Telemedicine and its Impact on the Preoperative Period

A Systematic Review of the Literature

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***Abstract*—The application of telemedicine has aroused a lot of interest in the field of chronic disease care, which is associated with clinical medicine. The aim of this research is to systematically evaluate the published evidence on telemedicine in the preoperative period. A systematic search was conducted over the last five years, excluding secondary research. Selection criteria were applied, obtaining 68 articles that met these criteria and quality criteria. The results show that the largest production is carried out in the United States and the United Kingdom, with collaboration between institutions and countries. The main use of telemedicine was in teleconsultation and telecounseling activities. In addition, the application of telemedicine in the preoperative period was made to a greater extent for general procedures without distinction of surgical specialty, oncological surgery and traumatology. An increased production observed can be related to the need for physical distancing due to the pandemic. Future research could include the co-occurrence of search terms, the impact of smartphones, NER terms, and the impact of polarity and objectivity on readers' choice of articles to read, share, and cite.**

Keywords*—*Telemedicine; digital health; e-health; preoperative care; preoperative period; systematic review

I. Introduction

The application of telemedicine has sparked interest in chronic disease care settings, which are generally encompassed in clinical disciplines. The application of telemedicine in surgical practice has become relevant in terms of the use of telesurgery. Reviews have been found about the use of applications in the prediction of mortality associated with surgery and the link with decision-making [1]. In this context, the question arises about the impact of telemedicine in the preoperative period.

There are a variety of experiences in the application of telemedicine in diverse health settings [2][3], which, despite the advantages regarding access to care, have also pointed out limitations such as difficulty in telephone access, omitted or erroneous information during data collection, and delay in the reporting of cases under investigation [4].

As Bokolo [5] points out, telemedicine and telehealth refer to the use of information and communication technologies embedded in software programs with high-speed telecommunications systems for the provision, management, and monitoring of health services.

In Peru, the definition of telemedicine is contained in the modifications of Telehealth Framework Law [6], as:

"The provision of remote health services in the components of promotion, prevention, diagnosis, treatment, recovery, rehabilitation and palliative care, provided by health personnel using ICTs, with the purpose of facilitating access to health services for the population".

Telemedicine could also be used to refer to the use of telecommunications for the remote provision of health services.

The World Health Organization (WHO) points out that telemedicine includes both diagnosis and treatment, as well as medical education, and that it is a technological resource that makes it possible to optimize health care services, saving time and money and facilitating access to distant areas for specialist care. In the context of the health crisis resulting from the pandemic, its use has become relevant [7].

Its applications include clinical practice and health education. Within clinical practice there are the following forms: Telediagnosis, Teleconsultation, Remote monitoring, medical meetings to obtain second opinions (Teleconference), Digital storage of data or medical records. Within the educational area, distance classes from medical centers (e-learning through videoconferencing) stand out [2] [4] [8].

Aspects related to the construction of bibliometric networks, polarity, objectivity, and subjectivity of the scientific production of telemedicine in the preoperative period have not been pointed out in the reviews on this topic.

In the current context, surgical activities have been suspended in most institutions around the world and considering the advantages of telemedicine in terms of timeliness of care [5], the aim is to investigate its usefulness in the field of preoperative activity.

This systematic review aims to explore the state of the art of telemedicine in the field of preoperative care.

In this vein, Section II covers the background and related works, where similar characteristics to the proposals of this work are specified. Section III is revision method which, details the methodology used in this document. Section IV delves into results and discussion which shows the compilation of studies and the data they generated, which are shown by graphs and tables to determine observations. To conclude, Section V, conclusions and future research, presents the recommendations reached because of the analysis of the

information obtained, as well as suggestions for scientific production on the subject addressed.

II. Background and Related Work

There are systematic reviews related to the application of telemedicine in the preoperative setting.

Research places telemedicine as a developing technology, and in the field of surgical practice, Sohn et al. [9] point to its use in plastic surgery and otolaryngology. In their review of telemedicine in the field of dermatological surgery, they point out that its application in preoperative consultation allows the planning of the intervention and increases access to care.

Bokolo et al., in its systematic review on the application of telemedicine and e-health technology in clinical services in response to the COVID-19 pandemic, points out the importance of the use of information and communication technologies (ICT) integrated with telecommunication software and systems for care, management and monitoring in patient care [5].

Asiri et al., on the other hand, in their review of the use of telemedicine in surgical care found that, for the most part, patients treated with this technology reported time savings and a reduction in the number of lost workdays as benefits [8].

However, not all reviews pointed to positive aspects. Moentmann et al., in their review on telemedicine in otolaryngology, noted that a negative aspect was the limitation of patient contact, although video-otoscopy is the most widely supported telemedical intervention limiting physical contact between otolaryngologists and their patients [9].

Kim et al. conducted a systematic review of research addressing the use of technology to intervene preoperatively on surgery anxiety in pediatric patients and their parents or guardians. They noted that the available literature is extremely heterogeneous and limits the ability to draw definitive conclusions about the effectiveness of technology-based interventions. In addition, the results showed that for this group of patients, tablets and manually operated devices with interactive capability may represent a viable option to address preoperative anxiety. However, they were unable to extrapolate these results to adults, with whom they had better results using videos [10].

More encouraging results are found with the reviews by Kolcun et al. [11] and Lu et al. [12]. In the first case, it highlights that the increase in the use of telemedicine has been favored by the crisis caused by the pandemic and represents an opportunity to continue developing this technology and validate its use in new fields. Their initial results show that this technology becomes a support for the interaction between doctors and patients during the need for social distancing, showing its usefulness for aspects that do not involve the need for physical contact. Aspects related to this point are indicated as, certain perioperative tasks (complementary patient education and postoperative surveys).

For Lu et al., in their review of the use of Short Message Service (SMS) and smartphones in surgical care, they conclude that applications of this type offer a sophisticated yet simple tool to improve perioperative health care, in addition to the need for a regulatory framework for communications [12].

Telemedicine is attracting attention in the healthcare sector, due to the diversity of interaction modalities that have been developed over the last decade, and which are becoming increasingly affordable for both patients and doctors. At this point, Shanbehzadeh et al. [13] highlight short message service, email and web portals, secure phone calls or VOIP, video calls, interactive mobile health applications (m-Health), remote patient monitoring, and video conferencing. At the same time, it points out that the synchronous modality through common social networks was the one that presented the highest percentage of use for clinical care. While data exchange activities using the store and forward service via secure messaging technology and pre-recorded media files had the least popularity.

III. Revision Method

The method used in this research is the systematic literature review (RSL), which is defined as a process of identifying, analysing and interpreting the existing scientific evidence on a topic, with the aim of providing answers to specific research questions.

The methodology used to develop the RSL in this paper is based on the document proposed by Kitchenham [14], who divides the whole process into three general parts: the planning of the review, the development, and the publication of results.

This research followed the phases defined by Kitchenham, as well as the activities that compose them. In the first phase, the research questions are specified, and the review protocol is developed, which is necessary to reduce the possibility of bias. In the second phase, the studies to be included in the research are identified, as well as the evaluation of their quality. Finally, in the third phase, the results obtained are detailed (see Fig. 1).

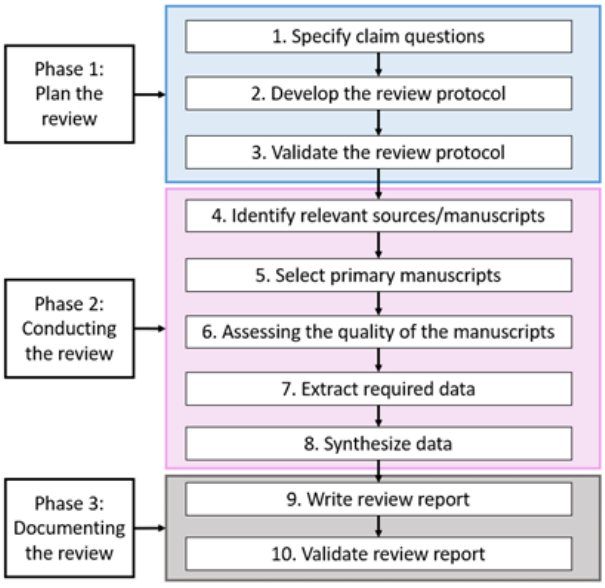

Fig. 1. Development phases of the Systematic Literature Review (RSL). Translation of the systematic literature review process proposed by kitchenham.

A. Problems and Objectives

When a systematic review of the literature is conducted, research questions are defined, which help in the extraction and analysis of data to meet the objectives of the research.

For this research, one general question and eight specific questions were posed.

The general question was:

What is the state of the art of Telemedicine and its impact on the Preoperative Period?

The objective of this study was to determine the current state of knowledge of the application of telemedicine in the preoperative period and to know the impact that this intervention generates in this period.

The specific questions and their objectives are shown in Table I.

TABLE I. CORRESPONDENCE BETWEEN RESEARCH QUESTIONS AND OBJECTIVES

Question	Objective
RQ1. What are the most used and most relevant keywords by Number of Articles in telemedicine research and their impact on the preoperative period?	Determine which are the most used and most relevant keywords by Number of Articles in telemedicine research and in the preoperative period
RQ2: What is the relationship between the polarity of article titles and the frequency with which they are cited by other authors in telemedicine research and their impact on the preoperative period?	To determine the relationship between the polarity of article titles and the frequency with which they are cited by other authors in telemedicine research and its impact on the preoperative period
RQ3: What are the most productive institutions in the development of telemedicine and its impact on the preoperative period?	To determine which institutions are the most productive in the development of telemedicine and its impact on the preoperative period
RQ4. In which countries is telemedicine being applied most frequently in the preoperative period?	Determine where telemedicine is most commonly applied in the preoperative period
RQ5: Which means of publication are the main objectives for the production of research in the area of telemedicine in the preoperative period?	To determine the main means of publication for the production of research in the area of telemedicine in the preoperative period
RQ6. What are the types of telemedicine services that are most frequently provided in the preoperative period?	Determine which types of telemedicine services are most commonly provided in the preoperative period
RQ7. Which surgical specialties are most frequently applying telemedicine solutions in the preoperative period?	Determine which surgical specialties are most frequently applying telemedicine solutions in the preoperative period
RQ8. Which are the Articles whose Abstracts are characterized by their high Objectivity by year and country in research on telemedicine and its impact on the preoperative period?	To determine which articles whose abstracts are characterized by their high objectivity by year and country in telemedicine research and its impact on the preoperative period

B. Search Sources and Search Strategy

For this work, a bibliographic search was carried out using the most well-known search engines (see Table II).

TABLE II. SEARCH SOURCE

Source
IEEE Xplore
Scopus
ARDI
ProQuest
ScienceDirect
ACM Digital Library
Wiley Online Library
Microsoft Academic
Springer
Google Scholar

The table shows the search engines that were used to locate the research papers related to the topic of telemedicine and the preoperative period.

To determine the search terms, two well-known thesauri were used, the DeSC/MeSH for the terms related to telemedicine and the preoperative period, and the IEEE Xplore thesaurus also for the term telemedicine, and for the term methodology (see Table III).

TABLE III. IDENTIFICATION OF SEARCH TERMS

Tesauro	Descriptor	Description
DeCS/MeSH IEEE Thesaurus	telemedicine digital health digital healthcare e-health m-health electronic health mobile Health	Independent Variable (A)
DeCS/MeSH	preoperative period preoperative care	Dependent Variable (B)
IEEE Thesaurus	methodology method model	Intervening Variable (C)

The table shows the search engines that were used to locate the research papers related to the topic of telemedicine and the preoperative period.

The general equation was determined using the dependent, independent and intervening variables (see Fig. 2).

(telemedicine OR “digital health” OR “digital healthcare” OR e-health OR m-health OR “electronic health” OR “mobile health”)

AND

(“preoperative period” OR “preoperative care”)

AND

(methodology OR method OR model)

Fig. 2. General search equation.

Equations based on the general equation were determined for each searcher (see Table IV).

C. Identified Studies

The search yielded a total of 10,741 articles (see Fig. 3), to which filters related to the temporality of publication were applied, accessing articles from the last five years, as well as segregation by language, selecting those that were in English or Spanish. Subsequently, articles published in scientific journals and those peer-reviewed, as well as documents that were not duplicates, were selected.

TABLE IV. EQUATIONS AND SEARCH SOURCES

Search Source	Search Equation
IEEE Xplore	("All Metadata":telemedicine OR "All Metadata":"digital health" OR "All Metadata":"digital healthcare" OR "All Metadata":e-health OR "All Metadata":m-health OR "All Metadata":"electronic health" OR "All Metadata":"mobile health") AND ("All Metadata":"preoperative period" OR "All Metadata":"preoperative care") AND ("All Metadata":methodology OR "All Metadata":method OR "All Metadata":model)
Scopus	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)
ARDI	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (method OR methodology OR model)
ProQuest	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)
ScienceDirect	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)
ACM Digital Library	[[All: telemedicine] OR [All: "digital health"] OR [All: "digital healthcare"] OR [All: e-health] OR [All: m-health] OR [All: "mobile health"] OR [All: "electronic health"]] AND [[All: "preoperative period"] OR [All: "preoperative care"]] AND [[All: method] OR [All: methodology] OR [All: model]]
Wiley Online Library	""telemedicine" OR "digital+health" OR "digital healthcare" OR "e-health" OR "m-health" OR "electronic+health" OR "mobile health"" anywhere and ""preoperative period" OR "preoperative care"" anywhere and ""method" OR "methodology" OR "modeling"" anywhere
Microsoft Academic	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)
Springer	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)
Google Scholar	(telemedicine OR "digital health" OR "digital healthcare" OR e-health OR m-health OR "electronic health" OR "mobile health") AND ("preoperative period" OR "preoperative care") AND (methodology OR method OR model)

The table shows the search engines that were used to locate the research papers related to the topic of telemedicine and the preoperative period.

D. Exclusion Criteria

The following exclusion criteria were established for selecting articles:

CE1: Articles are more than five years old.

CE2: Articles are written in a language other than English or Spanish .

CE3: Articles followed peer review methodology and were not reported in a scientific journal.

CE4: The article did not propose a telemedicine solution or did not mention method or technique.

CE5: The article is not relevant to the objectives of the research.

SC 6: The article is not available, or the full text of the article is not available.

CE 7: The article is not unique.

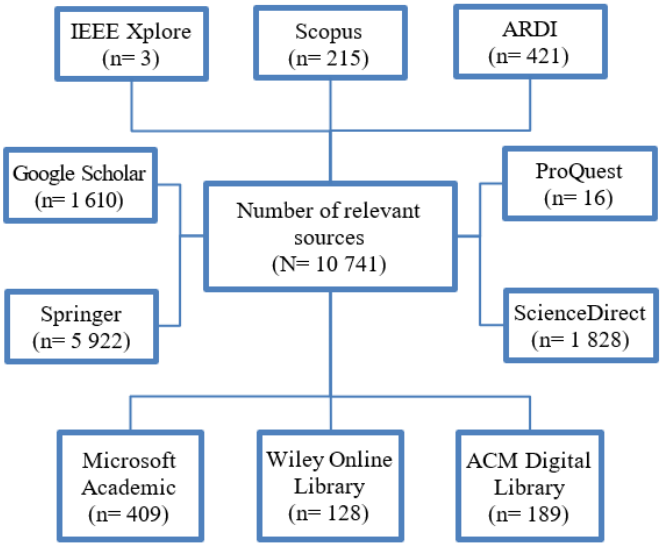

Fig. 3. Number of studies identified by search source.

E. Selection of Studies

Initially, 10 741 articles were obtained, to which exclusion criteria were applied for the filtering and selection of the most relevant articles that provide better answers to the research questions posed (see Fig. 4 to Fig. 5).

As a result of this stage, a total of 68 articles were included (see Table V).

F. Quality Assessment

To determine the final list of articles to be included in this research, criteria were applied to evaluate their quality.

Quality assessment criteria were determined for methodological characteristics and for substantive characteristics.

1) Methodological characteristics:

QA1: Are the objectives of the research clearly identified in the document?

QA2: Are research results clearly identified and reported?

2) Substantive features:

QA3: Does the research consider elective surgeries?

QA4: Is it possible to contact the principal investigator?

The full text for each document was analyzed and the criteria shown were applied to evaluate its quality and then conclude in maintaining the 68 articles.

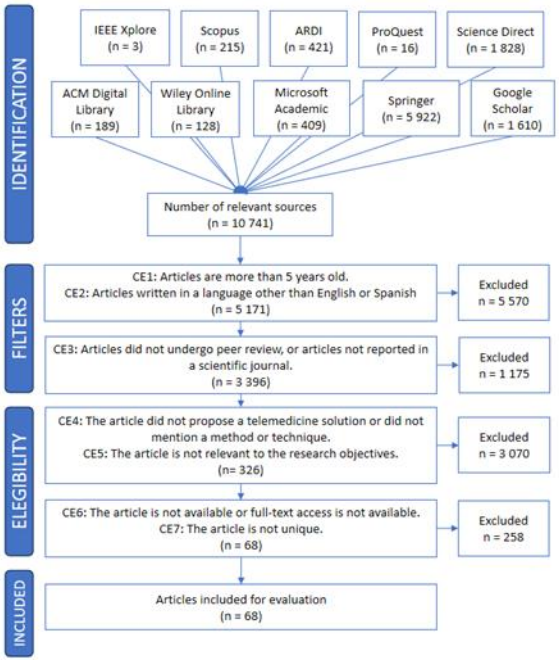

Fig. 4. PRISMA flowchart, on the application of criteria for the selection of articles.

TABLE V. RESULT OF THE APPLICATION OF SELECTION CRITERIA

Source	Initial Studies	Final Studies	%
IEEE Xplore	3	1	1%
Scopus	215	32	47%
ARDI	421	4	6%
ProQuest	16	1	1%
ScienceDirect	1 828	3	4%
ACM Digital Library	189	3	4%
Wiley Online Library	128	6	9%
Microsoft Academic	409	5	7%
Springer	5 922	5	7%
Google Scholar	1 610	8	12%
Total	10 741	68	1%

Note: Although ACM Digital Library provided the largest number of articles, the most relevant articles were obtained from Scopus.

G. Data Extraction Strategies

At this stage, the final list of articles was used, from which the necessary information was extracted to answer the research questions (RQ1 to RQ8).

The data extracted from each article were: Article ID, Article Title, URL, Source, Year, Country, Number of Pages, Language, Type of Publication, Publication Name, Research Methodology, Author(s), Affiliation, Number of Citations, Abstract, Keywords, Conclusions/Discussions, Sample Size, RQ1, RQ2, RQ3, RQ4, RQ5, RQ6, RQ7, RQ8.

Not all articles answered all research questions.

The web and desktop application, Zotero, was used to manage data extraction (see Fig. 6).

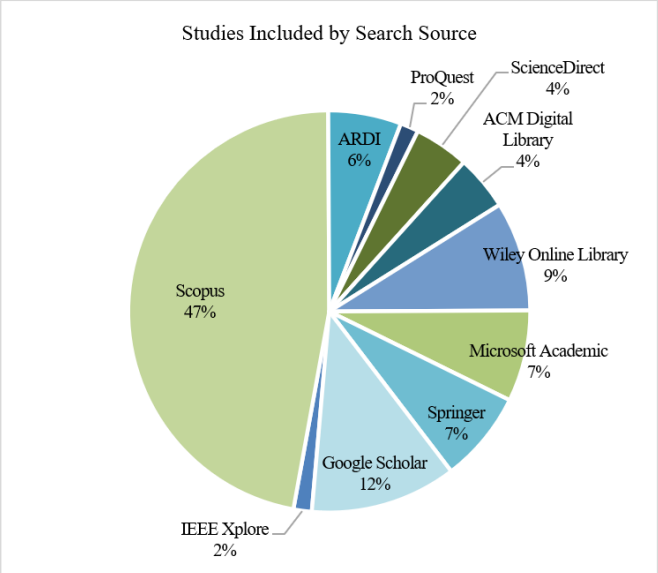

Fig. 5. The figure shows the result of the application of the search formula using the IEEE xplore, scopus, ARDI, ProQuest, sciencedirect, ACM digital library, wiley online library, microsoft academic, springer and google scholar search engines.

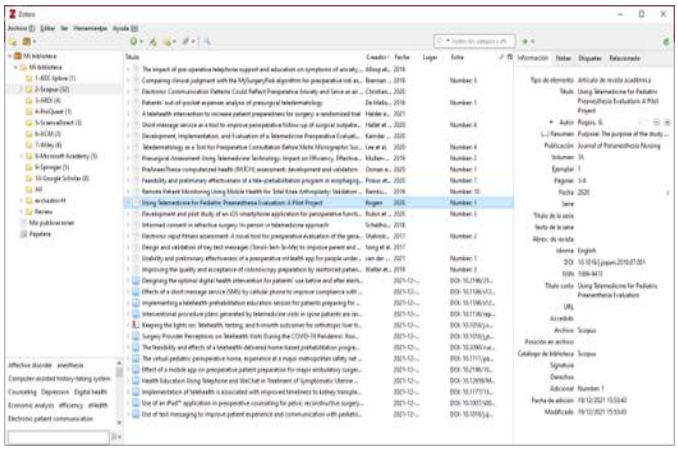

Fig. 6. Document management with Zotero.

H. Synthesis of Findings or Synthesis of Data

The information extracted for the Research Questions (RQ1 to RQ8) was tabulated and presented as quantitative data, using Excel, to statistically compare the various findings for each Research Question.

Certain patterns of research were found, as well as research directions that were carried out during the last few years.

Zotero was used for data management, while VOSViewer and Onodo were used for the analysis of bibliometric networks.

To determine objectivity and polarity, the Python program with the TextBlob library and the open access program CoreNLP v.4.3.2 were used.

IV. Results and Discussion

A. Study Overview

Of the 68 articles included in the research, there has been a sustained increase in scientific production in the last two years (see Fig. 7).

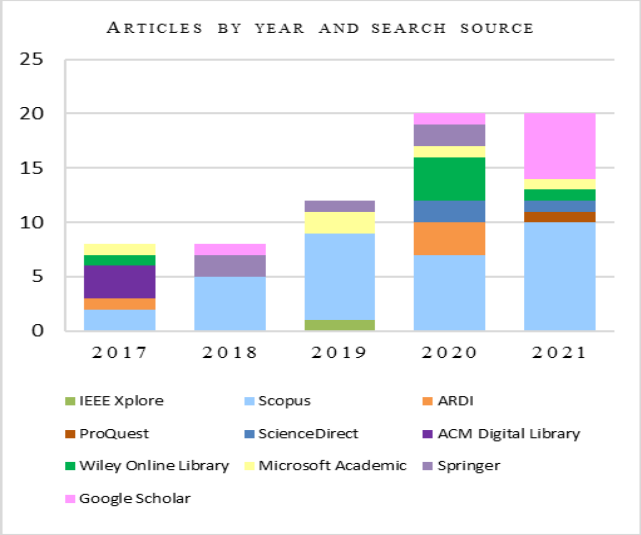

Fig. 7. The figure shows the distribution of scientific production by year and source.

A variety of sources were searched, including those that are not common for health research publications. At this point, we compare the results with those obtained by Bokolo et al. [5], which we searched Google Scholar, PubMed, ScienceDirect, ProQuest, Springer, Sage, Taylor & Francis, IEEE Xplore, Wiley, ACM, Emerald, Inderscience, ISI Web of Science, and Scopus. The results are also compared with reviews of articles published in more well-known sources in the healthcare sector, such as the research conducted by Asiri et al., in its review on telemedicine in surgical care, in which MEDLINE, EMBASE, CINAHL and Science Direct were used to obtain articles [8].

Other reviews, such as that of Jonker et al., on e-health in the perioperative in older adults, included PubMed, EMBASE, CINAHL [77]. On the other hand, the team of Moentmann et al., in its review on telemedicine in otolaryngology, searched Embase, PubMed, and Web of Science, [9].

The number of articles included in these reviews is similar, except for the review by Jonker et al., in which the number of articles included was lower due to the delimitation of search criteria for the target group (older adults) [15].

As for the number of authors, they amounted to 436 in the 68 articles included. The number of authors varied in terms of the number of authors, with an average of six authors per publication. No collaborative relationships were found between the different research groups (see Table VI and Fig. 8).

A point to consider is related to the words that are most repeated in the titles (see Fig. 9). The most frequent words were identified as the words "preoperative", "study", "surgery", "telemedicine", "patients", "COVID-19" and "mobile", which are related to the search terms used.

TABLE VI. Result of the Application of Selection Criteria

N°	Source	Number of authors
1	IEEE Xplore	8
2	ProQuest	7
3	ScienceDirect	7
4	Scopus	7
5	ARDI	6
6	Google Scholar	6
7	Microsoft Academic	6
8	Springer	6
9	Wiley Online Library	6
10	ACM Digital Library	4

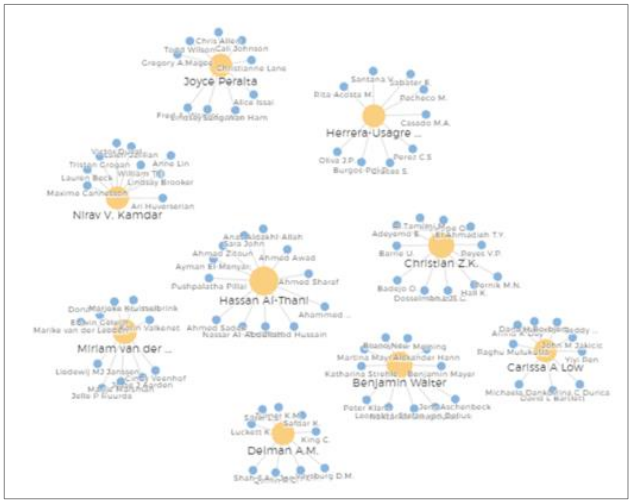

Fig. 8. First authors and co-authors who formed research teams with a larger number of members.

Fig. 9. Word cloud of the titles of the articles included in the research.

B. Answers to Research Questions

1) RQ1. What are the most used and relevant keywords by Number of Articles in telemedicine research and their impact on the preoperative period?

It is evident that the words that are most frequently used in medical articles are related to the search terms used. Table VII and Fig. 10 show the most frequently used keywords. It was consistent with other systematic reviews that include these keywords in their publications [5] [16], while other reviews, such as “surgical procedure”, “satisfaction” y “monitoring” [8].

TABLE VII. 20 KEY WORDS MOST FREQUENTLY USED

N°	Key Word	Number of Articles
1	telemedicine	26
2	humans	19
3	preoperative care	17
4	middle aged	13
5	female	12
6	male	11
7	aged	9
8	COVID-19	9
9	prehabilitation	7
10	adult	6
11	telehealth	6
12	text messaging	6
13	patient satisfaction	6
14	perioperative care	5
15	surgery	5
16	ehealth	5
17	osteoarthritis	5
18	exercise	4
19	Mhealth	4
20	smartphone	4

Fig. 10. Word Cloud of the keywords of the articles included in the research.

It has also been important to find co-occurrence between the keywords of the articles, such as "telemedicine", "COVID-19", "patient satisfaction", "preoperative care" and "prehabilitation", shown in Fig. 11. This result can provide guidance on the impact that the pandemic has had on the development of telemedicine research in the preoperative period, which in turn is related in the articles to patient satisfaction and better preparation for surgery [5]. It should be noted at this point that the Named-entity recognition (NER) term search program in the titles of the articles, also identified the terms "COVID-19" and "COVID-19 Pandemic".

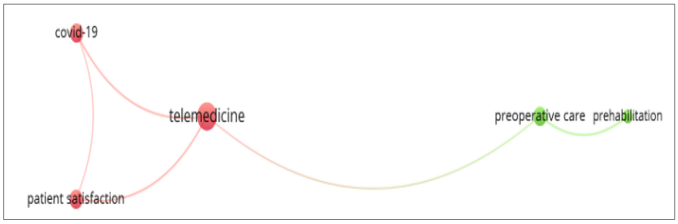

Fig. 11. Co-occurrance of keywords in the articles included in the study.

2) RQ2: What is the relationship between the polarity of article titles and the frequency with which they are cited by other authors in telemedicine research and their impact on the preoperative period?

Although no systematic reviews have been found that explore this point in the field of telemedicine, it is considered important to analyze the impact of this variable on readers.

As a result of the analysis of the titles of the articles, it was determined that, in general, titles with neutral polarity were the most cited, followed by those with positive polarity (see Fig. 12).

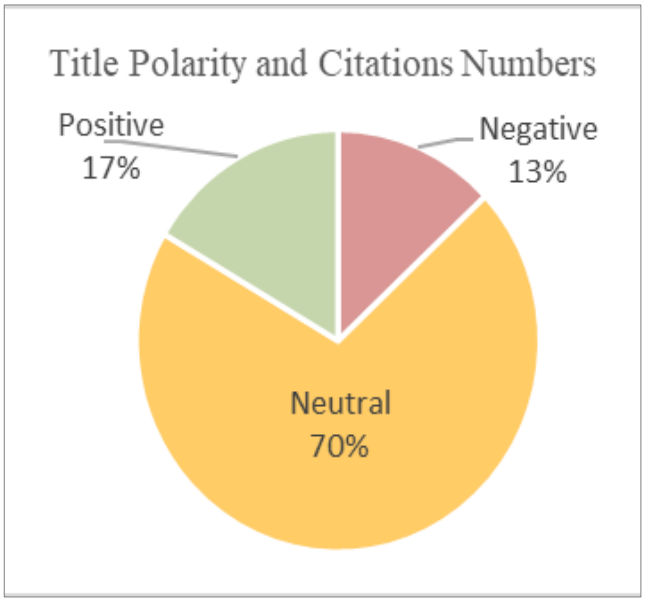

Fig. 12. Title polarity and citations.

On the other hand, the articles identified through the Microsoft and IEEE Xplore search engines showed greater neutrality in their writing (see Fig. 13).

Regarding the number of citations related to polarity and the search source in which the article was found, the highest frequency of citations is related to neutral titles extracted from Scopus (see Fig. 14).

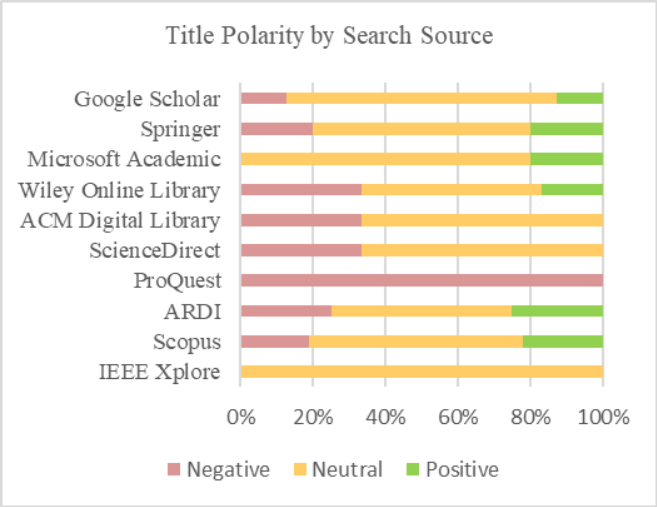

Fig. 13. Title Polarity by Search Source

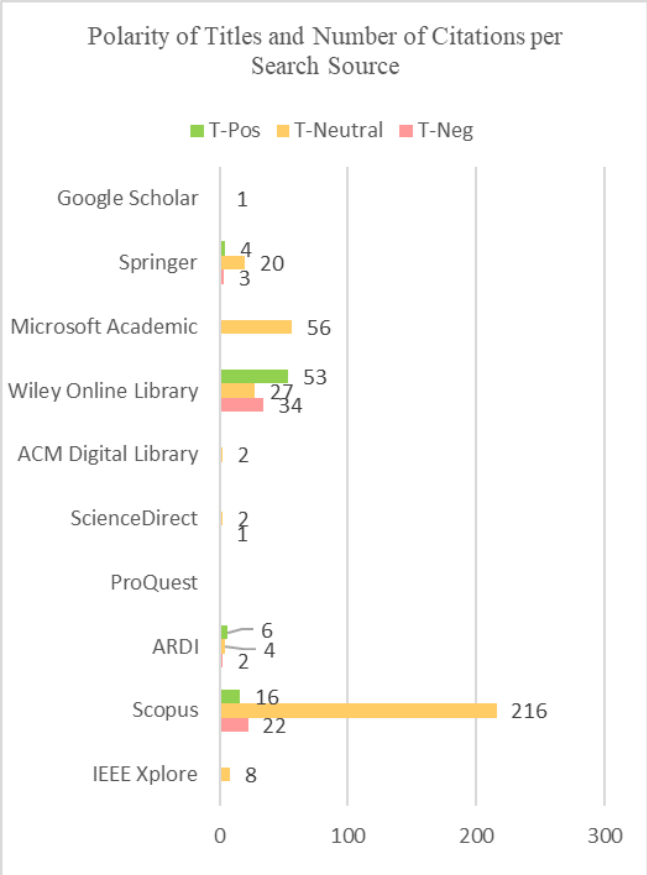

Fig. 14. The highest number of citations related to Scopus' neutral titles is observed.

3) RQ3: Which are the most productive institutions that establish collaborative networks in the development of telemedicine and its impact on the preoperative period?

Both public and private healthcare institutions, as well as those dedicated to research (universities, research groups) collaborated in the scientific production of telemedicine in the preoperative period. Six institutions produced two or more research articles (see Table VIII).

Collaboration between institutions is visualized in Fig. 15. Here we can see that the Technical University of Munich stands out. The articles that contributed the most to answering this question came from Scopus (see Table IX).

Some systematic reviews [1] [15] have pointed out the importance of collaboration between institutions and have included related experiences (first level and specialized centers, research institutions, universities, and hospitals) in their reviews.

4) RQ4. In which countries is telemedicine being applied most frequently in the preoperative period?

It is evident that publications related to telemedicine in the preoperative period have been carried out more frequently in the United States (49%) (see Table X and Fig. 16). This result is consistent with that described by M. Shanbehzadeh et al., in which the articles obtained were mostly (76.75%) carried out in this country [13].

Figures found in other reviews vary. Jonker et al. shows 28% [15], while Kolcun et al. 41.66% [11], with the United States occupying the first place in scientific production.

TABLE VIII. INSTITUTIONS THAT PUBLISH MOST FREQUENTLY ON TELEMEDICINE IN THE PREOPERTIVE PERIOD

N°	Institution	Number of Articles
1	University of Michigan	3
2	The University of Melbourne	3
3	Dalhousie University	2
4	University of Cincinnati	2
5	Mayo Clinic College of Medicine	2
6	Vanderbilt University Medical Center	2

TABLE IX. COLLABORATION NETWORKS BETWEEN INSTITUTIONS BY SEARCH SOURCE

Source	Article	Quantity(%)
IEEE Xplore	[25]	1 (2)
Scopus	[24] [28] [30] [33] [35] [37] [40] [42] [43] [44] [46] [48] [50] [60] [67] [72] [75] [78] [80] [81] [83]	21 (51)
ARDI	[51]	1 (2)
ProQuest	[19]	1 (2)
ScienceDirect	[59] [73]	2 (5)
ACM Digital Library	[49] [66]	2 (5)
Wiley Online Library	[18] [71]	2 (5)
Microsoft Academic	[63] [69] [77]	3 (7)
Springer	[31] [53] [61]	3 (7)
Google Scholar	[20] [34] [54] [74] [82]	5 (12)

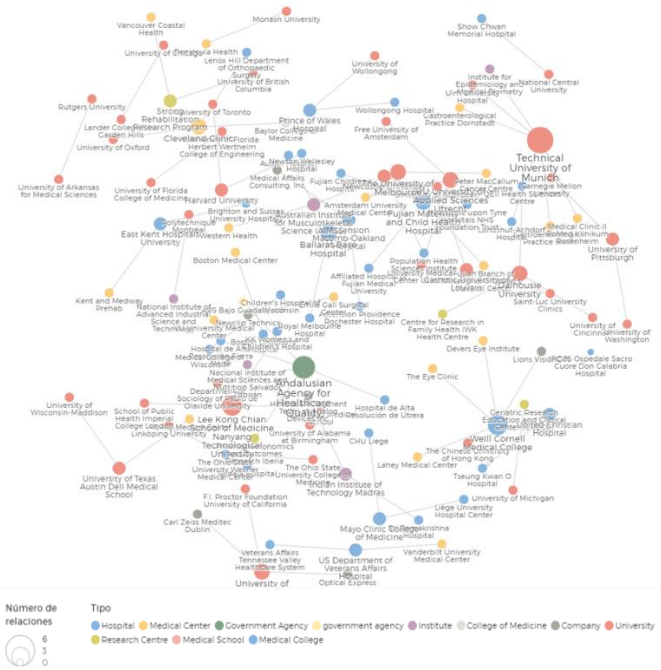

Fig. 15. Collaborative networks between institutions that carry out research on telemedicine in the preoperative period.

TABLE X. SCIENTIFIC PRODUCTION BY YEAR AND COUNTRY

Country	2017	2018	2019	2020	2021	Total (%)
Australia			1	2	2	5(6)
Belgium				3		3(4)
Canada	2	1		1	2	6(8)
China		1		1	1	3(4)
Finland				1		1(1)
France				1		1 (1)
Germany			1			1 (1)
India			1		1	2 (3)
Italy				1		1 (1)
Mexico			1			1 (1)
Netherlands				1	2	3 (4)
New Zealand		1				1 (1)
Portugal			1			1 (1)
Qatar					1	1 (1)
Scotland				1		1 (1)
Singapore				1		1 (1)
Spain			1			1 (1)
Sweden			1			1 (1)
Taiwan	1					1 (1)
United Kingdom		1	1	1	3	6 (8)
US	6	5	7	12	9	39 (49)

Regarding the establishment of collaboration networks with other countries, this research shows that the United States also leads this characteristic (see Fig. 17).

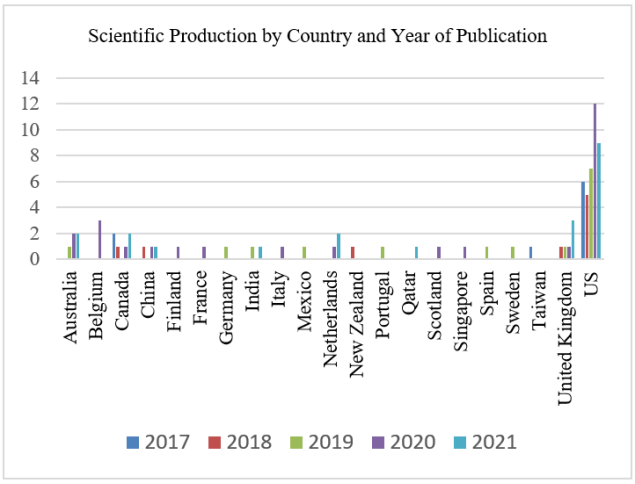

Fig. 16. Scientific production by country and year.

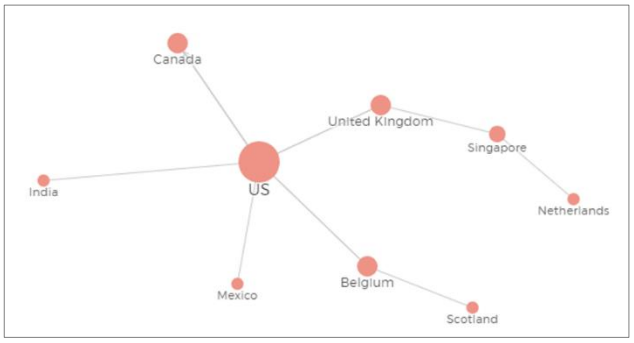

Fig. 17. Collaboration between countries on publications on telemedicine in the preoperative period.

5) RQ5: Which means of publication are the main objectives to produce research in telemedicine in the preoperative period?

Most of the publications correspond to journal-type articles (see Fig. 18).

This is consistent with other publications in the field of health [1] [5], in which the main input is publications of this type. It should be noted that some studies have only taken publications of this type as input, as in the research by Kolcun et al., which excludes publications such as "case reports", "technical reports" and "conference abstracts" [11].

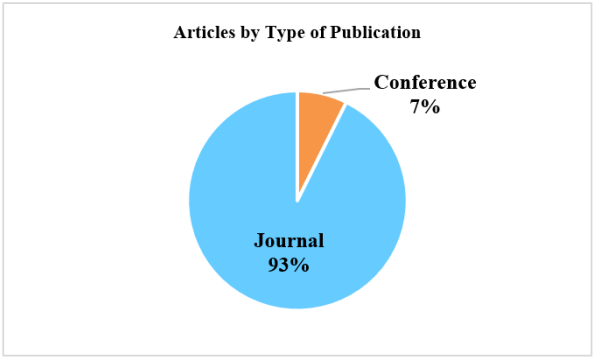

Fig. 18. Research by type of publication.

6) RQ6. What are the types of telemedicine services that are available? Are they given more frequently in the preoperative period?

The main use of telemedicine in this period was in teleconsultation and telecounseling activities (see Fig. 19).

In this regard, the findings are consistent with the results of Asiri et al. [8], Kolcun et al. [11] and Shanbehzadeh et al., in which the majority use of telemedicine for teleconsultation and teleguidance activities was evidenced. Additionally, the use for telesurgery, tele-education and telemonitoring was reported [13].

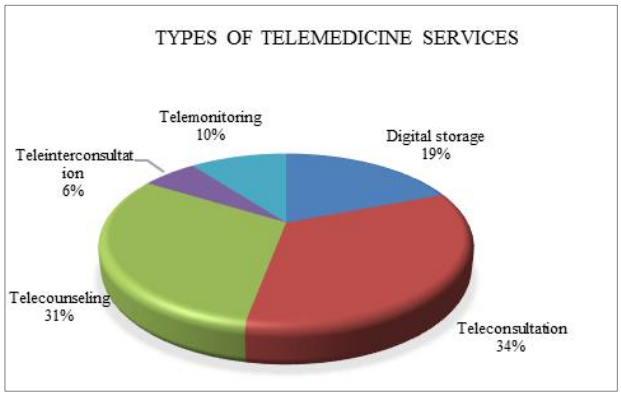

Fig. 19. Types of service that are most frequently provided in the preoperative period.

As for the modality used, it was mainly characterized by being asynchronous (43%), however, it does not differ greatly from the synchronous modality (38%). 19% of publications use both modalities to provide telemedicine services (see Table XI and Fig. 20).

These results do not differ greatly from other reviews, in which both modalities were used [5], preferring videoconferencing for aspects related to diagnostic assessment [11].

TABLE XI. TELEMEDICINE MODALITY USED

Modality	Articles	Quantity (%)
Asynchronous	[20] [21] [25] [27] [28] [29] [30] [32] [36] [40] [48] [50] [51] [52] [54] [57] [58] [61] [62] [63] [66] [67] [69] [72] [73] [75] [77] [81] [83]	29 (43)
Synchronous	[17] [18] [19] [22] [24] [26] [31] [34] [35] [37] [38] [43] [45] [47] [55] [56] [64] [68] [70] [71] [74] [76] [78] [79] [80] [82]	26 (38)
Both	[23] [33] [39] [41] [42] [44] [46] [49] [53] [59] [60] [65] [84]	13 (19)

The communication channels used by the researchers varied, according to the activity carried out, but the use of videoconferencing and mobile applications stands out (see Table XII). These results coincide with studies carried out at the first level of care, such as the one conducted by A. C. Shah and S. M. Badawy in 2020 [85].

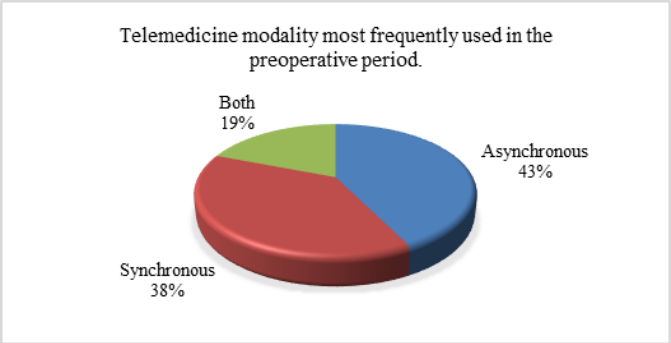

Fig. 20. Telemedicine modality most frequently used in the preoperative period.

TABLE XII. COMMUNICATION CHANNELS IN TELEMEDICINE MOST FREQUENTLY USED IN THE PREOPERATIVE PERIOD

Communication Channel	N° Articles
e-Form	4
e-Mail	8
Instant Messaging	5
Medical device	2
Mobile App	16
Phone Call	15
SMS	7
Smart device	4
Videoconference	25
Web	9

No percentages have been placed in this table, since in about half of the publications they refer to the use of more than one communication channel at the same time.

These results could be linked to the emergence of new technologies associated with videoconferencing equipment and the expansion of smartphones [8].

Chen E.A. et al. [1], he clarifies this topic in his review "Smartphone applications in orthopedic surgery", mentions that the use of this equipment by physicians amounts to 90%, and performs a descriptive analysis of the use of mobile phones in the field of orthopedics, finding that their use in this field varied in capabilities from angular management to preoperative and gait quantification. And it concludes that as more advanced applications are developed, smartphones are likely to gain an increasing presence in both the operating room and clinical settings.

Something that we should also point out is that the articles included in this research point to interventions that used more than one communication channel (see Fig. 21).

7) RQ7. What are the surgical specialties that are most frequently applying telemedicine in the preoperative period?

Telemedicine investigations in the preoperative period were carried out to a greater extent without distinction of surgical specialty. The concentration of publications related to general preoperative management, oncological surgery, traumatology, general surgery, and neurosurgery is observed (see Fig. 22).

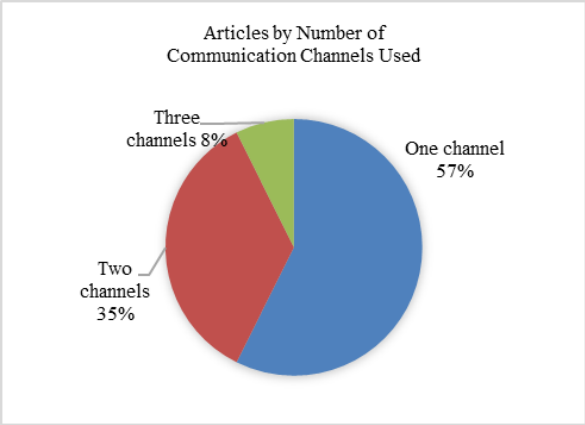

Fig. 21. Number of communication channels used in telemedicine activities during the preoperative period.

These results are in line with those published by Gachabayov et al., who addresses the issue of the role of telemedicine in surgical specialties during the pandemic and points out that most articles in the first six months were performed in orthopedic surgery followed by general surgery and neurosurgery, while in the second six months, urology and neurosurgery were the most productive, followed by transplantation and plastic surgery [86].

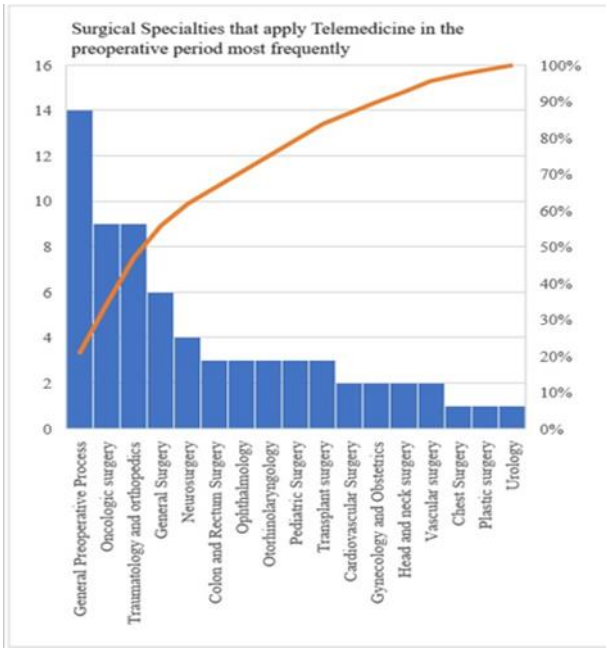

Fig. 22. The use of telemedicine in the preoperative period focuses on general procedures, oncological surgery, and traumatology.

8) RQ8. Which are the Articles whose Abstracts are characterized by their high Objectivity by year and country in telemedicine research and its impact on the preoperative period?

We observed that the production of articles during the first years was lower than during the last two years, but in recent years there has also been an increase in subjectivity in the abstracts of publications (see Fig. 23).

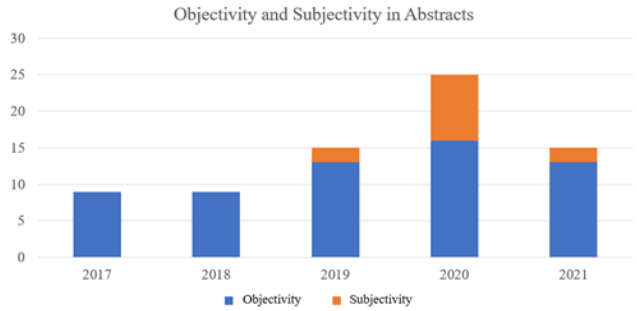

Fig. 23. Objectivity and Subjectivity of Abstracts

In terms of countries with highly objective summaries, the United States continues to lead (see Fig. 24).

Fig. 24. Abstracts with high objectivity by country.

V. Conclusions and Future Research

This document has been an input and provided a statistical analysis on the application of Telemedicine in the Preoperative Period, through the extraction of data from a total of 68 articles published between 2017 and 2021. The highest percentage of identified studies was obtained from Springer, however, when applying the filtering and exclusion criteria, the highest percentage of included studies came from Scopus. It should be noted that the greatest use of telemedicine in this period is concentrated in teleconsultation and telecounseling services, as well as a greater scientific production with aspects related to general preoperative procedures, followed by those applied to oncological surgery and traumatology. There has also been an increase in production in recent years, probably due to the need for physical distancing due to the pandemic and the demand for activities in the surgical field.

For future research, it would be opportune to consider the co-occurrence of search terms, in this case, telemedicine with COVID-19 and preoperative care. It would also be a great contribution to analyze the impact smartphones have on preoperative care. Another relevant aspect would be to point out the use of NQER terms and the impact of polarity and objectivity on readers' choice of articles to read, share and cite.

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