR LIMIT-TO ( SUBJAREA , "PHAR" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )" 123 publications were obtained. Data analysis and categorization are carried out based on the number of documents produced each year, the author, the reference, the journal source, the university affiliation, the document type, the topic area, and the country conducting an ERACS study.

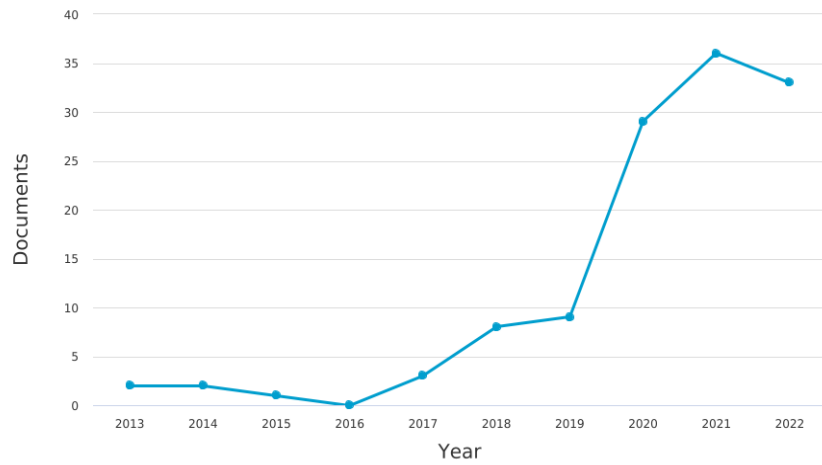
### Analysis of the Number of Publication Documents per Year

According to the curve in Figure 1, research on ERACS began to be widely conducted in 2017 and peaked in 2021. As many as 36 ERACS studies were published in 2021; 33 studies were published in 2022.

### Analysis of the Number of Publication Documents per Country in the World

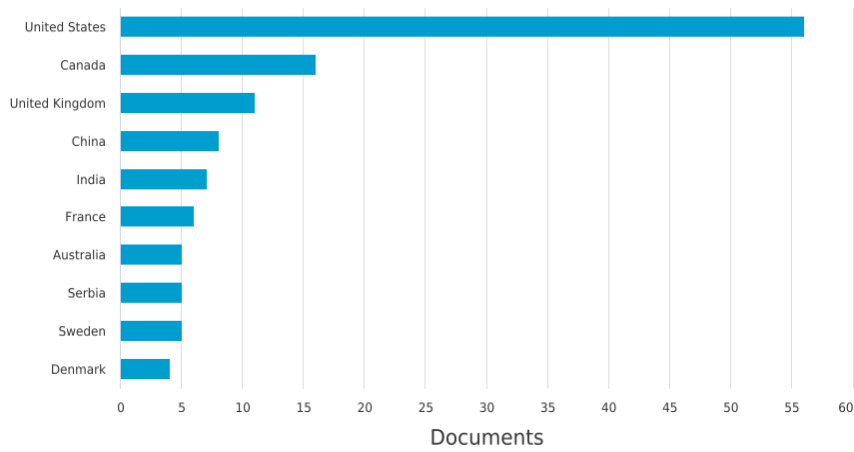
Figure 2 shows that the United States has the most ERACS research materials, with 56 publications. Following the United States, the top five nations producing ERACS research documents are Canada (16 documents), the United Kingdom (11 documents), China (8 documents), and India (7 documents). The global distribution of ERACS research and publications has been uneven. This is seen in the map in figure 3.

The majority of publishing papers, 52.8%, are in the form of articles. The second most often published items, 23.6%, were reviews. This is seen in Figure 5.



Source: Scopus database

Figure 1. Documents by year



Source: Scopus database

Figure 2. Documents by country

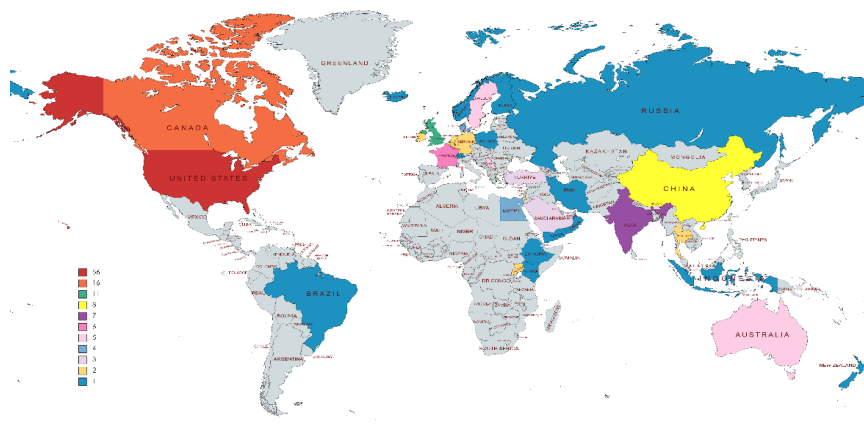
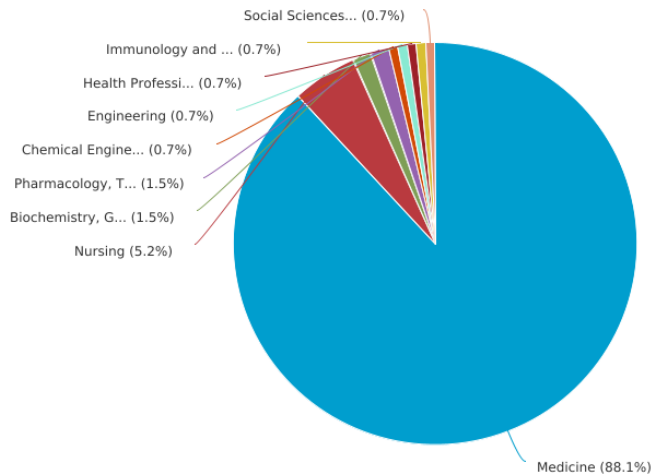
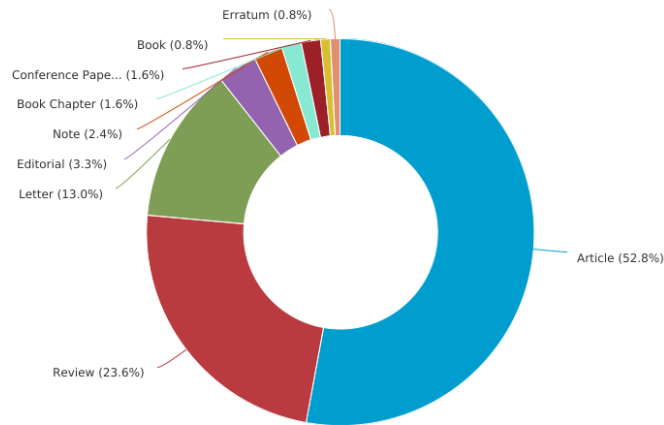


Figure 3. Spread of ERACS Research in the World

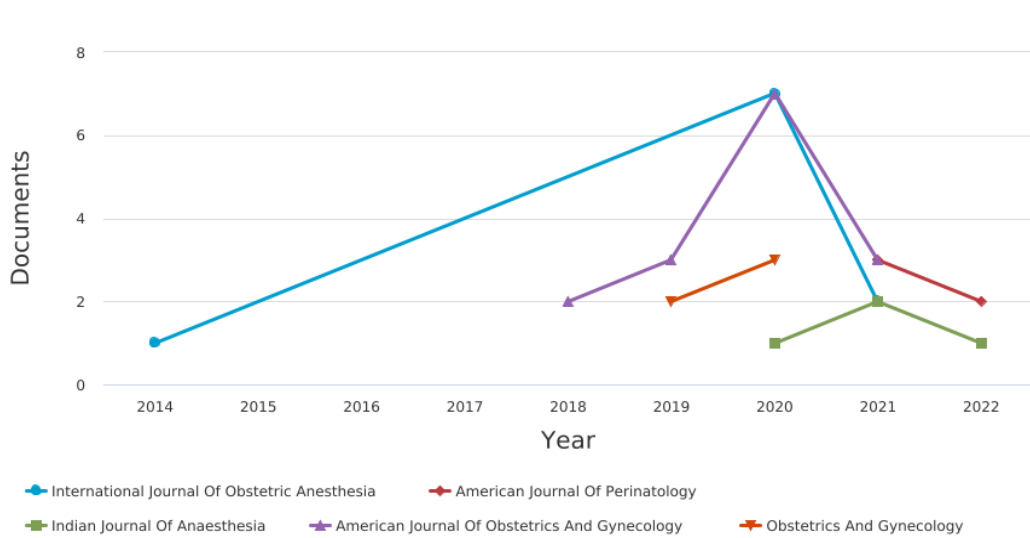
Source: Scopus database



**Figure 4. Comparison of The Number of ERACS research documents by Research Area**  
 Source: Scopus database



**Figure 5. Comparison of Number of Publications by Document Type**  
 Source: Scopus database



**Figure 6. Number of Publication Documents by Research Source per Year**  
 Source: Scopus database

The "American Journal of Obstetrics and Gynecology" is the most trustworthy research source, according to Figure 6. This source's documents were largely released in 2020.

Based on the keyword analysis used, cluster 1 theme is about "postoperative care", cluster 2 theme is about

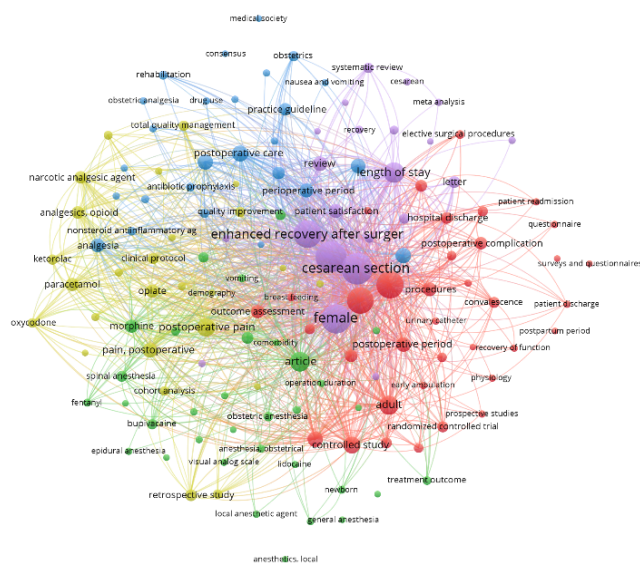
"obstetric anesthesia", cluster 3 theme is about "preoperative and perioperative care", cluster 4 theme is about "postoperative pain" and cluster 5 theme is about "enhanced recovery after surgery".

**Analysis of Terms in ERACS Research Abstract**

Cluster	Colour	Keywords	Theme
1	Red	Adult, Adverse event, analgetic agent, analgesics, breast feeding, comparative study, controlled study, convalescence, early ambulation, elective surgery, elective surgical procedures, hospital discharge, hospital readmission, humans, major clinical study, outcome assessment, pain, patient discharge, patient readmission, physiology, postoperative complication, postoperative complications, postoperative period, postpartum period, pregnancy, pregnant woman, procedures, prospective studies, prospective study, puerperium, questionnaire, randomized controlled trial, recovery of function, surveys and questionnaires, time factors, urinary catheter.	Postoperative care
2	Green	Anesthesia obstetrical, anesthetics local, article, bupivacaine, caesarean section, catheter removal, comorbidity, diclofenac, emergency surgery, enhanced recovery after surgery, epidural anesthesia, fentanyl, follow up, general anesthesia, gestational age, hospitalization, hypotension, infant newborn, lidocaine, local anesthetic agent, morphine, nerve block, newborn, obstetric anesthesia, operation duration, post operative analgesia, post operative nausea and vomit, spinal anesthesia, tramadol, treatment outcome, visual analog scale, vomiting, young adult.	Obstetric anesthesia
3	Blue	Analgesia, antibiotic prophylaxis, carbohydrate, caesarean delivery, consensus, drug use, enhanced recovery, fasting, foot intake, infusion fluid, maternal care, medical society, mobilization, nausea, nausea and vomiting, nonsteroid anti-inflammatory, obstetric analgesia, obstetrics, perioperative period, postoperative care, practice guideline, preoperative care, priority journal, regional anesthesia, rehabilitation, surgical technique.	Preoperative dan perioperative care
4	Yellow	Analgesics opioid, body mass, clinical practice, clinical protocol, cohort analysis, demography, evidence based medicine, health care planning, health care quality, ketorolac, narcotic analgesic agent, opiate, opiate addiction, oxycodone, pain management, pain postoperative, paracetamol, patient education, perioperative care, postoperative pain, quality improvement, retrospective studies, retrospective study, surgical infection, total quality management.	Postoperative pain
5	Purple	Abdominal surgery, caesarean, caesarean section, clinical outcome, colorectal surgery, enhanced recovery after surgery, eras, female, human, incidence, length of stay, letter, metaanalysis, patient care, patient safety, patient satisfaction, preoperative period, randomized controlled trial, recovery, review, surgery, systematic review.	Enhanced recovery after surgery

Source: VOS viewer

**Network Visualization**



**Figure 7. Term Network Map on ERACS Article Abstract**  
 Source: VOS viewer



Based on the analysis of terms often used in ERACS article abstracts (1303 keywords), there are 143 terms that have strong links, with an analysis using a minimum occurrence number of 5 terms. There are 5 clusters, with details: cluster 1 has as many as 36 items; cluster 2 has as many as 33 items; cluster 3 has as many as 26 items; cluster 4 has as many as 26 items; and cluster 5 has as many as 22 items. The most widely used terms in the abstract are "cesarean section" with 109 occurrences, "human" with 106 occurrences, "female" with 95 occurrences, and "enhanced recovery after surgery" with 87 occurrences.

The cluster density view is very useful for getting an overview of the assignment of items to the cluster and the way in which the clusters of items are related to each other. Figure 8 displays the terms in yellow and green. The yellow

color indicates that the term is often used in ERACS journals, while the green color indicates that the term has not been widely researched or used in research journals. Researchers might examine past research to identify areas that have received less attention and to identify potential future study subjects.

Figure 9 has color nodes that represent the year the article containing that term was published. The darker the color of the nodes, the older the topic.

In ERACS research, there are two clusters and 19 authors who have a link or relationship. Collaboration in research is carried out since research is not always carried out individually. Nelson, G., is the author with the most publications (12 documents). Figure 10 illustrates this.

### Density Visualization

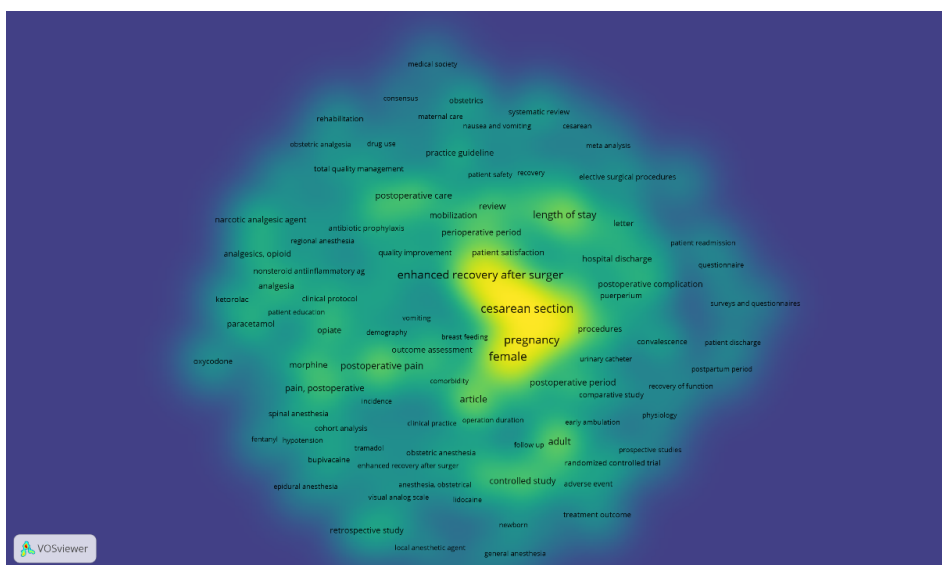


Figure 8. Density Visualization  
Source: VOS viewer

### Overlay Visualization

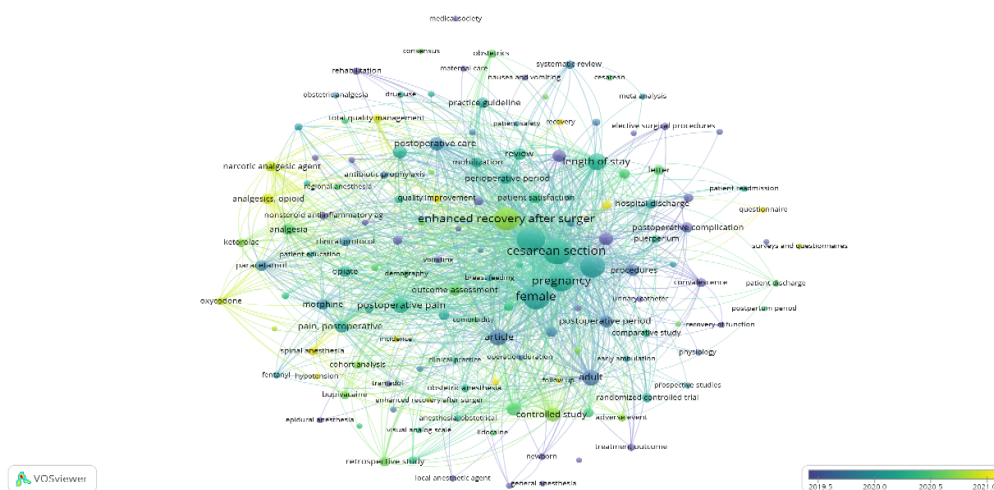
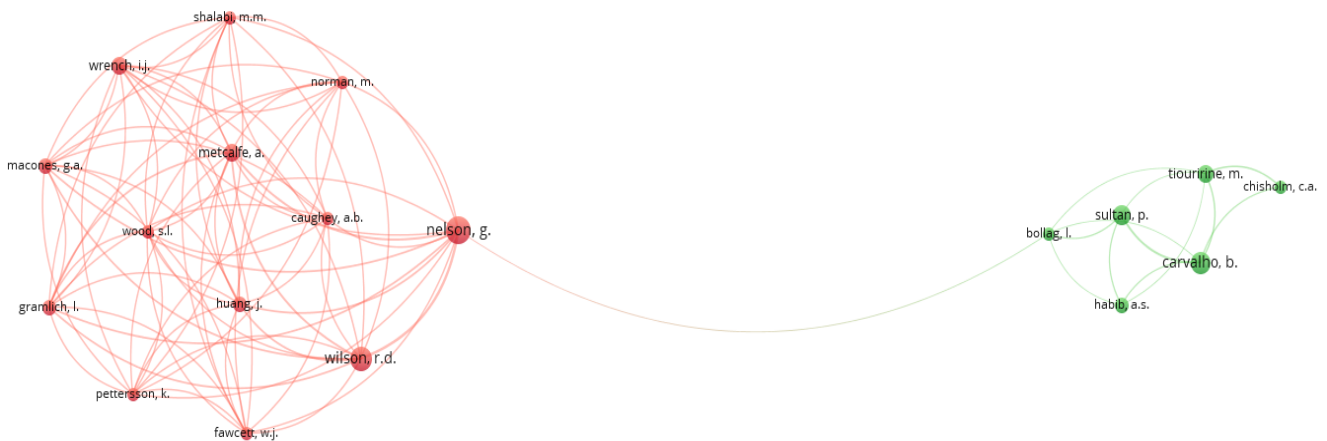


Figure 9. Overlay Visualization  
Source: VOS viewer

**Analysis of Author Collaboration**

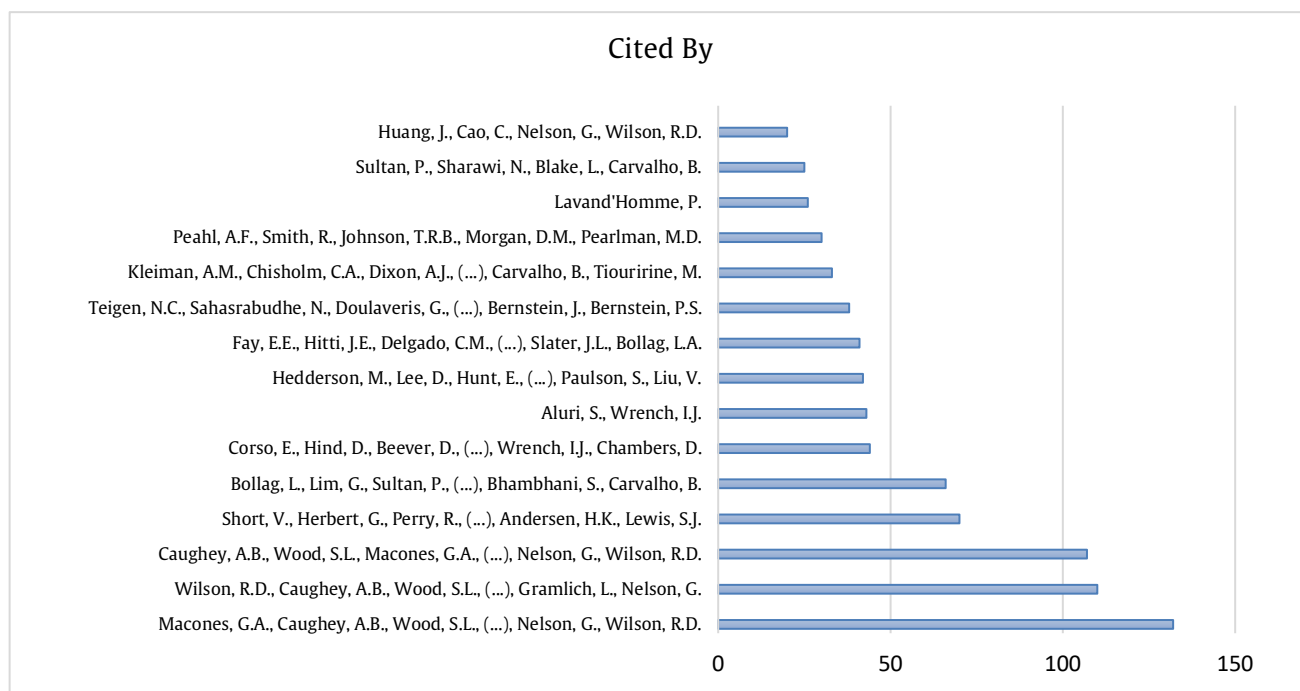


**Figure 10. Map of the Network of Collaboration between Authors.**  
 Source: VOS viewer

**Table 2. A list of publications that are frequently cited**

Author	Title	Source	Cited By
(Macones et al., 2019)	Guidelines for postoperative care in cesarean delivery: Enhanced Recovery After Surgery (ERAS) Society recommendations (part 3)	American Journal of Obstetrics and Gynecology, 221(3), pp. 247.e1-247.e9	132
(Wilson et al., 2018)	Guidelines for Antenatal and Preoperative care in Cesarean Delivery: Enhanced Recovery After Surgery Society Recommendations (Part 1)	American Journal of Obstetrics and Gynecology, 219(6), pp. 523.e1-523.e15	110
(Caughey et al., 2018)	Guidelines for intraoperative care in cesarean delivery: Enhanced Recovery After Surgery Society Recommendations (Part 2)	American Journal of Obstetrics and Gynecology, 219(6), pp. 533-544	107
(Short et al., 2015)	Chewing gum for postoperative recovery of gastrointestinal function	Cochrane Database of Systematic Reviews, 2015(2),CD006506	70
(Bollag et al., 2021)	Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery after Cesarean	Anesthesia and Analgesia pp. 1362-1377	66
(Corso et al., 2017)	Enhanced recovery after elective caesarean: A rapid review of clinical protocols, and an umbrella review of systematic reviews	BMC Pregnancy and Childbirth 17(1),91	44
(Aluri & Wrench, 2014)	Enhanced recovery from obstetric surgery: A UK survey of practice	International Journal of Obstetric Anesthesia, 23(2), pp. 157-160	43
(Hedderson et al., 2019)	Enhanced Recovery after Surgery to Change Process Measures and Reduce Opioid Use after Cesarean Delivery: A Quality Improvement Initiative	Obstetrics and Gynecology, 134(3), pp. 511-519	42
(Fay et al., 2019)	An enhanced recovery after surgery pathway for cesarean delivery decreases hospital stay and cost	American Journal of Obstetrics and Gynecology, 221(4), pp. 349.e1-349.e9	41
(Teigen et al., 2020)	Enhanced recovery after surgery at cesarean delivery to reduce postoperative length of stay: a randomized controlled trial	American Journal of Obstetrics and Gynecology, 222(4), pp. 372.e1-372.e10	38
(Kleiman et al., 2020)	Evaluation of the impact of enhanced recovery after surgery protocol implementation on maternal outcomes following elective cesarean delivery	International Journal of Obstetric Anesthesia, 43, pp. 39-46	33
(Peahl et al., 2019)	Better late than never: why obstetricians must implement enhanced recovery after cesarean	American Journal of Obstetrics and Gynecology, 221(2), pp. 117.e1-117.e7	30
(Lavand' Homme, 2018)	Postoperative cesarean pain: Real but is it preventable?	Current Opinion in Anaesthesiology 31(3), pp. 262-267	26
(Sultan et al., 2020)	Enhanced recovery after caesarean delivery versus standard care studies: a systematic review of interventions and outcomes	International Journal of Obstetric Anesthesia, 43, pp. 72-86	25
(Huang et al., 2019)	A Review of Enhanced Recovery After Surgery Principles Used for Scheduled Caesarean Delivery	Journal of Obstetrics and Gynaecology Canada, 41(12), pp. 1775-1788	20

Source: Scopus database



**Figure 11. The Most Frequently Cited Publications**  
 Source: Scopus database

### Analysis of the Most Frequently Cited Publications

Publications cited by other researchers can illustrate the interrelationships between studies. Then it is necessary to compile a list of publications based on how often such publications are cited by other researchers. The publication entitled "Guidelines for postoperative care in cesarean delivery: Enhanced Recovery After Surgery (ERAS) Society recommendations (part 3)" is the most frequently cited publication. A list of the order of such publications can be seen in Table 2 and Figure 11.

### LIMITATION OF THE STUDY

There are still certain restrictions on this study. Only the most recent research trends in ERACS were examined. It is necessary to conduct more study on ERACS, either by conducting a literature review or by coming up with fresh concepts.

### CONCLUSION AND SUGGESTION

Bibliometric analysis is a quantitative research method that can be used by researchers to get a broad picture of previous research. This article reveals ERACS research and publications over the past ten years. Bibliographic data retrieval through [www.scopus.com](http://www.scopus.com) was processed using the VOS viewer program.

The VOS viewer program makes it easier to collect and analyze large amounts of scientific data. Based on the findings and discussion, it is possible to conclude that 123 research documents have been published on ERACS in the last ten years. In 2021, the highest Scopus index was 36 studies. The United States is the country that publishes the

most ERACS research, with 56 studies. Nelson, G., has the most publications (12) and is the most productive researcher. There are five clusters in the analysis of terms in the research abstract. With 109 occurrences, the term "cesarean section" is the most commonly used in the article.

This bibliometric analysis presents the current state of ERACS programs from a variety of angles and serves as a resource and pointer for scholars conducting additional research. Postoperative care, obstetric anesthesia, preoperative and perioperative care, postoperative pain, and enhanced recovery after surgery are the themes that appear in this bibliometric analysis.

Based on the results of the bibliometric analysis in this article, an overview of the scope of research related to ERACS can be known. The authors support additional ERACS-related research, especially on unexplored subjects. Researchers can create ERACS-related study topics that have not been extensively studied before.

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### ETHICAL CONSIDERATIONS

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The authors received no funding from any entity for the work they submitted.



## Conflict of Interest Statement

According to the author, there is no potential conflict of interest in the creation and publication of this work.

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