AMBULATORY SURGERY

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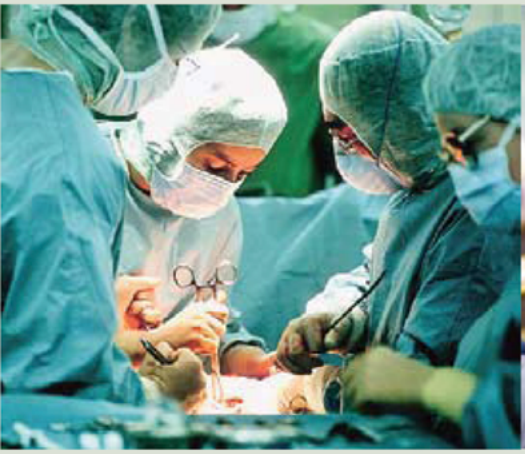


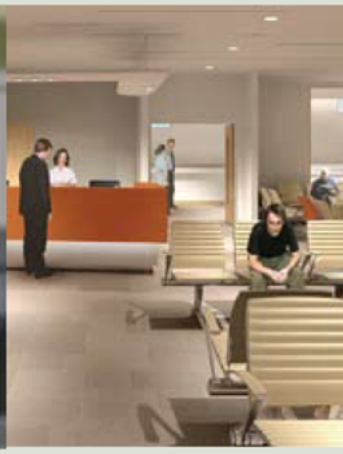

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Editorial

Mark Skues, Editor-in-Chief

Astute readers will have noticed the absence of the December edition of this Journal. The reason why this did not appear was simply, a lack of papers to publish. The impact of the COVID pandemic was quite significant on the number of submissions received, but the subsequent fall in number of papers suitable for *Ambulatory Surgery* is quite marked. So, if you wish to continue to receive and read this publication on a quarterly basis, the solution is quite simple . . . please submit something suitable.

As a consequence of this shortfall, the number of papers in this edition is reduced to three. It seemed logical to not delay the publication of these submissions any longer as timeliness of release is important to prospective authors. So here are the three manuscripts that were submitted.

Paper 1 is a submission from Pinto at alia, attempting to develop a consensus on quality indicators for Ambulatory Surgery in Portugal. Using a Delphic process, the authors convened a two round process seeking insight from 27 experts regarding importance and relevance of certain indicators in the ambulatory surgery process. They concluded that the chosen indicators were concordant with literature recommendations, but did not reflect all aspects of the quality process.

The second paper evaluates the development of robotic surgery in the United States of America, investigating the characteristics and trends of published material. A progressive increase in output was noted, with use now extending to new surgical specialities. Little discussion was made of Ambulatory Surgery, but I wonder how long it will be before we see a paper describing the use of robotic surgery in the short stay environment?

The final paper is a useful precis of the role and use of intravenous non-steroidal anti-inflammatory agents in ambulatory surgery. It offers useful insight into the relative value of such agents, particularly when combined with co-analgesics or gastroprotective agents.

In conclusion; the future of this Journal is in your hands. I will endeavour to maintain publication throughput to my best ability, but without submissions to sustain this, my abilities are somewhat limited. So . . . over to you.

Dr Mark Skues
Editor-in-Chief

Consensus on quality indicators in ambulatory surgery: a Delphi survey conducted in Portugal

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Abstract

Aim: To establish consensus on the most appropriate quality indicators for evaluating the quality of Ambulatory Surgery (AS) in Portugal.
Methods: Data were collected using a modified e-Delphi technique in two rounds. A total of 58 potential quality indicators in AS were assessed by 27 experts.

Results: In the first round consensus was found for accepting 44 indicators. The data analysis that took place in the second round revealed consensus for including 10 more quality indicators.
Conclusion: The quality indicators in AS used in Portugal are in line with the literature recommendations, but they only reflect some aspects of the quality process.

Keywords: Ambulatory Surgery; Quality Indicators, Health Care; Delphi Technique; Clinical Governance.

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Introduction

Quality of care is "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (1,2).

The dimensions of healthcare quality to be measured should be the definable, measurable and actionable, attributes of the system that are related to its functioning to maintain, restore or improve health. These dimensions incorporate effectiveness, safety, responsiveness, patient centeredness, accessibility, equity, efficiency, appropriateness, and timeliness (3).

Quality indicators must be simple and easy to obtain in order to implement an organized quality control system that is completely integrated with the normal activity of ambulatory surgery centres (4).

Regarding Ambulatory Surgery (AS), some authors identify a need for better quality measures (5). Research needs to focus on identifying quality metrics that convey patient's experience through the structure, outcomes, and efficiency of care. Measuring quality outcomes will be important for patient safety (6).

A thorough analysis of the existing literature was conducted to identify the globally used quality indicators in AS (7). There is no clear consensus on which indicators are most suitable for assessing quality in AS nor how to define them. These include hospital readmission rates, post-operative complications, patient satisfaction, waiting times, adherence to clinical guidelines, and resource use efficiency (ambulatorization rates).

We have sought to categorise various quality indicators found in the literature into a theoretical framework through which metrics could be organised and analysed. The approach first conceptualised by Donabedian, describes indicators as either structure, process or outcome and is widely accepted and a useful way of categorising health care quality indicators (8).

Structure indicators represent the necessary conditions for the provision of a given quality of health care. They refer to the attributes of the settings in which healthcare occurs and do not ensure that the appropriate processes will be carried out or that satisfactory outcomes will be achieved (3,8).

Process indicators correspond what is actually done in giving and receiving healthcare. They denote the measures of the delivery of appropriate health care to the relevant population (3,8).

Outcome indicators represent the effects of care on patients' health status (8).

It is necessary to standardize the assessment of quality in AS to obtain information on the performance of services, support decision-making, monitor the implementation of improvement measures, compare results over time and benchmark between different institutions.

This study aims to establish consensus on the most appropriate quality indicators for evaluating the quality of AS in Portugal.

Methods

Delphi is a scientific method to organize and structure an expert group discussion aiming to generate insights on controversial topics with limited information (9).

There are no standard quality parameters to evaluate Delphi methods in healthcare research. However, the Delphi method requires essential elements, such as anonymity, iteration, controlled feedback, and statistical stability of consensus (10). Using this method in this study, researchers provided anonymous communication between individuals with expertise in AS, with the goal of seeking their opinion in an iterative and structured way, aiming to achieve a consensual position (11)

A modified e-Delphi technique was used for this study. In the preparatory phase, a literature review was carried out (7) as well as a focus group to discuss and validate the first questionnaire to be used in the study, thus justifying its designation as a modified technique. The research team decided to conduct the Delphi in two online rounds due to the ease of use, time savings, ease of organising and data processing and the guarantee of the participants' anonymity(10).

Identification of experts

The consulted authors recommend the formation of expert panels with different levels of experience. Such composition ensures a wider range of opinions (collective wisdom), by prioritising individuals with practical knowledge and experience of the subject under study. Academic qualifications are not mandatory for all experts. The involvement of multiple stakeholders, with different perspectives on the quality of care, enhances the study's findings.(11,12).

A purposive sample of national participants was selected for the expert panel of this Delphi study. To ensure the aforementioned

features, the following inclusion criteria were used: 1) the participant had current clinical experience in AS, and 2) the participant had experience in research, teaching, practice, or policy regarding AS.

There is no consensus in the literature regarding the number of experts to include on the panel, although the consulted authors recommend a panel with 10 to 30 experts (9–11,13). Twenty-seven experts were selected, informed about the study and invited by email d to participate in both rounds.

Questionnaire development & Data collection

During the preparatory phase of the study, we developed its initial conceptualisation and a literature review to map the quality indicators globally used in AS (7). Subsequently, semi-structured interviews were conducted with a panel of 5 experts to further refine the results of the scoping review and assist with formulating the questions for the first round.

During the second phase of the study, two rounds of questionnaires were conducted, and the data from each round was analysed. The Qualtrics® platform was selected to program the questionnaire and collect data.

A version of the questionnaire was prepared for the first round, consisting of three sections: 1) informed consent to participate in the study; 2) sociodemographic characterization of the participant; 3) quality indicators in AS. In section 3, open response fields were provided for experts to submit comments, opinions, and suggestions on the study's subject. A 5-point Likert scale was used, where 1 corresponds to "Not sensitive", 2 to "Slightly sensitive", 3 to "Moderately sensitive", 4 to "Sensitive" and 5 corresponds to "Very sensitive".

Data analysis

Quantitative data analysis was performed using the IBM Statistical Package for the Social Sciences, version 28.0. For each response item, the mean, median, standard deviation, coefficient of variation (CV), content validity index (CVI), and percentage of responses 1 and 2 were calculated. The coefficient of variation determines the stability of responses for each item. It is calculated by dividing the standard deviation by the mean. (14). This measure is reported as a percentage with consensus being achieved when there is low dispersion in the results. Low dispersion is when the coefficient of variation (CV) is ≤15%, medium dispersion is when CV ranges between 15% and 30%, and high dispersion is when CV ≥30%. The CVI measured the percentage of agreement for each item. In this study, it was calculated by summing the number of responses "3", "4", and "5", dividing by the total number of responses, and reporting it as a percentage. For this study, consensus was defined as CVI≥80%.

If any of the experts were to make comments that expressed doubt or incomprehension regarding any item, regardless of its statistical analysis, that item would move on to the next round. The consensus criteria for accepting or excluding items were defined as shown in Table 1.

The results from the first round were analysed and compiled into a report to provide feedback to the experts. The second questionnaire was designed by eliminating the accepted and excluded items in the first round, retaining those that did not reach a consensus or raised doubts among the experts.

The report of the first round and the link to the second questionnaire were sent simultaneously via email to the same group of experts, with the link remaining accessible for 4 weeks.

The results of the second round were analysed in the same way described for the first round. Indicators that did not reach consensus were discussed within the research team to decide on their inclusion in the indicator summary. The decisions were based on the bibliographic research and statistical analysis carried out. The expert panel was informed of the second round results.

Table 1. Criteria Defined for Consensus.

Accept item (cumulative)	80% of the responses with a rating ≥3 (CVI x 100 ≥ 80%) Median ≥ 3; No doubts or misunderstandings regarding the item were mentioned by the experts.
Exclude item (non-cumulative)	80% of the responses with a rating ≤ 2; Median ≤ 2.
No consensus	Items not falling into the other classifications.

Ethical considerations

The proposal for the study was reviewed and approved by the Ethics Committee for Health of the Universidade Católica Portuguesa. All participants had access to the consent form on the first page of the questionnaire, which they had to read and accept in order to proceed with the questionnaire.

Results

Expert panel

The socioprofessional profiles of the participants in both rounds are presented in Table 2. In the second round, 72.7% of the experts had participated in the previous round (n=16) and the rest had not.

Table 2. Socioprofessional characteristics of the participants.

Variables	**Round 1**	**Round 2**
Response rate	62.9	81.4
Age (mean, years)	46.53	47.18
Professional experience (mean, years)	22.88	23.27
Profession		
Nurse (%)	64.7	77.3
Manager/Administrator (%)	5.9	4.5
Doctor (%)	29.5	18.2
Academic degree		
Doctorate (%)	23.5	13.6
Master (%)	35.3	36.4
Degree (%)	41.2	50.00

The sample included professionals from public and private hospitals, from the Portuguese health regulator and from a nursing school.

In the Delphi survey preparation phase, 42 indicators were identified from the literature search and grouped according to the Donabedian's framework. Meetings of the research team and initial interviews with experts revealed the need to clarify some of the indicators found, bringing the number of indicators analysed to 58.

Delphi round one

The 58 potential quality indicators in AS were assessed by the experts in round one.

Regarding the structural indicators, consensus was reached on four items: the existence of protocols regarding clinical information provided to the patient and accompanying person, the existence

of a standardized record platform, the availability of guidelines for professional safety, and the existence of a quality manual. The remaining items did not receive consensus among the experts, continuing to the next round.

Concerning the process indicators, consensus was not reached on five items: number of pre-operative delays and incidents, provision of drugs upon discharge, moderate to severe pain in patients undergoing outpatient surgery, pre-operative nursing consultation rate (due to experts' misunderstanding), and surgical site hair removal.

Six of the outcome indicators analysed by the expert panel did not reach a consensus, proceeding to the next round of the Delphi panel: incidence rate of Anterior Segment Toxic Syndrome, number of hospital transfers, number of same-day admissions with hospitalization exceeding 24 hours, number of Emergency Department visits within 30 days following surgery, number of primary care visits within 30 days following surgery, and number of days until the patient resumes their daily activities after surgery.

In the following table (Table 3), a detailed analysis is presented, considering the previously established consensus criteria.

Delphi Round two

In the second round of the Delphi panel, three structural indicators, five process indicators and nine outcome indicators were analysed. Based on the analysis conducted, there was no consensus among expert pannel for the item "Influenza vaccination compliance rate"and for the process indicator "Surgical site hair removal."

Of the nine outcome indicators analysed by the expert panel, two did not achieve consensus in the second round: incidence rate of Anterior Segment Toxic Syndrome, and Number of postoperative visits to primary care within 30 days. The quantitative analysis from the second round are presented in Table 4.

Discussion

The use of the Delphi technique in this study allowed the development of a profile of indicators suited to the reality of AS in Portugal.

To date, the knowledge regarding which quality indicators are used worldwide in AS has been mapped (7). This study highlights which of these indicators are truly useful in assessing the quality of AS from the perspective of Portuguese experts.

Initially, 58 indicators were presented to the expert panel, distributed across the three dimensions of Donabedian's model - structure, process and outcome. In the first round we found consensus for accepting 44 indicators. The data analysis that took place in the second round revealed consensus for including 10 more quality indicators.

Structure indicators

With regard to structure indicators, experts mentioned misunderstanding of the items "staff skill mix" and "Positive practice environments". Skill mix is a multi-component construct that seeks to capture the number, experience, and educational preparation of professionals working in a healthcare setting. To ensure that a patient needs are met, the appropriate number of professionals is available across the continuum of AS care, with a proper mix of education, skills and clinical experience (15).

Research has shown that positive working environments are related to higher job satisfaction among healthcare professionals, lower levels of burnout and reduced intent among employees to change their jobs (16,17). Thus, enhancing practice environments may help ensure quality of care and, consequently, improve organisational management and health outcomes improvement (16,18,19).

The indicator "Influenza vaccination compliance rate among healthcare personnel" did not met the criteria for being accepted or excluded in the panel. Consequently, was further examined by the research team. Many healthcare guidelines recommend influenza vaccination for specific populations, including healthcare workers. Adhering to these guidelines demonstrates alignment with evidence-based practices. Influenza vaccination among healthcare workers has direct influence in patient safety, healthcare costs and healthcare workers' safety. However, this is not a AS specific indicator, and in the Portuguese context ASC are usually integrated in an hospital, which means that the ASC worker must comply with the hospital's guidelines for influenza vaccination. This justifies the exclusion of the indicator "Influenza vaccination compliance rate among healthcare personnel" from the quality indicators summary.

Process indicators

Regarding process indicators, in the first round the expert panel referred doubts and misunderstanding of the items "Number of preoperative delays and incidents" and "Nursing preoperative consultation rate". For this reason, they were submitted to a second evaluation. The data analysis revealed a clear consensus on both indicators.

Seven of the presented process indicators are those in use in Portugal, as defined by the Portuguese Healthcare Regulatory Authority: Medication supply on discharge, Education on discharge, Post discharge assessment within 24 hours, Selection of postoperative nausea and vomiting prophylaxis, Patient selection for administration of postoperative nausea and vomiting prophylaxis, Regular Postoperative pain evaluation in AS, Moderate to maximum pain in patients undergoing AS.

"Medication supply on discharge" and "Moderate to maximum pain in patients undergoing AS" did not reach consensus in the first round. These findings may suggest that it is necessary to review the indicators in use in Portugal, even though they are aligned with the current international knowledge.

Pain is Pain is one of the leading causes of delayed discharge leading to same day hospitalization, as well as consultation outside the hospital after discharge and re-hospitalization. Also, poor initial management of post-operative pain may lead to chronic pain (20).

The value of having a preoperative nursing consultation is well established. It is of paramount value in a reality where patients are expected to complete their perioperative journey within 24 hours (21,22). The initial consultation with the surgeon should be reinforced by a nursing consultation to reiterate information and recommendations, and answer patients' additional doubts and questions (20).

The indicator "Surgical site hair removal" is not specific to AS and did not reach consensus among experts in any of the rounds, indicating that despite the extensive literature on this topic, doubts and constraints still exist in its operationalization (23,24).

Result indicators

Toxic Anterior Segment Syndrome (TASS) is a rare and serious postoperative complication that can occur after cataract surgery or other anterior segment eye surgeries. TASS is characterized by inflammation and other symptoms that affect the anterior segment of the eye, which includes the cornea, iris, lens, and the space between these structures. TASS typically manifests within the first 12 to 48 hours after surgery. The condition is usually non-infectious and is caused by a combination of inflammatory responses to substances introduced into the eye during surgery. These substances might include residual detergents, ophthalmic viscosurgical devices, preservatives, or other contaminants (25).

Table 3. Quantitative analysis from round 1.

		Mean	Median	Standard deviation	CV (%)	CVI (%)	Responses 1 or 2 (%)	Decision
Structure Indicators								
1.	Existence of protocols regarding clinical information provided to patients and relatives	3.88	4	0.332	8.56	100	0	Accept
2.	Influenza vaccination compliance rate among healthcare personnel	2.53	3	1.007	39.82	52.941	47.1	No consensus
3.	Existence of unified record platform	3.76	4	0.437	11.61	100	0	Accept
4.	Existence of guidelines for occupational safety	3.59	4	0.870	24.25	88.235	11.8	Accept
5.	Staff Skill mix	3.29	4	0.849	25.77	76.471	23.5	No consensus
6.	Existence of a quality manual	3.82	4	0.393	10.28	100	0	Accept
7.	Positive practice environments	3.71	4	0.686	18.51	88.235	11.8	No consensus
Process Indicators								
1.	Number of preoperative delays and incidents	3.29	4	0.849	25.769	76.471	23.5	No consensus
2.	Medication supply on discharge	3.18	3	0.809	25.467	76.471	23.5	No consensus
3.	Education on discharge	4.00	4	0.000	0.000	100	0	Accept
4.	Post discharge assessment within 24 hours	3.76	4	0.562	14.936	94.112	5.9	Accept
5.	Same day cancellation rate	3.29	3	0.588	17.846	94.118	5.9	Accept
6.	Patient selection for administration of postoperative nausea and vomiting prophylaxis	3.53	4	0.624	17.687	94.118	5.9	Accept
7.	Selection of postoperative nausea and vomiting prophylaxis	3.41	4	0.712	20.877	88.235	11.8	Accept
8.	Regular Postoperative pain evaluation in AS	3.71	4	0.588	15.863	94.118	5.9	Accept
9.	Moderate to maximum pain in patients undergoing AS	3.24	3	0.831	25.697	76.471	23.5	No consensus
10.	Waiting times at the ASC.	3.35	3	0.606	18.084	94.118	5.9	Accept
11.	Compliance with staff safety guidelines	3.47	4	0.717	20.672	88.235	11.8	Accept
12.	Nursing preoperative consultation rate	3.71	4	0.588	15.863	94.118	5.9	No consensus
13.	Safe surgery checklist correct use rate	3.76	4	0.437	11.614	100	0	Accept
14.	Safety events incidence rate	3.41	4	0.870	25.508	88.235	11.8	Accept
15.	Safety events report rate	3.65	4	0.493	13.507	100	0	Accept
16.	Medication errors incidence rate	3.59	4	0.870	24.253	88.235	11.8	Accept
17.	Correct timing of prophylactic IV antibiotic rate	3.65	4	0.606	16.625	94.118	5.9	Accept
18.	Surgical site hair removal	2.82	3.00	1.015	35.934	64.706	35.3	No consensus
Result Indicators								
1.	Postoperative complications rate – bleeding	3.53	4.00	0.717	20.327	88.235	11.8	Accept
2.	Postoperative complications rate – hematoma	3.41	4.00	0.712	20.877	88.235	11.8	Accept
3.	Postoperative complications rate – wound separation	3.41	4.00	0.870	25.508	88.235	11.8	Accept
4.	Postoperative complications rate – ischemia	3.35	4.00	0.931	27.781	82.353	17.6	Accept

Table 3 continues . . .

		Mean	Median	Standard deviation	CV (%)	CVI (%)	Responses 1 or 2 (%)	Decision
5.	Postoperative complications rate – postopertaive hypertension	3.06	3.00	0.966	31.592	82.353	17.6	Accept
6.	Postoperative complications rate – hypoxemia	2.94	3.00	0.899	30.578	82.353	17.6	Accept
7.	Postoperative complications rate – toxic anterior segment syndrome	3.06	3.00	0.899	29.402	76.471	23.5	No consensus
8.	Thromboembolic events rate	3.59	4.00	0.712	19.851	88.235	11.8	Accept
9.	Surgical site infection rate	3.82	4.00	0.393	10.277	100	0	Accept
10.	Morbidity Rate at 30 Days	3.41	4.00	0.795	23.308	82.353	17.6	Accept
11.	Mortality rate at 30 days	3.41	4.00	0.795	23.308	82.353	17.6	Accept
12.	Number of unplanned re-operations	3.65	4.00	0.606	16.625	94.118	5.9	Accept
13.	Unplanned re-hospitalisation rate	3.65	4.00	0.702	19.245	88.235	11.8	Accept
14.	Number of hospital transfers	3.29	4.00	0.849	25.769	76.471	23.5	No consensus
15.	Number of same day admissions with a length of stay greater than 24 hours	3.35	4.00	0.862	25.702	76.471	23.5	No consensus
16.	Number of unplanned overnight admissions	3.47	4.00	0.624	17.987	94.118	5.9	Accept
17.	Patient experience in the ASC	3.35	3.00	0.786	23.439	94.118	5.9	Accept
18.	Incidence of patient burn	3.59	4.00	0.507	14.123	100	0	Accept
19.	Incidence of patient fall	3.65	4.00	0.493	13.507	100	0	Accept
20.	Incidence of injuries related to surgical positioning	3.71	4.00	0.470	12.674	100	0	Accept
21.	Incidence of wrong site surgery	3.82	4.00	0.393	10.277	100	0	Accept
22.	Incidence of wrong side surgery	3.82	4.00	0.393	10.277	100	0	Accept
23.	Incidence of wrong patient surgery	3.88	4.00	0.332	8.554	100	0	Accept
24.	Incidence of wrong procedure surgery	3.88	4.00	0.332	8.554	100	0	Accept
25.	Incidence of wrong implant surgery	3.88	4.00	0.332	8.554	100	0	Accept
26.	Urinary retention rate	3.12	3.00	0.697	22.345	82.353	0	Accept
27.	Number of postoperative emergency department visit within 30 days	3.06	3.00	0.827	27.034	70.588	29.4	No consensus
28.	Number of postoperative visits to primary care within 30 days	2.82	3.00	0.728	25.769	64.706	35.3	No consensus
29.	Number of postoperative visits to surgical speciality clinics within 30 days	3.24	3.00	0.752	23.257	82.353	17.6	Accept
30.	Staff satisfaction	3.53	4.00	0.624	17.687	94.118	5.9	Accept
31.	Patient's ability to resume normal activities following surgery (days)	3.06	3.00	0.827	27.034	70.588	29.4	No consensus
32.	Maintenance of normothermia	3.47	4.00	0.624	17.987	94.118	5.9	Accept
33.	Health-related quality of life	3.18	3.00	0.883	27.793	82.353	17.6	Accept

Prevention of TASS involves strict adherence to sterile techniques during surgery and proper cleaning and sterilization of surgical instruments, as well as the avoidance of contaminated solutions or equipment (25).

There was no consensus on this indicator in any of the Delphi rounds, as the statistical analysis of the results was similar in both rounds. Considering that TASS is a medical emergency requiring immediate attention from an ophthalmologist, and that over 90% of cataract surgeries are performed in ambulatory setting in the majority of OECD countries and 96.7% in Portugal (26), the research team agreed that this indicator should be considered when evaluating the quality of AS.

In the reviewed literature, morbidity and mortality rates at 30 days after AS were mentioned by some authors as quality indicators for AS. However, others do not considered them useful for monitoring AS practice since they may not reflect the quality of care given in the perioperative period (27–29). Since these indicators are not in use in Portugal, we sought to understand expert's views on this

Table 4. Quantitative analysis from round 2.

		Mean	Median	Standard deviation	CV (%)	CVI (%)	Responses 1 or 2 (%)	Decision
Structure Indicators								
1.	Influenza vaccination compliance rate among healthcare personnel	2.50	3	0.964	38.5	54.545	45.5	No consensus
2.	Staff Skill mix	3.36	3	0.581	17.3	95.455	4.5	Accept
3.	Positive practice environments	3.59	4	0.503	14.0	95.455	0	Accept
Process Indicators								
1.	Number of preoperative delays and incidents	3.64	4	0.492	13.540	100	0	Accept
2.	Medication supply on discharge	3.59	4	0.796	22.177	90.909	9.1	Accept
3.	Moderate to maximum pain in patients undergoing AS	3.45	4	0.963	27.862	86.364	13.6	Accept
4.	Nursing preoperative consultation rate	3.86	4	0.351	9.091	100	0	Accept
5.	Surgical site hair removal	2.82	3	1.006	35.714	68.182	31.8	No consensus
Result Indicators								
1.	Postoperative complications rate – toxic anterior segment syndrome	3.14	3	0.774	24.688	77.273	22.7	No consensus
2.	Morbidity Rate at 30 Days	3.59	4	0.590	16.439	95.455	4.5	Accept
3.	Mortality rate at 30 days	3.36	4	0.902	26.820	81.818	18.2	Accept
4.	Number of hospital transfers	3.36	3.5	0.727	21.606	86.364	13.6	Accept
5.	Number of same day admissions with a length of stay greater than 24 hours	3.64	4	0.492	13.540	100	0	Accept
6.	Number of postoperative emergency department visit within 30 days	3.55	4	0.596	16.805	95.455	4.5	Accept
7.	Number of postoperative visits to primary care within 30 days	2.86	3	0.941	32.857	68.182	31.8	No consensus
8.	Patient's ability to resume normal activities following surgery (days)	3.36	3.5	0.790	23.473	90.909	4.5	Accept

topics, asking about their appropriateness of use in both rounds. In the first round both items were accepted and in the second round the statistical analysis revealed higher CVI a lower percentage of responder 1 and 2, revealing that Portuguese experts consider morbidity and mortality rates at 30 days after AS important quality indicators.

The item "Number of postoperative visits to primary care within 30 days" refers to unplanned visits to primary care due to unexpected circumstances. The expert panel considered that this indicator is redundant since the statistical analysis did not revealed consensus. This item intended to articulate with "Number of postoperative emergency department visit within 30 days", reflecting the need for a patient to seek medical attention for an acute complication resulting from the outpatient surgical procedure.

The majority of times patients seek medical unplanned medical attention after AS are related to pain and wound complications. Some authors suggest that interventions such as calling patients after surgery, facilitating contact with the AS healthcare team and tailoring discharge instructions to all levels of health literacy may limit ED and primary care visits in the first month after outpatient surgery (30).

Since patient centeredness is one of the fundamental features of AS, patient experience should be included as a key quality indicator. This item reached consensus on the first round. Nonetheless, it is important to clarify some concepts. We propose the inclusion of "patient experience" as an indicator instead of "patient satisfaction" as it is often seen in literature. Patient satisfaction refers to the patient's perception of how well their expectations and needs were met during their encounter with a healthcare provider or facility. Patient experience is a broader concept that encompasses patient satisfaction but also includes other dimensions of care, reflecting the entire journey a patient goes through. Patient experience takes into account factors like communication, coordination of care, access to information, involvement in decision-making, and the overall feeling of being treated with respect and dignity (31).

In essence, patient satisfaction is a component of patient experience. A patient can be satisfied with a specific aspect of their care (e.g., a short waiting time) but still have an overall negative experience due to poor communication or lack of empathy.

ASC and healthcare professionals working in AS aim to improve both patient satisfaction and patient experience to ensure that patients not only receive quality surgical care but also feel valued, respected, and supported throughout their outpatient journey. By focusing on patients' opinions, ASC staff is concerned with how healthcare meets their objective and subjective needs, and how it contributes to maintaining or improving their health status and quality of life (32).

It's important to choose the right moments to obtain feedback to capture a comprehensive view of the patient's experience. By evaluating patient satisfaction at various stages, healthcare providers

can identify areas for improvement, enhance patient communication, ensure a positive and satisfactory AS experience, and ultimately contribute to a better patient clinical outcome. As for the timing for performing this evaluation, authors recommend doing it at discharge and 30 days later (4,27).

Strengths and limitations

An important strength was the high response rates for both rounds 62,4% and 81,4%, revealing experts' commitment and interest in the study. Furthermore, by including experts who had clinical, teaching or policy-making experience, a broad scope of AS setting was reflected.

In the interpretation of the results, some limitations should be considered. First, only Portuguese experts were included in this study, which limits the generalization of the results. Second, patients were not included as experts because of the challenges regarding defining outcomes of care.

The risk of missing quality indicators was minimised by letting experts add and define missing indicators in the open answer sections of the questionnaire.

Conclusion

This study provides insight into AS quality indicators' appropriateness in the Portuguese reality. In total 56 indicators were considered suitable to evaluate the quality of AS in Portugal. The quality indicators in AS used in Portugal are coincident with the literature recommendations but they only reflect some aspects of the process of quality.

Ambulatory surgery is being performed with increasing frequency, but there are still few studies related to safety in this context. Patient safety, staff safety and safety occurrences tracking and management are of paramount importance for quality assessment in AS. Structural indicators are the foundation for a proper care delivery in this context, giving the specific features of AS. To have good outcomes, attention should be paid to the underlying process indicators. Therefore, measures must be established before carrying out AS to guarantee its safety and quality, as well as a monitoring and evaluation system.

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Robotic Surgery in the United States: A Comprehensive Analysis of Scientific Production and Trends

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Abstract

The aim of this study was to determine the characteristics and trends of articles published regarding Robotic Surgery by American authors. Research using Web of Science database was conducted in June 2023, considering only original articles published between 2018 and 2022. Robotic surgery is a rapidly growing field, with a consistent and steady increase in research output from American institutions during the last 5 years. The previous analysis was helpful to provide an overview of the scientific production in the leading country in the field, especially regarding the institutions with the highest contributions.

Keywords: Bibliometrics, Robotic-Assisted Surgery, United States.

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Introduction

Robotic surgery (RS) has transformed minimally invasive surgery and overcome the technological constraints of laparoscopy. RS is rapidly gaining ground across a range of disciplines, with an average yearly growth rate of about 15%. Furthermore, there are over 900 new robotic platforms installed globally each year (1).

With 1.24 million robotic units sold worldwide in 2020, the United States accounted for 70.6% of the total sales. The use of enhanced high definition (HD) and three-dimensional (3D) visualization, along with greater dexterity, tremor filtration, and extremely precise movement, has expanded the applications of robotic assistance in minimally invasive surgery. This advancement has particularly benefited more delicate and complex procedures, allowing for increased precision and improved outcomes (2).

The idea of telepresence and the development of surgical robots both evolved from necessity. The demand for surgical treatments for soldiers stationed in remote locations was one of the driving forces behind these advancements (3).

The Bradley 557A was created by the American military's Defense Advanced Research Projects Agency (DARPA). In 1994, it utilized a microwave connection to perform the first ex vivo organ anastomosis telepresence surgery. Furthermore, with the advancement of space exploration, astronauts on extended missions required the ability to perform long-distance tasks. As a result, a telemanipulator from the Stanford Research Institute was integrated with a head-mounted display and data glove from NASA Ames Research Center (4).

The U.S. Food and Drug Administration (FDA) granted its initial human use approval for the da Vinci surgical system (Intuitive Surgical, Sunnyvale, CA, USA) in 2000 (5).

The benefits that come from the application of RS are numerous. Among the most relevant: better visualization since the operating surgeon obtains a three-dimensional image that improves depth perception; camera motion is stable and easily controlled by voice-activated or manual master controls; manipulation of robotic arm instruments enhances range of motion, allowing the surgeon to conduct more complicated surgical operations (6); reduced the chance of readmission by half (52%); and revealed a 77% reduction in the prevalence of blood clots (deep vein thrombosis and pulmonary emboli) (7).

Robotic surgery has revolutionized the field of urology, enabling surgeons to perform complex procedures with greater precision and accuracy. One of the primary uses of RS in this specialty is the robotic-assisted laparoscopic radical and partial prostatectomy for the treatment of prostate cancer (8). It has been widely adopted in various other fields of medicine beyond urology, such as neurosurgery. Its usage in neurosurgery dates back to 1985, initially primarily used for biopsies (9).

In the early 1990s, the first robotic orthopedic surgery application was total hip arthroplasty, followed by knee arthroplasty (10). Since the 2000s, gynecology has also adopted this technique for common benign disorders, with hysterectomy and myomectomy being the most popular procedures (11).

Since the 2000s, there has been an increase in robotic cardiac surgery, with the majority of cases involving endoscopic coronary artery bypass grafting (CABG) and mitral valve repair (MVP). However, relatively few cases involve aortic valve repair (12).

Robotics will continue to change modern surgery over the next few years as haptic feedback, machine learning/artificial intelligence (AI), and training technologies progress.

By the end of 2017, the Institute company shipped 5,770 robot systems. After accounting for trade-ins and returns, a total of 4,409 platforms were installed globally, including 2,862 (65%) in the United States. The estimated annual procedure volume increased from 136,000 in 2008 to 877,000 in 2017. In 2017, 644,000 procedures (73%) were performed in the United States (13). This indicates that the United States is the leading country in robotic surgical procedures worldwide. Therefore, understanding its scientific production will provide us with a good overview of the progress and evolution of RS.

Bibliometric studies are ideal for providing an overview of scientific production in a specific field. They offer valuable information on the

results of the research process, including volume, evolution, visibility, and structure. These studies enable the assessment of scientific activity and the impact of research and sources within the field (14).

There is a limited number of bibliometric analyses available on the scientific production of RS specifically in the United States, despite the country's leadership in this field. Consequently, the objective of this study was to investigate the characteristics and trends of articles published by American authors on RS and examine how they have evolved over the years.

Methodology

A bibliometric analysis of original articles published by authors with American affiliation in journals indexed in Web of Science (WOS) was carried out.

Search strategy

The search strategy involved using the terms "United States," "Robotic," "robot," "Surgery," and "Surgical Procedures" in all fields of the Web of Science (WOS) database. This strategy aimed to retrieve studies where the patients, institution, or main author were American, rather than just studies where the American author was a collaborator. The search was conducted on June 10, 2022.

Selection of articles

The metadata of the identified records from the search were downloaded as a .ciw file. Subsequently, they were imported into the Rayyan web application, where a review process took place. During the review, the titles, abstracts, and authors of each record were examined to determine if they met the inclusion criteria: original articles with at least one author affiliated with an American institution and published between 2018 and 2022, as the year 2023 was still ongoing at the time.

Any records that did not meet these criteria were excluded. The WOS "Accession Number" was extracted from each excluded record to exclude them from the initial search and obtain the final set of complete records for the bibliometric analysis.

Bibliometric Analysis

Bibliometric indices were obtained using the Bibliometrix package in the R programming language. (15) Similarly, the VOS viewer software version 1.6.17 from Leiden University in the Netherlands (16) was utilized to develop bibliometric networks based on co-authorship. This analysis involved considering information such as author names, institutional affiliations, and keywords from the retrieved records. Prior to the network analysis, a manual standardization of the data was conducted for the author, institutional affiliation, and keywords fields. The aim was to eliminate redundancies and inconsistencies by creating thesauruses in .txt format, following the two-column format (label and replace by) as specified in the VOSviewer version 1.6.17 software manual. Additionally, Microsoft Excel was employed to create tables and graphs for data presentation (17).

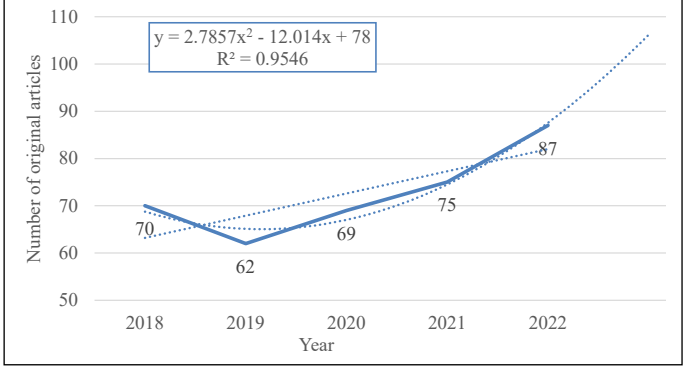
Results

The search strategy resulted in 561 articles, out of which 363 were included after the screening process from a total of 158 different journals.

There was a 5.59% annual increase in the scientific production of RS in the United States during the period studied, with an average of 72.6 original articles published per year. The highest production year was 2022, with 87 original articles.

Furthermore, a second-degree polynomial trend was observed in the publications between 2018 and 2022, with an R-squared value of 0.9546, as showed in Figure 1. This indicates a strong correlation between the year and the number of publications in the field of RS during that time period.

Figure 1. Scientific production in robotic surgery in United States 2018–2022.



The average number of citations per document was 13.3. The most cited article was a clinical trial conducted by Parekh et al., published in the journal Lancet in 2018. The article, titled "Robot-assisted radical cystectomy versus open radical cystectomy in patients with bladder cancer (RAZOR): an open-label, randomized, phase 3, non-inferiority trial," received a total of 413 citations. A detailed list of the top 10 most cited authors can be found in Table 1.

Table 1. Most Cited Articles in Robotic Surgery by North American Authors in 2018–2022.

Paper	Total Citations
Robot-assisted radical cystectomy versus open radical cystectomy in patients with bladder cancer (RAZOR): an open-label, randomised, phase 3, non-inferiority trial. 10.1016/S0140-6736(18)30996-6	413
Trends in the Adoption of Robotic Surgery for Common Surgical Procedures. 10.1001/jamanetworkopen.2019.18911	222
The Learning Curve Associated with Robotic Total Knee Arthroplasty. 10.1055/s-0037-1608809	90
Ultrarestrictive Opioid Prescription Protocol for Pain Management After Gynecologic and Abdominal Surgery. 10.1001/jamanetworkopen.2018.5452	86
Phase II Randomized Trial of Transoral Surgery and Low-Dose Intensity Modulated Radiation Therapy in Resectable p16+ Locally Advanced Oropharynx Cancer: An ECOG-ACRIN Cancer Research Group Trial (E3311). 10.1200/JCO.21.01752	84
The long-term survival of robotic lobectomy for non-small cell lung cancer: A multi-institutional study. 10.1016/j.jtcvs.2017.09.016	84
Minimally Invasive Versus Open Pancreaticoduodenectomy: A Propensity-matched Study From a National Cohort of Patients. 10.1097/SLA.0000000000002259	73
Proving the Effectiveness of the Fundamentals of Robotic Surgery (FRS) Skills Curriculum: A Single-blinded, Multispecialty, Multi-institutional Randomized Control Trial. 10.1097/SLA.0000000000003220	68
A deep-learning model using automated performance metrics and clinical features to predict urinary continence recovery after robot-assisted radical prostatectomy. 10.1111/bju.14735	61
Incidence of adverse events in minimally invasive vs open radical hysterectomy in early cervical cancer: results of a randomized controlled trial. 10.1016/j.ajog.2019.09.036	59

The most relevant topics were related with general surgery (46%), urology and nephrology (14.9%), oncology (11%), Obstetrics and Gynecology (8.3%), and Otorhinolaryngology (8%).

The journal Surgical Endoscopy and Other Interventional Techniques had the highest number of articles published by American authors in the last five years, with a total of 20 publications. It is worth noting that all of the 10 most productive journals in this field, as shown in Table 2, fall within Zone 1 as per Bradford's Law, indicating their high productivity (18)

Table 2. Journals with the highest number of articles in in Robotic Surgery by American authors.

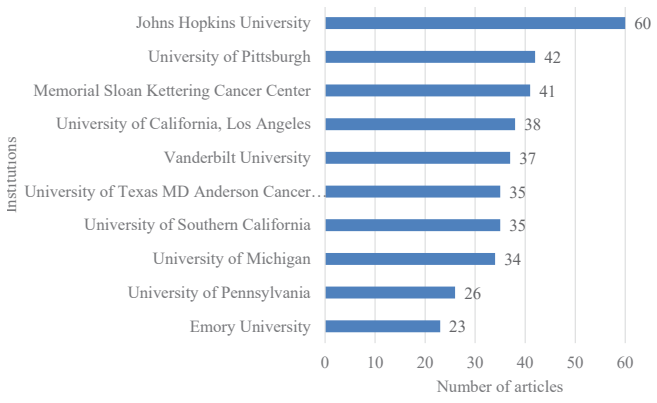
Sources	Q	Articles
Surgical endoscopy and other interventional techniques[1]	1	20
Journal of endourology[1]	1	14
International journal of medical robotics and computer assisted surgery[2]	2	11
Journal of robotic surgery[2]	2	11
Surgery for obesity and related diseases1	1	10
IEEE transactions on biomedical engineering[1]	1	9
Journal of urology[1]	1	9
Journal of surgical education[1]	1	8
Head and neck[1]	1	7
American journal of obstetrics and gynecology[1]	1	6

[1]From United States [2]From United Kingdom

The selected studies had an average of 15.4 authors per article, indicating a high level of collaboration. International cooperation in co-authorship was observed in 18.73% of the cases. The author with the highest scientific production was Hung AJ, who contributed 11 original articles. Hung AJ was affiliated with the University of Southern California Institute of Urology.

There were 528 affiliations, of which Johns Hopkins University was the most frequently reported in the articles, followed by the University of Pittsburgh, as shown in Figure 2. The University of Michigan and the Mayo Clinic were the institutions with the highest number of citations from their articles.

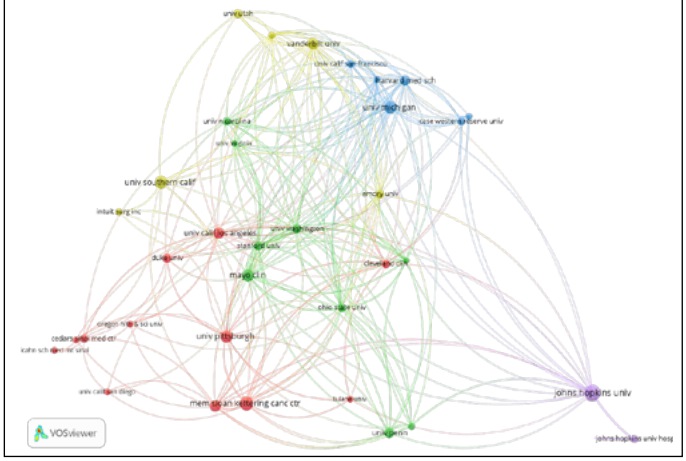
Figure 2. Scientific production in Robotic surgery by institution, 2018–2022.



When considering the different campuses (Los Angeles, San Diego, Irvine, Davis, Berkeley, etc.) of the University of California as one institution, it resulted in having the highest production.

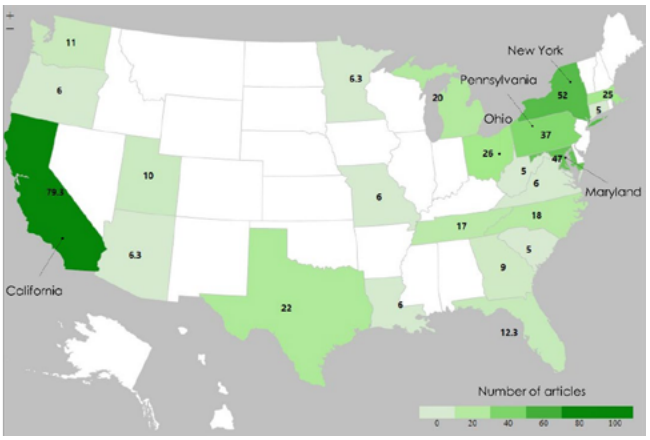
The density of the main affiliations and the collaboration networks between them can be observed in Figure 3.

Figure 3. Collaborative Network Map: Robotic Surgery Research among institutions in the United States in 2018-2022.



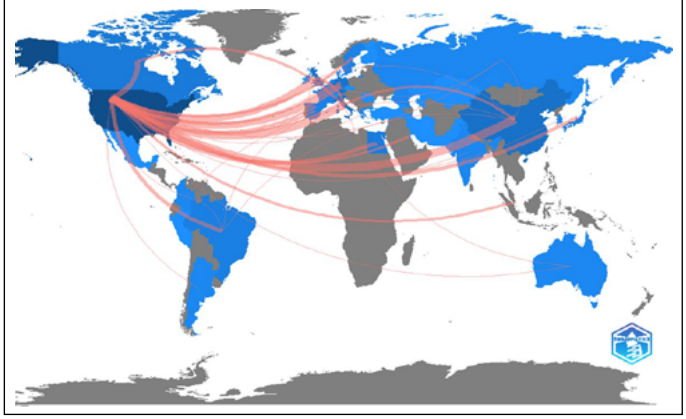
The distribution of scientific production by state was also analyzed, as shown in Figure 4.

Figure 4. Number of articles published on robotic surgery by state, 2018-2022.



The countries with which there was more collaboration were China, Italy, United Kingdom, Germany, and Canada. The network of collaborations by countries is seen in Figure 5.

Figure 5. Collaborative Network Map: Robotic Surgery Research in the United States and International Collaborations.



Regarding the keywords, a total of 1,618 terms were identified. After arranging them using thesauri and establishing a minimum occurrence of 4. As observed, the predominant keywords during the study period were "robotic-assisted surgery," "minimally invasive surgery," "laparoscopy," "cancer," and "complication."

Discussion

The present study aimed to determine the American scientific production in RS over the last five years, as this country holds the highest scientific output in this field. (19) The study also aimed to explore the different specialties related to RS. No previous analysis had specifically focused on the original scientific production in the United States.

An increase in the number of original articles from authors with American institutional affiliation was observed, with the highest production occurring in 2022. The study identified the leading authors and institutions, along with their respective collaborative networks. Additionally, the main scientific journals where the articles were published, and the most studied keywords in recent years were determined. Unlike other studies that covered longer time periods, (20) this analysis followed a screening process to specifically include original articles as a measure of new and substantial contributions to scientific production. Moreover, unlike other analyses that only considered the most relevant articles, this study aimed to provide a more comprehensive interpretation of the findings. (21)

Robotic surgery is undergoing rapid growth, with exponential expansion evident in the rising scientific production. This trend has been consistently observed in previous bibliometric analyses, including those with longer periods of analysis. (19,22) The present study served to reinforce and confirm this ongoing trend.

Urology remains the predominant specialty within RS research, (22) although others such as Gynecology & Obstetrics have been noted as one of the most common in other analyses encompassing all fields. (23) However, several bibliographic analyses have been conducted focusing on specific fields, such as spinal surgery, (24) robot-assisted arthroplasty, (25) urology, (26) or pediatrics. (27)

In this bibliometric analysis, the proportion of journals falling within Zone 1, as per Bradford's Law, was higher compared to other studies on the same topic (8% vs 2%, respectively). (22) This discrepancy may be attributed to the inclusion criteria, which focused exclusively on original articles from American institutions.

The analysis conducted highlights the leadership of John Hopkins University and the University of California in scientific research output in the field of RS. Similar findings were reported in a study by Mualen et al., where John Hopkins University emerged as the primary affiliation among the 100 most influential articles pertaining to spine surgery. (24) However, the distribution may vary as other studies focused on the same specialty identified Northwestern University and Harvard University as leading institutions in terms of research output and citations. (19) Institutions such as Cleveland Clinic, Mayo Clinic, and the University of Pittsburgh also exhibited substantial research productivity according to the analyses conducted by Shen et al. covering more than 20 years of RS research on a global scale. (20)

Due to the University of California's distinct campuses (Davis, Irvine, Los Angeles, San Diego, San Francisco) and the typical evaluation of affiliations on an individual campus basis rather than as a collective university, there is a potential for underestimating its genuine scientific impact and leadership in RS research. As a result, it was not recognized between the most productive institutions in previous analyses. (20)

China was found as the first country with scientific collaboration with the United States in RS. According to data from the Web of Science, the number of articles published by at least one Chinese author in the combined subjects of biomedical engineering and robotics climbed from 142 to 4,507 between 1999 and 2019, with two spikes during that time. There are two prominent peaks in this rapid expansion of RS in China, one in 2008, which was two years after the first deployment of the da Vinci robotic system for minimally invasive procedures in Chinese hospitals. The other one was in 2017, a year after the first Chinese-designed robot being made available for minimally invasive spinal surgery. (28)

Apart from the United States' leadership in scientific production of RS, Italy has positioned itself as one of the prominent countries conducting research in this field, as indicated by the analysis from Musbahi et al. on 20 years of literature. (22) Furthermore, this analysis reveals that Italy ranked second in terms of scientific collaboration. Germany, ranking fourth, is also a leading contributor to scientific production, particularly in the field of spine surgery. (24) These countries follow the United States in terms of global scientific production in RS. (20) Additionally, it is worth noting that England stands out as a leader in robotic-assisted arthroplasty, according to reference. (29)

Within the limitations of the study, the bibliometric analysis relies on the availability of data from articles obtained through the search strategy. Additionally, it should be noted that the search was conducted in a single database (WOS), therefore excluding American production on RS from other bibliographic databases such as Scopus or Medline. Despite these limitations, WOS is one of the most prominent bibliographic databases, enabling us to demonstrate the advancements in knowledge within these research areas and objectively highlight the leading role of academic institutions.

Robotic surgery is a rapidly expanding field, as evidenced by the consistent growth in the number of original publications affiliated with American institutions over the past five years. The preceding analysis has provided an overview of the scientific production of RS in the United States, although it should be acknowledged that the main institutions associated with this production may vary depending on the analytical approach. The screening process allowed to draw conclusions based on robust evidence. To enhance the accuracy of the analysis and its results, it is recommended to expand this research to include other databases. Such comprehensive investigation would facilitate scientific and academic comparisons and foster competitiveness among leading authors and institutions in the field.

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Intravenous Non-steroidal Anti-inflammatory Agents

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Abstract

A summary of intravenous Non-Steroidal Anti-inflammatory Agents (NSAIDs) is presented with mode of action, potential complications, and therapeutic indications reviewed. Their role in a multimodal analgesic regimen for ambulatory surgery is also discussed.

Keywords: NSAIDs, Ambulatory Surgery, Intravenous.

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Intravenous Ibuprofen

NSAIDs are very effective in reduction of pain and inflammation and are among the most popular used medicines worldwide. Together with paracetamol NSAIDs are invaluable in a multimodal analgesia protocol for ambulatory surgery. Ambulatory surgery is continuously increasing with a high number of extensive and painful procedures. Adequate pain relief by simple methods, readily available at home is crucial for the well-being and quick recovery of the ambulatory surgery patient. Quality of recovery after day surgery still is poor for some patients and is heavily impacted due to postoperative pain and nausea and vomiting. Wherever possible opioids should be avoided as first line pain treatment in ambulatory surgery. Discharge opioid prescriptions have been identified as a risk factor for persistent opioid use leading to opioid use disorder.

Postoperative pain after day surgery is the most common reason for delayed discharge and unanticipated hospital admission. Furthermore, the incidence of unscheduled contact with healthcare workers is high during the first days to weeks after surgery (>20%). Most often the general practitioner is contacted by the patient for further information and guidance, with inadequate pain management as the main reason (1).

NSAIDs block the cyclooxygenase, inhibiting the transformation of arachidonic acid to prostaglandins, prostacyclin and thromboxane A2. The degree of COX-inhibition varies among different NSAIDs. Two isoforms of COX enzyme are described; COX1 and COX2. COX1 is present in most human tissues and regulates normal physiology; gastric protection, vascular homeostasis, platelet aggregation and kidney function. COX2 is undetectable in normal conditions but its expression is increased during states of inflammation, such as after surgery. COX2 stimulates the production of prostaglandins E2 and I2 resulting in inflammation and pain. COX2 increases prostacyclin production, promoting vasodilation and inhibiting platelet aggregation.

Selectively blocking COX1 leads to gastrointestinal side effects, bleeding and kidney injury. Blocking COX2 could induce coronary thrombosis and cardiovascular adverse events (2).

NSAIDs induced gastropathy manifest as gastroduodenal erosions and ulceration, ultimately leading to perforation and potentially life threatening hemorrhage. Risk factors for serious gastrointestinal complications increases in patients over the age of 70, patients with a history of previous peptic ulcer disease, patients on corticosteroids, anticoagulants and aspirin. The NSAIDs subclass and duration of treatment are significant risk factors for gastropathy. Indomethacin (subclass of indolic derivates) has a higher risk of GI complications than for non-users with a relative risk (RR) of 2.25 with a maximum relative risk at 14 days. Naproxen has a RR of 1.83, diclofenac a RR of 1.73 while ibuprofen has a RR of 1.19(3). These latter NSAIDs have a maximum risk after 50 days. The RR for upper gastrointestinal complications of ketorolac compared with ibuprofen was 11.7.(4) However NSAID use after ambulatory surgery typically is of shorter duration. Alternatively, an H2-receptor blocking drug (ranitidine) or a proton pump inhibitor can be associated to protect gastroduodenal mucosa in patients at risk (omeprazole, pantoprazole 20mg) (Table 1) (near here).

COX2 blockers and more COX2 selective NSAIDs could lead to cardiovascular side effects. In patients with prior myocardial infarction diclofenac has the highest risk of death and recurrent myocardial infarction at day 1 to 7 of treatment (Hazard ratio 3.26). The risk of death caused by diclofenac was even higher than after rofecoxib as an example of a selective COX2 inhibitor. Naproxen is the NSAID with the lowest cardiovascular risk but a high gastrointestinal risk especially dangerous in patients with prior myocardial infarction. Ibuprofen has the lowest cardiovascular risk during the first days of treatment, however, the risk increases after one week of use.

The concept of preemptive analgesia relies on analgesic interventions given before any noxious stimulus. The use of NSAIDs before operation should, theoretically, be more effective than postoperative administration, and has successfully controlled postoperative pain in ambulatory surgery patients(5). Oral premedication with NSAIDs before surgery may not consistently achieve peak plasma concentrations at the time of operation. Intravenous administration at the time of induction guarantees maximal plasma levels at the time of incision

Diclofenac is a traditional component of analgesic regimens in ambulatory patients. When given intravenously it must be diluted with 100 to 500 ml of sodium chloride (0.9%) or glucose (5%) and should be buffered with sodium bicarbonate solution (0.5 ml 8.4% or 1 ml 4.2%). Diclofenac should not be given as an intravenous bolus injection as this can result in venous thrombosis and pain(6).

Pharmacokinetic modelling has shown that after an intravenous dose of ibuprofen as a 5-7 minute infusion the maximum peak plasma concentration (Cmax) is higher and comes faster than when the same dose is given as a 30 or 60 minute infusion. (120 µg/ml for a 5-7 minute infusion, 84 µg/ml and 73 µg/ml after a 30 and 60 minutes infusion respectively with tmax of 6.5 min vs 32 min vs 1 hour respectively). So Cmax increases as infusion times decreases and tmax decreases with decreased infusion duration. An oral dose of ibuprofen is not able to achieve these concentrations despite its bioavailability of near 100%(7). A rapid intravenous infusion of ibuprofen is well tolerated, although a mild discomfort is sometimes

Table 1. Suggested use of NSAIDS for Ambulatory Surgery.

NSAIDS PERIOPERATIVELY

LOW RISK
GASTROINTESTINAL COMPLICATIONS

- Age < 70
- No comorbidities
- No history of NSAIDs induced morbidities
- History of gastro-intestinal surgery
- Diaphragmatic herna

MODERATE RISK
GASTROINTESTINAL COMPLICATIONS

- Age < 70
- History of uncomplicated gastric ulcer
- Intake of aspirine (incl low dose)
  - Cortico-steroids (daily)
  - Anticoagulants

HIGH RISK
GASTROINTESTINAL COMPLICATIONS

- History of complicated gastric ulcer (recently)
- Multiple risk factors (>2)

START SURGERY

– Paracetamol 1gr IV	– Paracetamol 1gr IV	– Paracetamol 1gr IV
– Ibuprofen 600mg IV	– Ibuprofen 600mg IV	– Consider Parecoxib 40mg IV
	– Pantoprazole 20mg IV	– Consider Metamizole 100mg IV

AFTER SURGERY

– Paracetamol 1gr oral
  – max 4gr daily
	– Paracetamol 1gr oral
	  – max 4gr daily
		– Paracetamol 1gr oral
		  – max 4gr daily

– Ibuprofen 600mg oral
  – max 3 x 600mg
	– Ibuprofen 600mg oral
	  – max 3 x 600mg
		– Cox II

	– Pantoprazole 20mg oral	– Metamizole 100mg oral – max 4 x 100mg daily

reported at the site of infusion. So the place for intravenous ibuprofen seems valuable in a preemptive multimodal analgesia regimens. A network meta-analysis including 188 studies (13769 patients) on preemptive analgesia showed a reduced opioid consumption for ibuprofen and less postoperative nausea and vomiting(5).

A single dose of IV ibuprofen resulted in lower pain scores and reduced opioid use compared with paracetamol in patients undergoing laparoscopic cholecystectomy.(8, 9)

Intraoperative ibuprofen infusion can significantly reduce the incidence of emergence agitation following general anesthesia with propofol and remifentanil in children with less need for rescue fentanyl doses and positive effects on early postoperative pain after tonsillectomy(10). IV ibuprofen significantly reduced the number of postoperative doses and the amount of fentanyl administered after tonsillectomy. Ibuprofen did not increase the incidence of serious adverse events, surgical blood loss, postoperative bleeding, or the need for surgical re-exploration(11). NSAIDs are recommended in modern multimodal pain regimens after tonsillectomy(12).

Paracetamol should be first-line treatment in postoperative pain and should be associated to a traditional NSAIDs in otherwise healthy patients. Ibuprofen has a longstanding safety profile, can be administered intraoperatively as an intravenous infusion before any noxious stimulus has occurred and be continued postoperatively in different galenic forms. Patients at risk for gastrointestinal adverse events should be provided with gastroprotective drugs.

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