Indications, challenges, and characteristics for successful implementation of perioperative registries in low resource settings: a systematic review.

(Fitsum Kifle Belachew)

Thesis Presented for the Degree of

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In the Division of Global Surgery, Department of Surgery

Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN

Supervisor: Professor Bruce Biccard

Declaration

I, Fitsum Kifle Belachew, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgments indicate otherwise) and that neither the whole work nor part of it has been, is being, or is to be submitted for another degree in University of Cape Town or any other university.

This dissertation has been submitted to the Turnitin module to check the originality of the work and I confirm that my supervisor has seen my report and that any concerns revealed by such have been resolved with my supervisor.

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Acknowledgments, format, and contributions

In preparation for this manuscript, the criteria for Springer World Journal of Surgery (WJS) have been followed, including the Vancouver style of referencing since this work is intended to be submitted to this journal. I would like to express my gratitude to my UCT department, the Division of Global Surgery, and Prof Salome for supporting my research and allowing me to pursue this opportunity, as well as my supervisor, Prof Bruce Biccard, who has mentored me, shown me the way, and connected me with people who could assist me in a variety of ways. I would also like to express my appreciation to my colleagues Jolene and Tewodros for the support and commitment they have shown to the success of this work as co-authors. Last but not least, I would like to express my gratitude to my older brother, Assistant Professor Kokeb Desta, for motivating and supporting me in every way possible.

Title: INDICATIONS, CHALLENGES, AND CHARACTERISTICS OF SUCCESSFUL IMPLEMENTATION OF PERIOPERATIVE REGISTRIES IN LOW RESOURCE SETTINGS: A SYSTEMATIC REVIEW

Short Title: Perioperative registries in low resource settings

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Abstract

Background

Data is central to healthcare system improvement. Perioperative registries can be utilised for quality improvement initiatives through tracking outcomes, developing risk prediction models, and supporting policymakers and health professionals in making evidence-based decisions and interventions. This is particularly desirable in low-resource settings, where there is an unmet surgical demand and patients have a mortality rate up to double that of high-income countries. To better understand and support initiatives to establish clinical registries, this study aimed to assess the indications, challenges, and characteristics of successful perioperative registries in low-resource settings from the available literature on perioperative registry implementations.

Materials and Methods

We conducted a librarian-assisted literature search of international research databases; PubMed, Scopus, Cochrane Library, Web of Science, and WHOLIS WHO Library Database of articles published between January 1969 to January 2021 using controlled subject headings and keywords. Studies were filtered using predefined criteria and responses to two Mixed Method Appraisal Tool screening questions. A Direct Content Analysis Method was used to synthesize data for eligible studies based on predefined criteria.

Results

The search identified 2793 abstracts, with ten studies included after removing duplicates and excluding studies that did not meet eligibility criteria. Three were conducted in South America, four in Africa, two in the Middle East, and one in Asia. The lack of context-specific data for determining and evaluating patient outcomes (n=7) was the major indication for implementing registries. Organizing local research teams and engaging stakeholders in the host country was associated with successful implementation. However, inadequate funding to hire data collectors and monitor data quality was identified as a major challenge (n=4).

Conclusion

The goal of a perioperative registry is to generate data to influence and support quality improvement, and national surgical policies. Efforts to establish perioperative registries must continue while adhering to local ethical practices and broader principles and should consider those characteristics associated with successful registry implementation identified in this review.

Keywords: Perioperative, Registry, Data, Research, Quality

Background

Digitalisation, the rise of artificial intelligence, big data analytics, cloud storage, and machine learning have all changed the structure of the information sector, making data the most valuable resource available today [1]. In healthcare, effective data storage can be used to reduce healthcare costs, improve the quality of care, forecast epidemic outbreaks, and help to avoid preventable diseases [2,3]. The use of clinical registries and data-driven decision-making and policy implementation has become ubiquitous in developed countries, assisting in improving the quality of healthcare and research initiatives (4). Perioperative registries are defined as clinical datasets designed with insight from the surgical provider community to improve and/or inform care. However, limited access to perioperative registries compromises these improvements in low-resource healthcare countries, aggravating global health and data disparities.

Global surgery accounts for 30% of the global health burden (5). Low-income countries (LICs) are underserviced to provide surgical services, contributing only 3.5 percent of the global surgical volume, but with significantly high mortality and morbidity [6,7]. To improve the access, safety, and overall quality of the surgical and anaesthetic care and the perioperative journey of patients, continuous local data is required for feedback and auditing. Most of the current data is dependent on either short-term data collection, e.g., the African Surgical Outcome Study (ASOS) [8], or data from predominantly high-income countries without much involvement from the data owner countries, further exacerbating global inequalities in patient care and research capacity.

This study aimed to determine the indications, challenges, and characteristics necessary for establishing and implementing locally owned perioperative registries in low- and low-middle-income countries (LMICs) by systematically reviewing the literature. The objective of the review was to contribute to the evidence needed for researchers and clinicians to implement perioperative registries in low-resource settings in order to strengthen local research capacity and improve patient care.

Methods

The International Prospective Register of Systematic Reviews (PROSPERO) database was checked to ensure that a similar study had not been previously conducted, and the protocol was registered (CRD42021265077) and available on https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021265077. The PICO (population, intervention, comparator, and outcome) model was used to frame the research questions; P = Low- and middle-income nations, population: Low- and middle-income countries, Intervention: Implementation of perioperative registry networks, Comparison: None, Outcomes: Indications, challenges, and characteristics of successful registries.

A librarian assisted with the development of an inclusive literature search in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (9), and Assessing the Methodological Quality of Systematic Reviews (AMSTAR) (10) guidelines of five international databases: PubMed, Scopus, Cochrane Library, Web of Science, and WHOLIS WHO Library Database. The review covered articles published between and including January 1969 and January 2021. The search was limited to studies published in English.

The search was conducted using controlled medical subject headings (MeSHs) and keywords for each database: "(Registry OR registries)," "Perioperative medicine", "Perioperative medicine", or "perioperative care", or "perioperative care" OR "surgery" or "surgical", and LIC/LMICs filters as per World Bank classification (11). The search strategy can be found in supplemental file 1. The inclusion criteria were quantitative, qualitative, or mixed-method studies of the implementation of a perioperative registry network or/and hospitals with a perioperative/surgical registry which presented the study outcomes of indications, needs, and challenges in LMICs.

We excluded studies that were not the primary registry implementation research published in peer-review journals (i.e. conference papers, commentaries, letters to the editor, editorials, opinion, discussion, case reports, review studies, meta-analyses, and other secondary studies), non-English studies, studies for which the full text was not available, and studies for which the either or both screening questions, (i.e., "Do the collected data allow us to address the research questions?" and "Are there clear research questions?") were negative on the Mixed Methods Appraisal Tool (MMAT) (12). The Mixed Methods Appraisal Tool is a checklist for

simultaneously evaluating and/or describing research in systematic mixed studies (reviews including original qualitative, quantitative, and mixed methods studies). The abstracts were screened by FK, TK, and JM using the MMAT, with any inconsistencies resolved through discussion with BB.

The following variables were extracted to a spreadsheet from included publications: authors, publication year, registry objective(s), country of study, study design, the language of study, and MMAT score. Data synthesis was undertaken on the needs, challenges, and characteristics associated with the successful implementation of perioperative registries. Utilizing the Directed Content Analysis Method (13), we synthesized and reduced these data into fewer categories based on agreed-upon and predefined criteria.

The agreed-upon and predefined criteria were not used as keywords in the literature search. These criteria were:

Indications/needs: The primary indication or need to establish a registry in the hospital or region as described by the investigators.

Successful implementation: The positive outcome or opportunity created by implementing the perioperative registry, as determined by the investigators.

Challenges in establishing a registry: The reported difficulties in implementing the data registry.

Results

A total of 2793 literature were screened, 931 duplicate records were removed, and 1840 records were excluded based on responses to the screening questions of the MMAT (Figure 1). Twenty-two studies underwent full review and nine were excluded as four were negative for both screening questions, and five were negative for the first MMAT question. The 13 full articles with two positive answers to the MMAT screening questions were reviewed, and 3 were excluded as the full text was not available in English.

Of the 10 included studies, three were conducted in South America; four in Africa; two in the Middle East; and one in Asia. They were all carried out within individual countries, with five being multi-center studies. The data software included Research Electronic Data Capture

(REDCap) used by three hospitals (14–16); three further hospitals used unspecified apps, two of which were hosted in the United States of America (USA), where the principal investigators were located (17–19), one used FILE MAKER Pro (20), and the remaining two hospitals used locally designed software (21,22). The databases were located outside the nations where the data collection was conducted in four sites, mainly in the USA and the remaining sites used local storage (17,18). Researchers with specific registry objectives typically initiated implementation efforts (n=9) (14–18,20–23). Details of the included studies are shown in Table 1.

Indications for establishing the registry

The indications for setting up a perioperative registry in LIC/LMICs included limited data for determining and evaluating patient outcomes (n=7) (15–17,19,21–23), understanding the volume of surgeries (n=2) (15,22), recognising the burden of diseases (n=2) (17,20), evaluating economic impact (n=2) (22,23), conducting quality improvement initiatives and research (n=4) (16,19,21,22), and informing national/ global surgical indicators and practice (n=3) (16,19,22) (Table 2). The lack of context-specific data for linking institutions and developing national, regional, and global networks for research and shared learning, as well as identifying short- and long-term training needs for medical and allied professionals, were described (n=2) (16,19).

Characteristics associated with successful implementation

Characteristics of successful implementation is dependent on the personnel, data handling, and data storage and security (Table 3). Personnel requires the building of local research capacity and establishing a local technical team, engaging different stakeholders (including the Ministry of Health), creating a sense of ownership and responsibility, following local policies, and obtaining appropriate ethical approval from the hosting country's responsible institution, and appropriate recruitment of data collectors in terms of skill-mix and academic background/ability are all associated with the successful implementation of perioperative registries (n=4) (15,17,19,23).

Successful software (applications) associated with high-quality data collection were simple to use, had offline compatibility (n=3) (16,18,19), limited bandwidth (needs nominal data or Wi-Fi connection) (n=1) (17), were easily adaptable, and locally made. Data storage transparency (location of the server, number of people who could access the data), providing a scalable, cost-effective, and secure platform, allowing decentralisation, and enabling FAIR (findability, accessibility, interoperability, and reusability) principles of data sharing were associated with successful data storage (n=5) (16,18,20,23).

Automated analysis and public view of core surgical indicators were also associated with successful implementation by aiding quality monitoring and creating a convenient way for academics and policymakers to find aggregate information (n=1) (15).

Challenges

The challenges in the implementation of a clinical registry are shown in Table 4. Data handling challenges included concerns related to trust and security of the data collection software and storage (n=3) (14,16,19), lack of policy for data management and sharing (6,16,19), challenges in data quality including data incompleteness (15,17,20,22), data inaccuracies due to data collectors educational levels (14,15), and poor adherence to data collection in areas where surgeons or perioperative care providers themselves collect or input data (14,23).

Finance-related challenges included insufficient funds to organise a team, build infrastructure, and pay data collectors' salaries, as well as rapid depreciation of local currencies resulting in difficulties paying data collector salaries in lower-income countries by investigators from higher-income countries (14,16–18,20,21), and high costs for software support from outside the country due to lack of an established technical team within the hosting country (n=3) (14,20,21). A lack of adequate funding also contributed to restricted follow-up on data collection resulting in incomplete data and an inefficient work process (n=1) (14,18).

Technical challenges included difficulty with connectivity (n=1) (18), power outages (n=1) (20), as well as the heterogeneity of results between sites when multiple centers were involved (n=1) (18).

Discussion

In this review, we examined ten studies conducted in low- and low-middle-income countries (LMICs) in the past 50 years from 1969 to 2021 to better understand the indications, challenges, and characteristics of successful perioperative registries in low-resource settings.

The indications for establishing perioperative registries include informing the volume and outcomes of surgeries (n=7) (14–16,18,20–22), as most of the available data comes from developed countries with little engagement in the data owner countries (8,24). The cost implications of surgery and the extent of catastrophic expenditures have been less understood (15,21,22), also shown in other reviews (25), and undertaking collaborative research and quality

improvement initiatives have been difficult (15,18,20,22), as it requires extensive time and effort, resulting in higher costs. Furthermore, as outlined in other studies, there are relatively few providers in low-resource settings and there is no established registry network to report the Lancet Commission for Global Surgery indicators consistently even though refinements are suggested (26,27). The reasons discussed in this systematic review and supported by other literature suggest that it is possible to establish perioperative registries in low-resource settings.

However, the implementation process is complex and challenging. The main challenge for any registry is to collect useable data, which demands agreement on what to collect and how to collect it and keeping the dataset as small as possible (28). Otherwise, it will be impossible to maintain data quality. As described in this review, most of the registries arose from investigators with specific outcome interests (n=9) (13–17,19–22), which itself is helpful in determining and minimising the dataset. The question then arises: what is the most efficient method of data collection?

In low-resource contexts, local health data management policies are hard to come by; therefore, investigators will be compelled to use various techniques to implement a clinical registry, often resulting in a protracted and laborious procedure (29,30). Finding local collaborators, obtaining ethical approval (n=5) (13–16,19), and making it a national project (21,22) with the involvement of responsible governmental offices such as the Ministry of Health, Ministry of Education, and the National Social Security Administration were all part of the implementation process in most of the successful studies reviewed. In the absence of a data management policy that might save time and work, acquiring applicable ethical approvals and finding and engaging local stakeholders are all linked to successful perioperative registries in low-resource settings.

When designing software (mobile applications), local constraints such as unreliable connectivity and insufficient power supplies must be considered. As a result, designed software and programs must be offline compatible, have a low bandwidth requirement, be adaptive, and be user-friendly. Data collection hardware (e.g., tablets and computers) must have a long battery life, particularly when data is collected from remote areas, and data collectors must travel long distances to upload it to the server. REDCap was the most commonly utilised data collection application amongst included studies n=3 (13–15), and it can provide the above functionalities. In addition, even though it has not been observed in the studies reviewed, District Health

Information 2 (DHIS 2) is free and open-source software that is available, and it is recommended software by the WHO (31).

The next consideration is data storage and security, which should be highly transparent to ensure public trust in the electronic data gathering system. The best data storage solution must be cost-effective, synchronisable, scalable, and accept data in different formats. Plus, it should be able to support the FAIR principles of data sharing (32). The findings of this study show that cloud storage has significant advantages in terms of the qualities described above, while security issues remain (15). New research suggests cloud storage combined with Blochian technology may provide more robust security and better deception management in clinical data management (33).

The next stage is to agree on who will collect the data, as the quality of the data was influenced by the training of the data collectors. Data collectors that are academically qualified and well-trained are desirable (13,20). With a basic understanding of the data elements provided, medical/health science students, nurses, interns, and registrars (residents) may provide higher quality data (15,19). However, surgeons and perioperative care providers appear to be associated with underreporting adverse events in our review (n=2) (19,21), which could be attributed to data collection bias.

Once data collection has commenced, continuous data quality monitoring and regular and irregular data quality auditing have proven to be useful (13). In addition to supporting regular aggregate data monitoring, the inclusion of key local surgical (15), and Lancet Commission for Global Surgery indicators via aggregate dashboard is likely to prove beneficial in making the data monitoring process simple and assisting the public and policymakers in identifying gaps and improving overall care.

Finally, building local teams and giving ownership are also indicated for long-term sustainability (17), particularly when work is led and coordinated outside the hosting country, and this should be considered from the start; this includes building the ICT team, data analysis, and the scientific community (perioperative clinicians and researchers), as well as inviting major stakeholders such as the Ministry of Health and professional societies. Everyone should understand that they own the data resource (14,15), which they can use in accordance with local ethical approval and data management policies. The regular meeting of collaborators to establish standards and share best

practices has proven highly beneficial in high-income countries as well to improve the quality of care, share responsibility, and obtain sustainable funding sources (5,34).

There are some limitations to this study. This study excluded non-English and grey literature which may have included data relevant to this topic. Furthermore, we did not scan the references of included papers for further eligible articles. Additionally, some studies, whilst focused on LMICs, were funded by HICs, hence making the extrapolation of findings focused on LMICs more complex. Furthermore, the search may have missed potential registries by not using the keywords such as "anesthesiology". The evaluated studies were primarily focused on specific surgical specialties, therefore, the findings from this analysis may not be generalisable to large-scale, all-inclusive perioperative registries. However, as similar challenges and characteristics were identified across studies it is possible, that these findings may be more broadly generalisable. These data did not allow for a meta-analysis to further inform practice.

Conclusion

The goal of a perioperative registry is to generate data to influence and support quality improvement, and national surgical policies. Continuously generating clinical data is necessary to represent and lead this effort to make evidence-based collaborations, decisions, and interventions to improve the capacity and quality of care delivered. Artificial intelligence and big data analytics will only be possible if data registries can be routinely established in low-resource environments (35,36). This paper provides information on the strategies necessary to achieve this goal.

Recommendations

Low and middle-income countries must not fall further behind as new surgical technology innovations are launched. As a result, every effort to establish perioperative registries must continue while adhering to local ethical practices and broader principles and should consider those characteristics associated with successful registry implementation identified in this review.

Competing Interests

The authors declare no competing interests.

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List of Tables and Figures

Appendices

Appendix A: Search strategies

Appendix B: Ethical Approval Letter

As this study was based entirely on literature available to the public, the Human Research Ethics Committee (HREC) of the UCT Faculty of sciences waived the need for ethical review and approval.

Appendix C: Instructions to authors

Figure 1: P R ISMA flow diagram

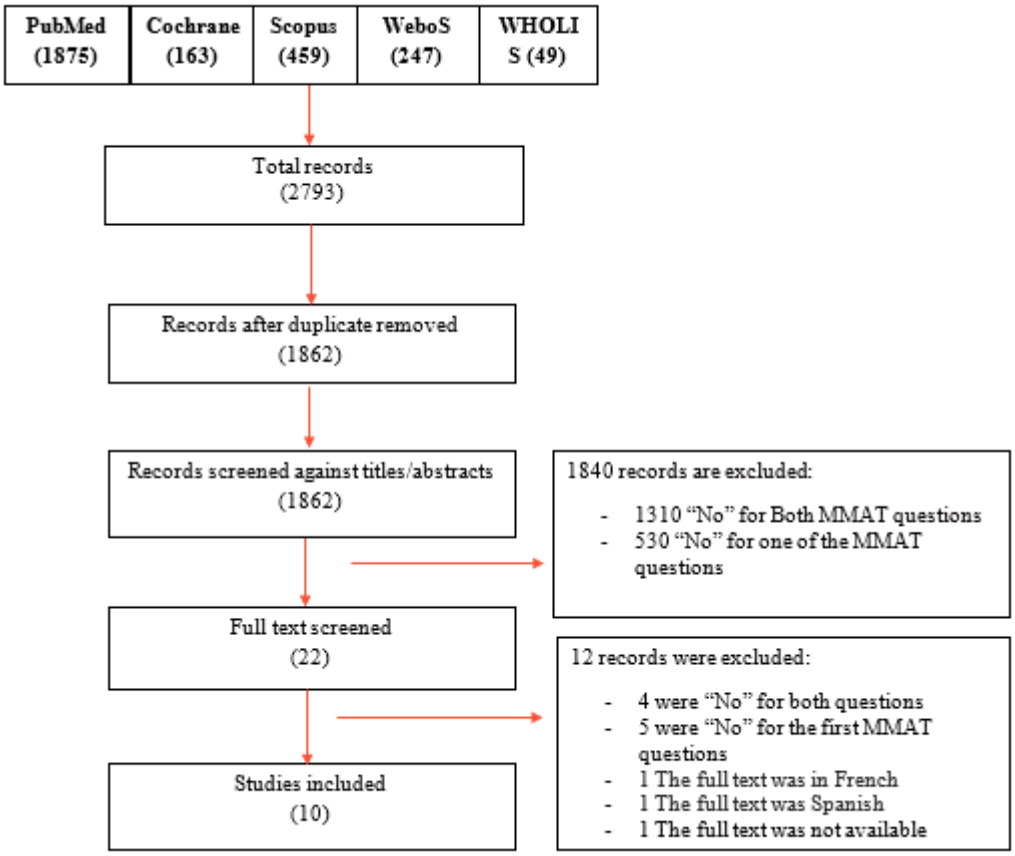

Table 1: Details of included studies

Title	Publication Year	Corresponding author location/country	Source of funding	Surgical specialty	Registry Developers
Development, implementation, and evaluation of a hybrid electronic medical record system specifically designed for a developing world surgical service	2014	South Africa (Africa)	Unknown	Surgical (general)	Investigators with specific registry objective
Iranian Joint Registry (Iranian National Hip and Knee Arthroplasty Registry)	2016	Iran (Middle East)	Local (Iran MoH)	Orthopedics (Joint replacement)	Investigators with specific registry objective
Implementing Electronic Surgical Registries in Lower-Middle Income Countries: Experiences in Latin America	2016	USA (south America)	USA NIH	Surgery -trauma	Investigators with specific registry objective
Challenges and opportunities for effective data collection in global neurosurgery: traumatic brain injury surveillance experience in Malawi	2018	USA (all authors) - Africa	USA	Neurosurgery	Investigators with specific registry objective
National Joint Registry of Iran	2019	Iran (Middle East)	Local (Iran MoH)	Orthopedics (Joint replacement)	Investigators and orthopedic association
Pakistan Registry of Intensive Care (PRICE): Expanding a lower middle-income, clinician-designed critical care registry in South Asia	2019	UK (Asia)	UK and Sri Lanka	Critical care	Local critical care society and international collaborators
Collaborative Brazilian pediatric renal transplant registry (CoBrazPed-RTx): A report from 2004 to 2018	2019	Brazil (South America)	No funding	Pediatric renal transplant	Investigators with specific registry objective
REPLICCAR II Study: Data quality audit in the Paulista Cardiovascular Surgery Registry	2020	Brazil (South America)	Local (Brazil)	Cardiovascular (CVS)	Investigators with specific registry objective
Postoperative Rheumatic Heart Disease Follow-Up: Creating a National Registry and First Results from Rwanda	2020	Rwanda (Africa)	Local and other partners	Postop RHD	Investigators with specific registry objective
Addressing priorities for surgical research in Africa: implementation of a multicentre cloud-based peri-operative registry in Ethiopia	2021	Ethiopia (Africa)	UK	Perioperative	Investigators with specific registry objective

CVS: Cardiovascular System; MOG: Ministry of Health; NIH: National Institutes of Health; RHD: Rheumatic Heart Disease; UK: United Kingdom; UDA: United States of America.

Table 2: Indications for implementing perioperative registries

Indications (References)	Total (N)
To evaluate the demographics of patients (16, 21)	2
To identify risk factors (16, 21)	3
To predict mortality and morbidity (13)	1
To track surgical volume (15, 22)	2
To evaluate patient outcomes (14, 15,17, 18, 20, 21, 22)	7
To understand the burden of surgical diseases (15,18)	2
To evaluate economic impact (21,22)	2
To conduct quality improvement initiatives and research (15,17,18,19)	4
To develop national, regional, and global collaboration networks (15,17,18)	3
To inform policy and practice (15,18, 22)	3
To digitize paper-based clinical data collection mechanism (17)	1
To introduce a Clinical Decision Support System (CDSS) for junior doctors (20)	1
To establish context-specific data for linking institutions (17,19)	2
To identify short- and long-term training needs for medical and allied professionals (15)	1

Table 3: Characteristics associated with successful implementation

Characteristics associated with successful implementation	Total
Personnel	
Engaging different stakeholders (14, 15, 18, 21, 22)	5
Providing adequate training for data collectors before commencing data collection (13, 15, 16, 18)	4
Appropriate recruitment of data collectors in terms of skill-mix and academic background/ability (13, 15, 16)	3
Data handling	
Obtaining appropriate ethical approval (13, 14, 15,16, 19)	5
Building local research capacity (15, 16, 17, 18)	4
Regular data validation (15,18, 22)	3
Establishing a local technical team (16, 17)	2
Direct and indirect auditing of the collected data (13)	1
Software (mobile applications)	
Easily adaptable or/and locally made (13,14, 18, 21)	4
Offline compatibility (15, 17)	2
Limited bandwidth (15)	1
Data storage and security	
Enabling fair principles of data management (14, 17, 18,19)	4
Secure platform (14, 17)	2
Allowing decentralization (13, 14)	2
Data storage transparency (location of the server, number of people who can access the data) (16)	1
Scalable (14)	1
Cost-effective (14,16,18)	1
Automated analysis and public view of core surgical indicators (14)	1

Table 4: Challenges of implementing perioperative registries in LMICs

	Challenges of implementing perioperative registries in LMICs	Total
	Data Handling	
1.	Trust regarding data collection software and storage (13,15, 18)	3
2.	Lack of policy for data management and sharing (15, 17, 18)	3
	Data Quality	
1.	Data incompleteness (14, 16, 19, 22)	4
2.	Data inaccuracy due to data collectors' educational levels (13,14)	2
3.	Limitation on 30 days patients' follow-up due to difficulty to re-call patients and confirm data. (13,14)	2
4.	Poor adherence to data collection in areas where surgeons or perioperative care providers themselves collect or input data (13,21)	2
5.	Underreporting of adverse events and poor adherence to data collection in areas where surgeons or perioperative care providers themselves collect or input data (13,21)	2
6.	Underreporting of adverse events by surgeons (13)	1
7.	Heterogeneity of results between sites when multiple centers were involved (17)	1
	Funding/Finance	
1.	Insufficient funds to organize a team, recruit and pay data collectors (13,19,20)	3
2.	High costs for software support from outside the country due to the lack of an established technical team within the hosting country (15, 19, 20)	3
3.	Rapid depreciation of local currencies resulting in difficulties paying data collector salaries in lower-income countries by investigators from higher-income countries (14)	1
	Technical Issues	
1.	Connectivity issues (17)	1
2.	Power outages (19)	1

Appendix A: Search strategies

Indications, challenges, and characteristics of successful implementation of perioperative registries in low resource settings: a systematic review

Supplemental material 1: Search strategies

PubMed Database

Search date July 23/2021

Database	MESH	Keywords
PubMed	Registries	Registry OR registries
	AND	
	"Perioperative Medicine"[Mesh] OR "Perioperative care"[Mesh] OR "General Surgery"[Mesh]	Perioperative medicine OR peri-operative medicine OR peri-operative care OR Perioperative care OR surgery OR surgical
	AND	
Filter: LMIC	TW	Deprived Countries OR Deprived Population OR Deprived Populations OR Developing Countries OR Developing Country OR Developing Economies OR Developing Economy OR Developing Nation OR Developing Nations OR Developing Population OR Developing Populations OR Developing World OR LAMI Countries OR LAMI Country OR Less Developed Countries OR Less Developed Country OR Less Developed Economies OR Less Developed Nation OR Less Developed Nations OR Less Developed World OR Lesser Developed Countries OR Lesser Developed Nations OR LMIC OR LMICS OR Low GDP OR Low GNP OR Low Gross Domestic OR Low Gross National OR Low Income Countries OR Low Income Country OR Low Income Economies OR Low Income Economy OR Low Income Nations OR Low Income Population OR Low Income Populations OR Lower GDP OR lower gross domestic OR Lower Income Countries OR Lower Income Country OR Lower Income Nations OR Lower Income Population OR Lower Income Populations OR Middle Income Countries OR Middle Income Country OR Middle Income Economies OR Middle Income Nation OR Middle Income Nations OR Middle Income Population OR Middle Income Populations OR Poor Countries OR Poor Country OR Poor Economies OR Poor Economy OR Poor Nation OR Poor Nations OR Poor Population OR Poor Populations OR poor world OR Poorer Countries OR Poorer Economies OR Poorer Economy OR Poorer Nations OR Poorer Population OR Poorer Populations OR Third World OR Transitional Countries OR Transitional Country OR Transitional Economies OR Transitional Economy OR Under Developed Countries OR Under Developed Country OR under developed nations OR Under Developed World OR Under Served Population OR Under Served Populations OR Underdeveloped Countries OR Underdeveloped Country OR underdeveloped economies OR underdeveloped nations OR underdeveloped population OR Underdeveloped World OR Underserved Countries OR Underserved Nations OR Underserved Population OR Underserved Populations

	OR	
	TW	Afghanistan OR Albania OR Algeria OR American Samoa OR Angola OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Byelarus OR Belorussia OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Botswana OR Brazil OR Bulgaria OR Burma OR Burkina Faso OR Burundi OR Cabo Verde OR Cape Verde OR Cambodia OR Cameroon OR Central African Republic OR Chad OR China OR Colombia OR Comoros OR Comores OR Comoro OR Congo OR Costa Rica OR Côte d'Ivoire OR Cuba OR Djibouti OR Dominica OR Dominican Republic OR Ecuador OR Egypt OR El Salvador OR Equatorial Guinea OR Eritrea OR Ethiopia OR Fiji OR Gabon OR Gambia OR Gaza OR Georgia OR Georgia Republic OR Ghana OR Grenada OR Grenadines OR Guatemala OR Guinea OR Guinea- Bissau OR Guyana OR Haiti OR Herzegovina OR Hercegovina OR Honduras OR India OR Indonesia OR Iran OR Iraq OR Ivory Coast OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Democratic People's Republic of Korea OR Kosovo OR Kyrgyz OR Kirghizia OR Kirghiz OR Kyrgyzstan OR Lao PDR OR Laos OR Lebanon OR Lesotho OR Liberia OR Libya OR Macedonia OR Madagascar OR Malawi OR Malay OR Malaya OR Malaysia OR Maldives OR Mali OR Marshall Islands OR Mauritania OR Mauritius OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR Papua New Guinea OR Paraguay OR Peru OR Philippines OR Principe OR Romania OR Ruanda OR Rwanda OR Samoa OR Sao Tome OR Senegal OR Serbia OR Sierra Leone OR Solomon Islands OR Somalia OR South Africa OR South Sudan OR Sri Lanka OR St Lucia OR St Vincent OR Sudan OR Surinam OR Suriname OR Swaziland OR Syria OR Syrian Arab Republic OR Tajikistan OR Tadzhikistan OR Tajikistan OR Tadzhik OR Tanzania OR Thailand OR Timor OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmen OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbek OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR West Bank OR Yemen OR Zambia OR Zimbabwe
Final search: https://www.ncbi.nlm.nih.gov/sites/myncbi/1LwlVrv_cv_5m/collections/60952653/public/		((Deprived Countries[Text Word] OR Deprived Population[Text Word] OR Deprived Populations[Text Word] OR Developing Countries[Text Word] OR Developing Country[Text Word] OR Developing Economies[Text Word] OR Developing Economy[Text Word] OR Developing Nation[Text Word] OR Developing Nations[Text Word] OR Developing Population[Text Word] OR Developing Populations[Text Word] OR Developing World[Text Word] OR LAMI Countries[Text Word] OR LAMI Country[Text Word] OR Less Developed Countries[Text Word] OR Less Developed Country[Text Word] OR Less Developed Economies [Text Word] OR Less Developed Nation[Text Word] OR Less Developed Nations[Text Word] OR Less Developed World[Text Word] OR Lesser Developed Countries[Text Word] OR Lesser

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Cochrane Database Search

Search conducted 9 August 2021

https://www.cochranelibrary.com/advanced-search/search-manager?search=5700006

ID	Search	Hits
#1	(Registry OR registries):ti,ab,kw AND ("Perioperative medicine" OR "peri-operative medicine" OR "peri-operative care" OR "perioperative care" OR surgery OR surgical):ti,ab,kw (Word variations have been searched)	4042
#2	(Afghanistan OR Albania OR Algeria OR "American Samoa" OR Angola OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Byelarus OR Belorussia OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Botswana OR Brazil OR Bulgaria OR Burma OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR "Cape Verde" OR Cambodia OR Cameroon OR "Central African Republic" OR Chad OR China OR Colombia OR Comoros OR Comores OR Comoro OR Congo OR "Costa Rica" OR "Côte d'Ivoire" OR Cuba OR "Democratic People's Republic of Korea" OR Djibouti OR Dominica OR "Dominican Republic" OR Ecuador OR Egypt OR "El Salvador" OR Eritrea OR Ethiopia OR "Equatorial Guinea" OR Fiji OR Gabon OR Gambia OR Gaza OR "Georgia Republic" OR Georgia OR Ghana OR Grenada OR Grenadines OR Guatemala OR Guinea OR "Guinea Bissau" OR Guyana OR Haiti OR Herzegovina OR Hercegovina OR Honduras OR India OR Indonesia OR Iran OR Iraq OR "Ivory Coast" OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyz OR Kirghizia OR Kirghiz OR Kyrgyzstan OR "Lao PDR" OR Laos OR Lebanon OR Lesotho OR Liberia OR Libya OR Macedonia OR Madagascar OR Malawi OR Malay OR Malaya OR Malaysia OR Maldives OR Mali OR "Marshall Islands" OR Mauritania OR Mauritius OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR "Papua New Guinea" OR Paraguay OR Peru OR Philippines OR Principe OR Romania OR Rwanda OR Ruanda OR Samoa OR "Sao Tome" OR Senegal OR Serbia OR "Sierra Leone" OR "Solomon Islands" OR Somalia OR "South Africa" OR "South Sudan" OR "Sri Lanka" OR "St Lucia" OR "St Vincent" OR Sudan OR Surinam OR Suriname OR Swaziland OR Syria OR "Syrian Arab Republic" OR Tajikistan OR Tadzhikistan OR Tajikistan OR Tadzhik OR Tanzania OR Thailand OR Timor OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmen OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbek OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR "West Bank" OR Yemen OR Zambia OR Zimbabwe):ti,ab,kw (Word variations have been searched)	96568

#3	(Deprived Countries OR "Deprived Population" OR "Deprived Populations" OR "Developing Countries" OR "Developing Country" OR "Developing Economies" OR "Developing Economy" OR "Developing Nation" OR "Developing Nations" OR "Developing Population" OR "Developing Populations" OR "Developing World" OR "LAMI Countries" OR "LAMI Country" OR "Less Developed Countries" OR "Less Developed Country" OR "Less Developed Economies" OR "Less Developed Nation" OR "Less Developed Nations" OR "Less Developed World" OR "Lesser Developed Countries" OR "Lesser Developed Nations" OR LMIC OR LMICS OR Low GDP OR "Low GNP" OR "Low Gross Domestic" OR "Low Gross National" OR "Low Income Countries" OR "Low Income Country" OR "Low Income Economies" OR "Low Income Economy" OR "Low Income Nations" OR "Low Income Population" OR "Low Income Populations" OR "Lower GDP" OR "lower gross domestic" OR "Lower Income Countries" OR "Lower Income Country" OR "Lower Income Nations" OR "Lower Income Population" OR "Lower Income Populations" OR "Middle Income Countries" OR "Middle Income Country" OR "Middle Income Economies" OR "Middle Income Nation" OR "Middle Income Nations" OR "Middle Income Population" OR "Middle Income Populations" OR "Poor Countries" OR "Poor Country" OR "Poor Economies" OR "Poor Economy" OR "Poor Nation" OR "Poor Nations" OR "Poor Population" OR "Poor Populations" OR "poor world" OR "Poorer Countries" OR "Poorer Economies" OR "Poorer Economy" OR "Poorer Nations" OR "Poorer Population" OR "Poorer Populations" OR "Third World" OR "Transitional Countries" OR "Transitional Country" OR "Transitional Economies" OR "Transitional Economy" OR "Under Developed Countries" OR "Under Developed Country" OR "under developed nations" OR "Under Developed World" OR "Under Served Population" OR "Under Served Populations" OR "Underdeveloped Countries" OR "Underdeveloped Country" OR "underdeveloped economies" OR "underdeveloped nations" OR "underdeveloped population" OR "Underdeveloped World" OR "Underserved Countries" OR "Underserved Nations" OR "Underserved Population" OR "Underserved Populations"):ti,ab,kw (Word variations have been searched)	9065
#4	#2 OR #3	100762
#5	#1 AND #4	540
Limited to Cochrane Reviews		163

Scopus includes EMBASE
Search conducted 7 August 2021

Search	Query	Records retrieved
#1	TITLE-ABS-KEY (registry OR registries)	211 827
#2	TITLE-ABS-KEY (“Perioperative medicine” OR “peri-operative medicine” OR “peri-operative care” OR “Perioperative care” OR surgery OR surgical)	3 241 897
#3	#1 AND #2	38,060
#4	TITLE-ABS-KEY (“Deprived Country“ OR “Deprived Countries” OR “Deprived Population” OR “Deprived Populations” OR “Developing Countries” OR “Developing Country” OR “Developing Economies” OR “Developing Economy” OR “Developing Nation” OR “Developing Nations” OR “Developing Population” OR “Developing Populations” OR “Developing World” OR “LAMI Countries” OR “LAMI Country” OR “Less Developed Countries” OR “Less Developed Country” OR “Less Developed Economies” OR “Less Developed Nation” OR “Less Developed Nations” OR “Less Developed World” OR “Lesser Developed Countries” OR “Lesser Developed Nations” OR LMIC OR LMICS OR “Low GDP” OR “Low GNP” OR “Low Gross Domestic” OR “Low Gross National” OR “Low Income Countries” OR “Low Income Country” OR “Low Income Economies” OR “Low Income Economy” OR “Low Income Nations” OR “Low Income Population” OR “Low Income Populations” OR “Lower GDP” OR “Lower Gross Domestic” OR “Lower Income Countries” OR “Lower Income Country” OR “Lower Income Nations” OR “Lower Income Population” OR “Lower Income Populations” OR “Middle Income Countries” OR “Middle Income Country” OR “Middle Income Economies” OR “Middle Income Nation” OR “Middle Income Nations” OR “Middle Income Population” OR “Middle Income Populations” OR “Poor Countries” OR “Poor Country” OR “Poor Economies” OR “Poor Economy” OR “Poor Nation” OR “Poor Nations” OR “Poor Population” OR “Poor Populations” OR “Poor World” OR “Poorer Countries” OR “Poorer Economies” OR “Poorer Economy” OR “Poorer Nations” OR “Poorer Population” OR “Poorer Populations” OR “Third World” OR “Transitional Countries” OR “Transitional Country” OR “Transitional Economies” OR “Transitional Economy” OR “Under Developed Countries” OR “Under Developed Country” OR “Under Developed Nations” OR “Under Developed World” OR “Under Served Population” OR “Under Served Populations” OR “Underdeveloped Countries” OR “Underdeveloped Country” OR “Underdeveloped Economies” OR “Underdeveloped Nations” OR “Underdeveloped Population” OR “Underdeveloped World” OR “Underserved Countries” OR “Underserved Nations” OR “Underserved Population” OR “Underserved Populations”)	383 798
#5	TITLE-ABS-KEY (Afghanistan OR Albania OR Algeria OR “American Samoa” OR Angola OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Byelarus OR Belorussia OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Botswana OR Brazil OR Bulgaria OR Burma OR “Burkina Faso” OR Burundi OR “Cabo Verde” OR “Cape Verde” OR	4 612 856

	Cambodia OR Cameroon OR “Central African Republic” OR Chad OR China OR Colombia OR Comoros OR Comores OR Comoro OR Congo OR “Costa Rica” OR “Côte d'Ivoire” OR Cuba OR “Democratic People’s Republic of Korea” OR Djibouti OR Dominica OR “Dominican Republic” OR Ecuador OR Egypt OR “El Salvador” OR Eritrea OR Ethiopia OR “Equatorial Guinea” OR Fiji OR Gabon OR Gambia OR Gaza OR “Georgia Republic” OR Georgia OR Ghana OR Grenada OR Grenadines OR Guatemala OR Guinea OR “Guinea Bissau” OR Guyana OR Haiti OR Herzegovina OR Hercegovina OR Honduras OR India OR Indonesia OR Iran OR Iraq OR “Ivory Coast” OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyz OR Kirghizia OR Kirghiz OR Kyrgyzstan OR “Lao PDR” OR Laos OR Lebanon OR Lesotho OR Liberia OR Libya OR Macedonia OR Madagascar OR Malawi OR Malay OR Malaya OR Malaysia OR Maldives OR Mali OR “Marshall Islands” OR Mauritania OR Mauritius OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR “Papua New Guinea” OR Paraguay OR Peru OR Philippines OR Principe OR Romania OR Rwanda OR Ruanda OR Samoa OR “Sao Tome” OR Senegal OR Serbia OR “Sierra Leone” OR “Solomon Islands” OR Somalia OR “South Africa” OR “South Sudan” OR “Sri Lanka” OR “St Lucia” OR “St Vincent” OR Sudan OR Surinam OR Suriname OR Swaziland OR Syria OR “Syrian Arab Republic” OR Tajikistan OR Tadzhikistan OR Tajikistan OR Tadzhik OR Tanzania OR Thailand OR Timor OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmen OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbek OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR “West Bank” OR Yemen OR Zambia OR Zimbabwe)	
#6	#4 OR #5	4 809 910
#7	#3 AND #6	2 305
#8	INDEX(Medline)	28 010 453
#9	#7 AND NOT #8	459

SciELO Citation Index via Web of Science
Search conducted 7 August 2021

https://www.webofscience.com/wos/scielo/summary/f388e026-a9bc-4072-a1a8-23200a9a18f9-0374055f/relevance/1

Search	Query	Records retrieved
#1	Registry OR registries (Topic)	2 419
#2	“Perioperative medicine” OR “peri-operative medicine” OR “peri-operative care” OR “Perioperative care” OR surgery OR surgical (Topic)	38 064
#3	#1 AND #2	247

Web of Science Core Collection
Search conducted 7 August 2021

https://www.webofscience.com/wos/woscc/summary/6c4181b0-b8b0-4847-9052-541f0cc27eaa-0373bb18/relevance/1

Search	Query	Records retrieved
#1	Registry OR registries (Topic)	169 593
#2	"Perioperative medicine" OR "peri-operative medicine" OR "peri-operative care" OR "Perioperative care" OR surgery OR surgical (Topic)	1 720 896
#3	#1 AND #2	26 299
#4	(TS=) "Deprived Country" OR "Deprived Countries" OR "Deprived Population" OR "Deprived Populations" OR "Developing Countries" OR "Developing Country" OR "Developing Economies" OR "Developing Economy" OR "Developing Nation" OR "Developing Nations" OR "Developing Population" OR "Developing Populations" OR "Developing World" OR "LAMI Countries" OR "LAMI Country" OR "Less Developed Countries" OR "Less Developed Country" OR "Less Developed Economies" OR "Less Developed Nation" OR "Less Developed Nations" OR "Less Developed World" OR "Lesser Developed Countries" OR "Lesser Developed Nations" OR LMIC OR LMICS OR "Low GDP" OR "Low GNP" OR "Low Gross Domestic" OR "Low Gross National" OR "Low Income Countries" OR "Low Income Country" OR "Low Income Economies" OR "Low Income Economy" OR "Low Income Nations" OR "Low Income Population" OR "Low Income Populations" OR "Lower GDP" OR "Lower Gross Domestic" OR "Lower Income Countries" OR "Lower Income Country" OR "Lower Income Nations" OR "Lower Income Population" OR "Lower Income Populations" OR "Middle Income Countries" OR "Middle Income Country" OR "Middle Income Economies" OR "Middle Income Nation" OR "Middle Income Nations" OR "Middle Income Population" OR "Middle Income Populations" OR "Poor Countries" OR "Poor Country" OR "Poor Economies" OR "Poor Economy" OR "Poor Nation" OR "Poor Nations" OR "Poor Population" OR "Poor Populations" OR "Poor World" OR "Poorer Countries" OR "Poorer Economies" OR "Poorer Economy" OR "Poorer Nations" OR "Poorer Population" OR "Poorer Populations" OR "Third World" OR "Transitional Countries" OR "Transitional Country" OR "Transitional Economies" OR "Transitional Economy" OR "Under Developed Countries" OR "Under Developed Country" OR "Under Developed Nations" OR "Under Developed World" OR "Under Served Population" OR "Under Served Populations" OR "Underdeveloped Countries" OR "Underdeveloped Country" OR "Underdeveloped Economies" OR "Underdeveloped Nations" OR "Underdeveloped Population" OR "Underdeveloped World" OR "Underserved Countries" OR "Underserved Nations" OR "Underserved Population" OR "Underserved Populations"	204 944
#5	(TS=) Afghanistan OR Albania OR Algeria OR "American Samoa" OR Angola OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Byelarus OR Belorussia OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Botswana OR Brazil OR Bulgaria OR Burma OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR "Cape Verde" OR Cambodia OR Cameroon OR	2 960 856

	“Central African Republic” OR Chad OR China OR Colombia OR Comoros OR Comores OR Comoro OR Congo OR “Costa Rica” OR “Côte d'Ivoire” OR Cuba OR “Democratic People’s Republic of Korea” OR Djibouti OR Dominica OR “Dominican Republic” OR Ecuador OR Egypt OR “El Salvador” OR Eritrea OR Ethiopia OR “Equatorial Guinea” OR Fiji OR Gabon OR Gambia OR Gaza OR “Georgia Republic” OR Georgia OR Ghana OR Grenada OR Grenadines OR Guatemala OR Guinea OR “Guinea Bissau” OR Guyana OR Haiti OR Herzegovina OR Hercegovina OR Honduras OR India OR Indonesia OR Iran OR Iraq OR “Ivory Coast” OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyz OR Kirghizia OR Kirghiz OR Kyrgyzstan OR “Lao PDR” OR Laos OR Lebanon OR Lesotho OR Liberia OR Libya OR Macedonia OR Madagascar OR Malawi OR Malay OR Malaya OR Malaysia OR Maldives OR Mali OR “Marshall Islands” OR Mauritania OR Mauritius OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR “Papua New Guinea” OR Paraguay OR Peru OR Philippines OR Principe OR Romania OR Rwanda OR Ruanda OR Samoa OR “Sao Tome” OR Senegal OR Serbia OR “Sierra Leone” OR “Solomon Islands” OR Somalia OR “South Africa” OR “South Sudan” OR “Sri Lanka” OR “St Lucia” OR “St Vincent” OR Sudan OR Surinam OR Suriname OR Swaziland OR Syria OR “Syrian Arab Republic” OR Tajikistan OR Tadzhikistan OR Tajikistan OR Tadzhik OR Tanzania OR Thailand OR Timor OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmen OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbek OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR “West Bank” OR Yemen OR Zambia OR Zimbabwe	
#6	#4 OR #5	3 074 443
#7	#3 AND #6	1 268

Appendix B: Ethical Approval Letter

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45, E-52 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-enquiries@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

22 November 2021

HREC/REF 794/2021

Prof B Biccard
Department of Anaesthesia & Perioperative Medicine
D23 NGSH
Email: Bruce.biccard@uct.ac.za
Student: BLCFIT001@myuct.ac.za

Dear Prof Biccard

PROJECT TITLE: UNDERSTANDING THE INDICATIONS AND CHALLENGES FOR IMPLEMENTING PERIOPERATIVE REGISTRY AND CHARACTERISTICS ASSOCIATED WITH SUCCESSFUL REGISTRIES IN LOW RESOURCE SETTINGS: SYSTEMATIC REVIEW-MSC CANDIDATE FITSUM KIFLE BELACHEW

Thank you for submitting your request to the Faculty of Health Sciences Human Research Ethics Committee.

The HREC note that the proposed study is a systematic review.

As the systematic review involves published literature available through publicly accessible electronic databases, research ethics review and approval is not required.

This is in accordance with Section 1.1.8 of the Department of Health's Ethics in Health Research: Principles, Processes and Structures (South African Department of Health, 2015), which states: "*Research that relies exclusively on publicly available information or accessible through legislation or regulation usually need not undergo formal ethics review. This does not mean that ethical considerations are irrelevant to the research.*"

The HREC recommend that researchers refer to the PRISMA website, for the PRISMA statement and checklist, to facilitate the reporting of systematic reviews and meta-analyses. For more information, please refer to http://www.prisma-statement.org/.

Further, fundamental ethical principles for health-related research should be considered in the objectives and methods of the systematic review. See, for example, the Declaration of Helsinki (Fortaleza, Brazil, 2013) and the Department of Health's Ethics in Health Research: Principles, Processes and Structures (South African Department of Health, 2015).

The HREC acknowledge that the MSC candidate, Fitsum Belachew, is also involved in this project.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Hrec.ref:794/2021sa

WORLD JOURNAL OF SURGERY INSTRUCTIONS FOR AUTHORS

GENERAL

World Journal of Surgery (WJS) publishes original articles that offer significant contributions to knowledge in the broad fields of clinical surgery, innovative developments in surgery, global surgical practice and economics, surgical education, rural surgery and surgical history. WJS welcomes predominantly human research, including clinical research, outcomes, and health service research. Laboratory research will be published only if it is highly significant and with clear and immediate translational potential to surgical care. WJS has an international circulation and is designed to serve as a medium for rapid dissemination of new and important information about the science and art of surgery throughout the world. In the interests of a wide international readership, use of the English language is required. Articles that are

accepted for publication are done so with the understanding that they, or their substantive contents, have not been and will not be submitted to any other publication.

TYPES OF MANUSCRIPTS

PLEASE NOTE: *World Journal of Surgery* does not accept Case Reports and Book Reviews for review or publication.

Word Limit Table

Word Limits do not include abstract and reference list.

	Article Type	Word Limit	Other Notes
	Original Reports	2,500	
	Original Reports with Video	2,500	
	Scientific Review	3,000	Limit of 75 references
	Innovative Techniques in Surgery Around the World	1,000	Limit of 5 references and 3 authors, limit of 8 figures/video
	Surgery in Low and Middle Income Countries	2,500	
	Letter to the Editor	500	Limit of 5 references
	Surgical History	2,000	Limit of 5 references and 3 authors, limit of 8 figures / tables
	Surgical Symposia Contribution	3,000	Limit of 75 references and 3 authors, limit of 10 figures/tables
By Invite Only	*Editorial Perspective*	1,000	Limit of 5 references and 2 authors
By Invite Only	*Invited Commentary*	1,000	Limit of 5 references and 2 authors
By Invite Only	*We Asked the Experts*	1,000; 750 with table/figure	Limit of 5 references and 3 authors, no abstract

Original Reports (Including Papers Presented at Surgical Conferences):

Original Scientific Reports are full-length reports of original basic or clinical investigations. All clinical trials must be registered through a public trials registry that is acceptable to the International Committee of Medical Journals Editors (ICMJE). For information on ICMJE's statement to register clinical trials, please go to http://www.icmje.org/recommendations/browse/publishing-andeditorial-issues/clinical-trial-registration.html . The trial registration number and agency should be listed on the title page and at the end of the abstract.

Randomized clinical trials should be reported following the CONSORT criteria and provide a completed checklist and flow diagram upon manuscript submission. For information on CONSORT and to download the CONSORT checklist and flow diagram, please go to http://www.consortstatement.org/ .

➔Original Scientific Reports must adhere to a 2,500 word limit (not including the title page, abstract, references, tables, and figures). The final word count should be included in the title page of the manuscript.

Original Scientific Reports with Video:

WJS also seeks original basic or clinical investigation manuscripts that contain brief video clips of surgical techniques or operative findings. Please see the "MULTIMEDIA MANUSCRIPT SUBMISSION" below for submitting video augmented manuscripts. For manuscript formatting, please follow the requirements listed above "Original Scientific Reports."

Scientific Reviews (Systematic Reviews and Meta-analyses):

Systematic reviews and meta-analysis of the literature are of interest to the journal, and will be handled with the standard peer review process.

Guidelines and a checklist for composing systematic reviews and meta-analysis can be found at: http://www.prisma-statement.org/. Please do not submit such reviews without consulting these guidelines and completing the PRISMA checklist.

➔Reviews should not exceed 3,000 words, should have less than 75 references, and should contain no more than 5 figures or tables. Additional tables and figures can be submitted as supplementary information.

Innovative Techniques in Surgery Around the World:

The WJS in interested in publishing high quality descriptions of innovative surgical techniques that have the potential to improve the quality or efficiency of care. While techniques with universal appeal are most sought after, novel techniques that allow broader access to care in resource challenged environments are also desirable.

The successful manuscript will contain a detailed description of the technique and be richly illustrated with figures, and/or video.

Line drawings are much superior to intraoperative photos, generally. A brief description of the authors experience with the technique should also be included, if possible.

➔Qualifying manuscripts should be less than 1,000 words, have no more than 3 authors, have no more than 5 references, and no more than 8 figures/video segments. A brief unstructured abstract is also required. Please see our instructions for submitting streaming video, below.

Surgery in Low and Middle Income Countries

WJS seeks high quality manuscripts describing the unique problems and unique solutions facing surgeons in rural and impoverished settings, globally. WJS requires that manuscripts that use primary data from a low- or middle-income country should include one or more local co-authors. A local co-author is defined as a national of that country who is living and working in their home country. All other author requirements need to be met for the author(s) from the low and middle income country. The editors understand that there may be extenuating circumstances in which this requirement cannot be met. In such cases, a cover letter should explain why a local co-author is not included. Further details on this editorial policy can be found at: Editorial Policy on Co-authorship of Articles from Low- and Middle-Income Countries; DOI: 10.1007/s00268-011-1255-8

Cost-effectiveness research is especially valuable for the field of global surgery. However, unless the methods are sound, findings can sometimes be erroneous. WJS calls upon authors who undertake cost-effectiveness research in global surgery to review the methodologic points brought out by the following article when they develop, conduct, and write up their studies: World J Surg. 2017 Jan 19. DOI: 10.1007/s00268-017-3875-0 PMID: 28105528.

WJS also requires completion of the checklist contained in the above article at the time of submission of cost effectiveness studies. The checklist is available at: https://scholar.harvard.edu/shrime/cost-effectiveness-analysischecklist
If the authors feel another checklist is more suitable for their particular study, they may use that checklist. In all cases of cost effectiveness studies, the checklist used should be stated in the cover letter and the completed checklist attached to the cover letter.

➔Surgery in Low and Middle Income Countries articles must adhere to a 2,500 word limit (not including the title page, abstract, references, tables, and figures). The final word count should be included in the title page of the manuscript.

Letter to the Editor

Letters should pertain to material previously published in WJS. The title must include the words "Letter to the Editor" followed by the full title of the original article that is being referenced in the letter. Please follow this format to structure the title for your Letter to the Editor:

➔Letters should not exceed 500 words with no more than five references, the first of which should be the article on which you wish to comment.

Surgical History

Surgical History manuscripts describe either a surgical practice or pioneering surgeon that helped to help reshape the practice of surgery.

➔These review style pieces should be limited to 2,000 words, 5 references and 3 authors. Please limit tables, figures or video to no more than 8.

Surgical Symposia Contribution

➔Symposia should be limited to 3,000 words, 50 references and 3 authors. Additionally, please limit your use of figures or tables to no more than 10.

My First Paper

WJS My First Paper is not a separate article type, but a feature within some of the above article types. The aim is to highlight the first journal publications for a manuscript's first author. On the WJS submission portal, the following question is asked "Would this be the very first publication in a peer reviewed journal for the first author? Yes / No "

If yes, and if the work is accepted, this manuscript will be eligible to be published in our special feature "My First Paper" in WJS. The first author will be asked to provide a 100 word biography and a photograph. This will be published along with the manuscript. This additional information can be emailed to the *World Journal of Surgery* editorial office at: worldjsurg@ohsu.edu . Please include the manuscript number in the email.

World Journal of Surgery does check to ensure no prior works have been published by authors claiming a first publication.

Publishing the manuscript in our special feature will provide visibility to the first author and is a prestigious way to highlight the accomplishments of a budding surgeon-scientist.

By Invitation Only

WJS will also consider for publication the following types of manuscripts **by invitation only**:

- Editorial Perspective
- Invited Commentary
- Surgical Symposium Contribution
- Reply, Letter to the Editor
- We Asked the Experts

Editorial Perspective

This article type requires a pre-submission inquiry by the EIC or the Associate Editor for Special Features and Innovation.

- ≤1000 words, no abstract, table or figure
- ≤5 references at submission
- ≤2 authors, with no more than 2 affiliations

Invited commentary

This article requires a pre-submission inquiry by the EIC or the Associate Editor for Special Features and Innovation.

This commentary will be related to a manuscript to be published that is of particular interest to the reader. The Invited Commentary should place the accompanying manuscript in perspective in the current state of science of its topic, highlight its significance and implications in surgery, and foresee future directions. The commentary should be positive and illuminate the manuscript from an expert's viewpoint.

- ≤1000 words, no abstract, table or figure
- ≤5 references at submission
- ≤2 authors, with no more than 2 affiliations

Surgical Symposium Contribution

Symposium articles should not exceed 3500 words, and should not have more than 75 referenced citations. Figures and tables (in total) should not exceed 10. There should be no more than 3 authors, although one or two is the standard.

Reply, Letter to the Editor

The title must include the words "Author's Reply" followed by the full title of the original article that is being referenced in the reply. Letters should not exceed 500 words with no more than five references, the first of which should be the article on which you wish to comment.

We asked the experts

This article requires a pre-submission inquiry and approval by the EIC or the Associate Editor for Special Features and Innovation. Succinct review of specific interesting topics or questions in surgery/medicine, including common clinical dilemmas, innovations in the delivery of clinical care, controversial issues, or cutting-edge developments in education, quality, safety, policy, global surgery, or other nonclinical areas relevant to practicing surgeons.

- ≤1000 words (or 750 words with 1 small table or figure); no abstract
- ≤5 references at submission
- ≤3 authors, with no more than 2 affiliations per author

MANUSCRIPT SUBMISSION GUIDELINES AND REQUIREMENTS

All manuscripts must be submitted online to WJS via the ScholarOne Manuscripts website (formerly Manuscript Central).

Please login directly onto the site at http://mc.manuscriptcentral.com/WJS and upload your manuscripts following the instructions given on the screen. Authors should keep copies of all manuscript files. WJS accepts no responsibility for files that are lost or destroyed due to electronic problems. Upon manuscript submission, the Editorial Office will review all manuscript files to verify that guidelines and policies stated in this document are adhered to.

Your manuscript will be unsubmitted if it does not meet the proper submission requirements.

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• Names and details of all contributing authors [i.e., e-mail, first name, middle initial(s), surname, degree(s); the departmental and institutional affiliation(s); complete street or mailing address for each affiliation, including the city, state or province, and country where the work was performed].

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MANUSCRIPT PREPARATION AND ORGANIZATION

General instructions:
• Use a normal, plain font (e.g., 10-12 point Times Roman or Arial) for text
• Double-space the text
• Use italics for emphasis
• Include page numbers
• Do not use field functions
• Use tab stops or other commands for indents, not the space bar
• Use the table function, not spreadsheets, to make tables

Manuscript style and text formatting:

Styling and text formatting refers to the use of special effects to enhance the appearance of the published article. Please make note of the following "Dos and Don'ts" regarding styling:
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• DO NOT center text for headings. All text should be justified left, with ragged (unjustified) right margins.
• DO NOT use italic, underline, or other type effects for the entire text of a heading.
• DO NOT use all capital letters for a heading; use initial caps instead.
• DO NOT use multiple spaces to set up columns or tables; use tabs instead.
• DO NOT use carriage returns at the end of each line of text (use the word wrap feature).

Manuscript organization:

Manuscripts should be organized and follow the sequence as indicated below:

TITLE PAGE: The title page should include:

- A concise and informative title
- The name(s) of the author(s) including the affiliation(s) and address(es) of each author. The complete name and address of the author to whom correspondence should be sent, as well as his/her phone number, fax number, and email address.
- A short title for use as a running head.
- Keywords: 3-6 keywords relevant to the manuscript
- Trial registration number for randomized clinical trials (see "Types of Manuscripts: Original Scientific Reports" above)
- Grant support for the research reported
- Statements to comply with ethical requirements (see "Compliance with Ethical Requirements" below for more details):
- A statement for each author in the manuscript must be included declaring whether there are any conflicts of interest in the manuscript. Even if there is no conflict of interest, this should also be explicitly stated as none declared on the title page.
- Statement of informed consent should be included if individual participants are included in the study. For example: "Informed consent was obtained from all individual participants included in the study."

- Statement of human and/or animal rights should be included (if applicable) stating that the study was approved by the appropriate institution and/or national research ethics committee
- **Manuscript word count of your submission**

ABSTRACT (if applicable):
The abstract must appear between the title page and the Introduction section of the manuscript, even if it has been uploaded separately. Manuscripts that require an abstract should contain a structured abstract of not more than 250 words. It should be a factual description of the study performed organized with the headings of: *Background* (includes aims, hypotheses, or objectives), *Methods* (includes patient population, procedures, and data analysis), *Results*, and *Conclusions.*

The abstract should contain the data to support the key findings or conclusions of the study. The trial registration number for randomized clinical trials must be included at the end of the abstract. The first time an abbreviated term is used, spell it out in full and follow with the abbreviation in parentheses – for example: ultrasound (US).

TEXT:
Original Scientific Reports should be arranged in sections titled Introduction, Material and Methods, Results, and Discussion.
1. Introduction: conveys the background and purpose of the report
2. Material and Methods
3. Results & Discussion
When required by the nature of the report, manuscripts that do not follow this specific format may be accepted.

ACKNOWLEDGEMENTS:
A brief statement should acknowledge individuals, other than authors, who were of direct help in the reported work or if the work was supported by a federal or commercial grant. All acknowledged persons should give their written consent to being named in the manuscript. This consent is to be uploaded upon manuscript submission.

REFERENCES:
Reference citations in the text should be identified by numbers in brackets (e.g. [4]). Number the references in order of their first appearance in the text (not alphabetically). Once a reference is cited, all subsequent citations should be to the original number. References may not appear in your Reference List unless they have been cited in the text or tables. Manuscripts that have been accepted for publication or are in press may be listed as references, but the Journal does not reference unpublished data and personal communications. Use the form for references adopted by the U.S. National Library of Medicine, as in Index Medicus. For each reference, show inclusive page ranges (e.g., 7-19).

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1. surname and initials (without periods) of the first three authors and ‘et al’ for all others,
2. the year in parentheses
3. title of article
4. abbreviated Journal name
5. volume number
6. inclusive page numbers, in that order.

An example follows:
1. Honda T, Nozaki M, Isono N, et al (2001) Endoscope-assisted facial fracture repair. World J Surg 25:1075-1083

In references to books, please include :
1. surname and initials (without periods) of the first three authors and et al. for all others
2. chapter title, if any
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4. the year in parentheses
5. editor(s), if any
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7. publisher
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9. inclusive page numbers. Volume and edition numbers
10. name of translator should be included when appropriate

Examples follow:
1. Harlan BJ, Starr A, Harwin FM, Anesthesia for cardiac surgery (1996) In: Illustrated Handbook of Cardiac Surgery, Springer-Verlag, New York, p. 6-12
2. Jones MC, Smith RB, Treatment of gastric cancer (1976) In: Ford TL (ed) Cancer of the Digestive System, Springer-Verlag, Berlin, p. 140-154

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• All tables are to be numbered using Arabic numerals
• Tables should always be cited in text in consecutive numerical order
• For each table, please supply a table heading
• The table title should explain clearly and concisely the components of the table
• Identify any previously published material by giving the original source in the form of a reference at the end of the table caption
• Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body

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Author's in need of assistance to translate their work into English, and at the level expected of a scientific manuscript, may need to use a paid language editing service. Many such services are available. Some handle translation only, such as: American Journal Experts. Others focus on helping explain your work or adjusting grammar, such as: Nature Research Editing Service, Editage, Merudio and others. **Use of any one language services does not play a role in manuscript acceptance**.

ARTWORK, General:

Figure Submission
• Supply all figures electronically
• Indicate what graphics program was used to create the artwork
• For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MS Office files are also acceptable.
• Vector graphics containing fonts must have the fonts embedded in the files
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Color Art
• Color art is free of charge for online publication
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• If the figures will be printed in black and white, do not refer to color in the captions.
• Color artwork should be submitted as RGP (8 bits per channel).

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• All figure lettering has a contrast ratio of at least 4.5:1

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Preparing your Image

Figure Lettering

• To add lettering, it is best to use Helvetica or Arial (san serif fonts)
• Keep lettering consistently sized throughout your final-sized artwork, usually about 2-3mm (8-12 pt).
• Variance of type size within an illustration should be minimal, e.g., do not use 8-pt type on an axis and 20- pt type for the axis label.
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• Do not include titles or captions into your illustrations

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• All figures are to be numbered using Arabic numerals
• Figure parts should be denoted by lowercase letters (a, b, c, etc.)
• Figures should always be cited in text in consecutive numerical order
• If an appendix appears in your manuscript and it contains one or more figures, continue the consecutive numbering of the main text. Do not number the appendix figures, "A1, A2, A3, etc." Figures in online appendices (Electronic Supplementary Material) should, however, be numbered separately.

Figure Captions

• Each figure should have a concise caption describing accurately what the figure depicts. Include the captions in the text file of the manuscript, not in the figure file.
• Figure captions begin with the term Fig. in bold type, followed by the figure number, also in bold type.
• No punctuation is to be included after the number, nor is any punctuation to be placed at the end of the caption.
• Identify all elements found in the figure in the figure caption; and use boxes, circles, etc., as coordinate points in graphs.
• Identify previously published material by giving the original source in the form of a reference citation at the end of the figure caption

Line Art

• Definition: Black and white graphic with no shading
• Do not use faint lines and/or lettering and check that all lines and lettering within the figures are legible at final size
• All lines should be at least 0.1 mm (0.3 pt) wide
• Scanned line drawings and line drawings in bitmap format should have a minimum resolution of 1200 dpi

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• Definition: Photographs, drawing, or paintings with fine shading, etc.
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• Definition: a combination of halftone and line art (e.g., halftones containing line drawing, extensive lettering, color diagrams, etc.)
• Combination artwork should have a minimum resolution of 600 dpi

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• A Multimedia manuscript is an article with imbedded video material. Up to 3 videos per manuscript submission will be accepted. All standard instructions for Audio, Video, and Animations should be followed for Multimedia Manuscript Submissions.
• The content of these files must be identical to that reviewed and accepted by the editors of *World Journal of Surgery*
• All narration should be in English.
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• Resolution: 16:9 or 4:3
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