UCSF
UC San Francisco Previously Published Works

Title

Optimal Resources for Children's Surgery 2: Tiered Quality Improvement Recommendations for Children's Surgical Care Across Health System Levels

Permalink

https://escholarship.org/uc/item/5561b7ft

Journal

WORLD JOURNAL OF SURGERY

ISSN

0364-2313

Authors

Sedano, Sabrina
Ameh, Emmanuel A
Lakhoo, Kokila
et al.

Publication Date

2026-10-19

DOI

10.1002/wjs.70611

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

Title: Optimal Resources for Children's Surgery 2: Tiered Quality Improvement Recommendations for Children's Surgical Care Across Health System Levels

Authors: Sabrina Sedano[1], Emmanuel A. Ameh[2,3], Kokila Lakhoo[2,4], Mohamed Shalaby[2,5], Sarah B Cairo[2,6] on behalf of GICS Membership

[1] University of California, San Francisco, School of Medicine, San Francisco, California, USA
[2] Global Initiative for Children's Surgery (GICS)
[3] Division of Paediatric Surgery, Department of Surgery, National Hospital, Abuja, Nigeria
[4] Department of Surgical Sciences, University of Oxford, Oxford UK
[5] Department of Paediatric Surgery and Urology, Bristol Royal Hospital for Children, Bristol, United Kingdom
[6] Department of Paediatric Surgery, University of California San Francisco, United States of America

Corresponding Author:
Sarah Beth Cairo (ORCID ID: 0000-0001-9060-6900)
Division of Pediatric Surgery, University of California San Francisco
Sarah.cairo@ucsf.edu

Short Title: ORECS 2: Quality Improvement

Keywords: Children's Surgery, Quality Improvement, Global Health

Authors Sabrina Sedano, Emmanuel Ameh, Kokila Lakhoo, Mohamed Shalaby, and Sarah Cairo have no conflicts of interest to report.

Manuscript Word Count: 3986

ABSTRACT

Background: The previously published Optimal Resources for Children's Surgical Care (OReCS) addressed disparities in access to high-quality children's surgery in low- and middle-income countries (LMICs) with an emphasis on physical and human resources. Data from high-income countries (HICs) show a clear advantage in outcomes when there is an investment in quality improvement (QI) programs. In-hospital adverse events, many of which are avoidable through implementation of quality improvement programs, contribute disproportionately to morbidity in LMICs. The objective of this document is to make recommendations for quality improvement programming by hospital level.

Methods: We performed a systematic review of the literature to identify quality improvement programming appropriate for a variety of healthcare settings. We then used an iterative Delphi like approach to rank specific quality improvement programs by hospital level according to DCP3 and WHO classification system. Participation was open to all members of the Global Initiative for Children's Surgery (GICS) with representation from 21 working groups and 50 LMICs and HICs. Final recommendations were made based on greater than 75% agreement by respondents and review by the GICS executive board.

Results: After three rounds of an iterative Delphi like approach, it is recommended that facilities of all levels, participate in a minimum of local data collection and review and establish an antibiotic stewardship program. Recommendations increased by complexity of work done at each hospital level with the addition of surgical safety checklists, and protocols for multiple domains including the operating room, radiology, and transfusion medicine at first level hospitals. Surgical quality improvement committees and routine mortality and serious event review processes should be implemented at second level hospitals and above. At the National Children's Hospital level, program recommendations mirror those of most HICs including continuous data collection and monitoring, multidisciplinary review boards, morbidity and mortality conferences and more.

Conclusion: Quality improvement is defined in the literature as a systematic, data driven approach to improve outcomes and safety of healthcare delivery. Despite significant barriers in data collection, we recommend a minimum level of quality improvement programming and standardization of care for facilities of various levels.

LIST OF ABBREVIATIONS

GICS: Global Initiative for Children's Surgery

OReCS: Optimal Resources for Children's Surgery
HIC: High Income Countries
LMIC: Low to Middle Income Countries
LCoGS: Lancet Commission on Global Surgery
NSOAPs: National Surgical, Obstetric and Anesthesia Plans
DCP: Disease Control Prevention
QI: Quality Improvement
PDSA/PDCA: Plan Do Study Act, Plan Do Check Act
OR: Operating Room
ACS: American College of Surgeons
SSI: Surgical Site Infection

INTRODUCTION

There have been tremendous advances in the delivery of medical and surgical care around the globe over the past half century. This is due in large part to the investment in equitable delivery and access to care by local and international organizations. The aims of these efforts have been to increase access through enhanced education and training of providers. In parallel, the work of non-governmental organizations and investing partnerships have worked to address deficits in physical resources and equipment [1]. While small studies demonstrate improved access based on number of procedures performed, data on the quality of care delivered is lacking [2]. In fact, the existing data on outcomes from surgery in low- and middle-income countries (LMICs) highlights the fact that patients in LMICs experience twice the perioperative mortality despite having a lower risk profile. Specifically, children in LMICs are reported to have a higher perioperative mortality rate than their high-income country (HIC) counterparts, particularly for congenital conditions in neonates [3]. Understanding that resource and training limitations must be addressed first, incorporation of formal quality improvement programs, as defined below, into surgical training and care delivery is essential to bridging the quality gap worldwide. [4] Based on the surgical procedures performed, the equipment and resources identified, and the staffing available or required, the quality assurance programs help protect and elevate the standards at facilities based on the 2017 DCP3 (Disease Control Priorities, 3rd edition) classification system.

In OReCS 1, there was an emphasis on defining what type of care should be provided at the different facility levels and what resources are needed to provide such care. The final portion of that document discussed strategies for improving children's surgical care through training and quality improvement programs. In many low-resource settings, publications focus on increasing volumes of care and mortality as the only outcome rather than emphasizing the multifaceted resource optimization required to deliver higher quality care of children [5]. This volume over quality paradigm is perhaps even more exaggerated in the treatment of children with surgical conditions. While increasing volume is an important component of access to surgical care, there is a need to set variable expectations or standards based on health care facility level. Understanding the minimum standards or capacity at each level is critical to defining what

programming, specifically from a quality assurance perspective, should be expected and required. Just as it is neither feasible nor desirable to provide all types of surgical care at every level of the health care system, the quality assurance programs should vary by level of care.

A variety of approaches have been employed worldwide to improve the quality of health care delivery by addressing the six aims of the Institute of Medicine (IOM) framework; safety, effectiveness, patient-centeredness, timeliness, equity, and efficiency [6]. Rather than dictating which framework all centers should use in their efforts towards continuous improvement (i.e. Plan-Do-Study-Act, six-sigma, etc), OReCS version 2 seeks to define the essential quality assurance programs needed to support a package for optimal care of children at each facility level. As in OReCS 1, these recommendations are made by and for providers in LMICs with experiential input from HIC colleagues [7].

METHODS

The specific programs for quality assurance and recommendations for inclusion at each level of delivery of care were determined through an iterative Delphi like approach. This process involved a review of the literature and a qualitative or open-ended assessment, a ranking evaluation, and a consensus assessment [8]. Participation was opened to all members of the Global Initiative for Children's Surgery (GICS). The initial survey and list of quality improvement programs was created by the OReCS working group and referenced the programs suggested in ORECS 1 (Appendix 2). Initial assessment was conducted at the GICS V International meeting held in Manila, Philippines in 2024 with representation from 20 surgical, nursing, and advocacy working groups and 50 countries (79% respondents from LMICs). This stage included ranking of programs needed at various facility level and open-ended questions about programs prioritized by providers. The responses were reviewed by the ORECS working group, and a list of quality assurance programs was generated. The list was then distributed to all working group leads via email and participants were asked to specify which programs should be required at each level of care (priority ranking). Responses for participants from all working groups were combined. Agreement amongst respondents was then reviewed and

recommendations with greater than 75% concordance were included for the third stage, consensus assessment. The final stage involved review of recommendations by a core group of board and committee members with equal representation from HICs and LMICs.

The programs and measures used to assess and compare the quality of health care organizations are classified based on their impact and target effect. While several schemata have been developed to describe the areas of quality improvement or metrics used, the simplest divides into structural measures, process measures, and outcome measures (Figure 1). This framework will be used to describe the GICS and ORECS recommendations for implementation of quality improvement programming at various levels of health care facilities.

Facility levels are defined using a modification of the Disease Control Priorities (DCP) 3rd edition. In brief, the DCP classifies platforms of delivery of care into five categories including population based, community level, health center, first-level hospital, and referral hospital [9]. As in the first publication of the Optimal Resources in Children's Surgical Care (OReCS) version 1, we focus here on the delivery of surgical care which is performed at the highest three levels. Based on the experience of children's surgery providers from LMICs, the referral hospital level was divided into second and third level facilities and National Children's Hospitals. This distinction of National Children's Hospitals as a component of tertiary care was important because of the substantially different complexity of care and therefore requirements for policy makers. While physical resources and equipment may be similar between facilities, the children's hospital category is found to have a large impact on training, research, and advocacy at the national and international level according to LMIC providers [10]. The World Health Organization (WHO) uses three level to categorize healthcare facilities; level 1 (Primary), level 2 (Secondary), and level 3 (Tertiary) [11]. GICS employed the DCP3 definitions throughout the delphi process but in order to allow broader application of the results, the association between the classification systems is outlined in Table 1. Henceforth, "Health Center" corresponds with WHO Primary or Level 1 Facility; "First Level Hospital" and "Second Level Hospital" correspond with WHO Secondary or Level 2 Facility; and "Third Level Hospital" and "National Children's Hospital" correspond with WHO Tertiary or Level 3 Facility.

RESULTS AND RECOMMENDATIONS

Table 2 shows the results of the Delphi process and final input from the GICS membership. As noted, recommendations are based on greater than 75% concordance or agreement in respondents on which elements should be included at each facility level. The deeper shading corresponds to higher levels of agreement and stronger recommendations.

Structural Measures

Structural measures refer to the physical and human resources largely addressed in OReCS 1. These measures also identify key gaps and constraints that must be addressed to improve quality of care. Though less well socialized than the need for safety checklists and operating room protocols, the World Health Organization (WHO) identified health information systems (HIS) as one of the key building blocks for health systems [12]. HIS serves to support care of individual patients while integrating with registries, disease surveillance data, and monitoring data within the workforce. These data can also be used to support resource distribution and capacity restraints [13]. It is known that in many LMICs multiple factors contribute to the incomplete or cumbersome HIS. While the WHO has not gone so far as to explicitly recommend patient held versus facility held paper versus electronic medical record, the need for iterative and tailored HIS to improve patient care and decision making is paramount [14].

Through the aforementioned modified Delphi process and collaboration between GICS working groups, the use of data management or record collection was identified as a key structural measure for ensuring delivery of high-quality care. 66.7% of respondents felt that paper medical records should be required at all facility levels (Table 2). Between 78-90% of respondents felt that electronic medical records should be required for 2nd level, 3rd level, and National Children's Hospitals. Maintenance of health records not only aides in individual patient care but also

provides data to monitor the ratio of providers to patients, a key metric in understanding a health care system's capacity.

Appendices are included as examples of existing quality assurance protocols and policies. Adaptations for LMIC settings are critical to successful implementation and are underway.

Process Measures

These measures address what a provider or health care system does to maintain or improve health. While commonly monitored in high income settings, activities around preventive care and standardized approaches to common conditions are inconsistently tracked, and in some cases not tracked at all, in many LMICs. Continuous monitoring of processes of care allows for identifying gaps and creating structured improvement programs. While process measures and outcome measures are often interrelated, the recommendations included here focus on protocols, checklists, and systematic approaches to care.

Operating room (OR) protocol and surgical safety checklists have been standard of care since the World Health Organization launched Safe Surgery Saves Lives in 2006 and the WHO surgical safety checklist in 2009 (Appendix 3) [15, 16]. We recommend OR protocols and surgical safety checklists at all facilities that provide surgical care including 1st, 2nd, 3rd level hospitals, and National Children's Hospital. Protocols around safe care, particularly for children, in the areas of radiology and transfusion medicine are also recommended for 1st level hospitals and above (Appendix 4 and Appendix 5)[17, 18]. These include having designated transfusion thresholds and facility specific guidelines around testing as well as radiology protocols to ensure use of as low as reasonably acceptable (ALARA) radiation exposure for children. Specialized nursing protocols and perioperative anesthesia risk assessment protocols are recommended for 2nd level hospitals and above based on consensus (Appendix 6)[19]. Additionally, all respondents felt that clear recommendations were needed to identify patients not appropriate for surgery or intervention at health centers and 1st level hospitals. These recommendations are in alignment with those put forth on the optimal physical resources, personnel, and procedures performed at corresponding facility levels. Based on recommendations for higher level care and localization of

subspecialists, regular attendance at multidisciplinary tumor board and use of palliative care protocols are recommended for 3rd level hospitals and National Children's Hospitals. Despite the variability in procedures and specialists at each level, 77.8% of respondents agreed that antibiotic stewardship programs are needed at all facility levels, including the health center [20].

Outcome Measures

Outcome measures, often described as the gold standard with quality improvement programs, reflect the impact of health care services or interventions on the status of the patient. Literature describing outcomes in surgery and other high-risk fields acknowledges that outcomes, good or bad, are the result of numerous factors, some related to an individual provider, some to a system of care, and many related to the patient. Recommendations around outcome measures include regular review of patient level data within an institution, tracking of complications, and efforts towards understanding risk-adjusted death rates, a key step in performance improvement processes.

Given the breadth of factors contributing to patient outcomes, a multidisciplinary committee is often used to cultivate continuous process improvement. Such committees should include representative providers from anesthesia, radiology, surgical and medical specialties, nursing, critical care, and hospital administration, to name a few. While the committee members and cadence of meetings may vary, the key functions include data analysis, adverse event review, education and collaboration, quality initiative development, oversight and monitoring of other clinical and quality efforts, and risk management. A surgical quality improvement committee was recommended at 2nd level hospitals and above based on the threshold defined for concordance but was also recommended at 1st level hospitals by more than 50% of respondents. Similarly, most respondents felt that regular (defined locally as quarterly or semi-annual) data review should be done at all levels.

A formal morbidity (i.e. serious event) and mortality (M&M) review process has a long history in the field of surgery as a method for identifying potentially preventable factors contributing to outcomes and improving care for future patients. While the process of conducting this review has

evolved in most settings, the review is meant to be a forum for open, non-punitive education focused on peer review while identifying correctable problems. Audit filters should be used to streamline the discussion and allow for risk-adjusted comparison across cases and institutions. These include categories of events such as surgical site infection, death within a defined period following surgery, need for escalation of care, and unexpected return to operating room (Appendix 7). Filters also include categories of factors that contribute to patient outcomes such as pre-hospital and patient related, resource constraints and system related, and provider related factors. Mortality and serious event review should occur anywhere patients are cared for but a formal process is recommended at 2nd level, 3rd level, and National Children's Hospitals. Patient data and outcome metrics should also be compared across centers to help identify factors that may contribute. Local data collection and review is recommended at all facility levels. Participation in national and international data collection, including patient centered outcomes, is specifically recommended for 3rd level facilities and National Children's Hospitals.

DISCUSSION

Quality improvement is defined in literature as a systematic, data driven approach to improve outcomes and safety of healthcare delivery. Defining quality, especially in a resource restrained environment, involves balancing factors like utility of diagnostic and therapeutic procedures, patient satisfaction, and society's sense of well-being without losing sight of ever-increasing costs of care delivery. To make recommendations on the integration of quality improvement programs in LMICs, it is important to understand their origin and impact on health care in HICs starting with simple data collection and tracking of outcomes. In 1917 the American College of Surgeons (ACS) established its Hospital Standardization Program with publication of the "minimum standards." In brief, these standards called for the organization of medical staff, the need for licensed physicians and surgeons, rules and regulations around regular staff meetings and clinical review, proper medical records, and establishment of supervised diagnostic and treatment facilities [21]. These standards have helped launch a series of standards for physical plant issues, equipment, and administration which have evolved to hospital-wide quality assurance programs and continuous quality improvement [22].

Creation of quality assurance programs alone was quickly identified as being insufficient to impact outcomes [22][23]. Principles such as distinguishing "attributable," or special cause variation from common cause variation, clarification of the applicability of the 80:20 rule in health care, that 80% of results come from 20% of causes, and the popularization of the Plan-Do-Check-Act (PDCA) or Plan-Do-Study-Act (PDSA) cycle underpin contemporary quality improvement programming in HICs [24-26]. Originally developed to enhance efficiency and reduce human error in American manufacturing, emphasis on standardized workflows, continuous measurement, and shared responsibility for performance was adopted as the groundwork for modern systems-based change in health care.

Despite clear benefits of structured quality improvement programs in HICs, the experience in LMICs remains limited, with distinct barriers and contextual factors shaping program design and effectiveness. Although many LMICs have pursued universal health coverage as a means to improve health and expand access, increases in service utilization have not consistently translated into better health outcomes [27, 28]. The Lancet Global Health Commission on High Quality Health Systems demonstrated that poor quality care contributes to as much preventable mortality as no health care access at all [29]. Kurk et al.'s systematic analysis revealed 8.6 million excess deaths were preventable through access to health care; after excluding deaths preventable through public health measures, however, an estimated 5.0 million of these were due to receipt of poor-quality care [29]. These data emphasize that quality, not access alone, must be central to the design and scaling of QI initiatives in settings that are resource-limited.

While progress has been made including children's surgery in the National Surgical, Obstetric and Anesthesia Plans (NSOAPs) in LMICs, there is variability in implementation [30]. Thanks in large part to the work of GICs members and leadership, several NSOAPs in sub–Saharan Africa now include children's surgery in at least two of the seven domains focusing on human resources and training [17] [31] [32][33, 34]. There is a consistent emphasis on increasing surgical volume without a parallel focus on quality assurance programs - an imbalance that will undoubtedly increase morbidity and mortality worldwide. The results of the work done by GICs

and previously published expert opinion and experience support the need for facility level specific recommendations on the essential programming to provide optimal care for children.

Building Packages for Safe Surgery by Facility Level

Health Centers

As described in the original OReCS publication, care at each health facility level serves a distinct purpose and should not be duplicative. At the community health center level, we recommend a minimum of record keeping. This allows for tracking volume of work in addition to disease and population metrics which can help shape future public health interventions. While the primary goal of the health center is to triage and quickly identify patients in need of higher level of care, some basic procedures and management has been deemed appropriate. This demands participation in local data review to ensure outcomes and care are standardized. Additionally, respondents felt an antibiotic stewardship program should exist to guide providers to administer the correct antibiotics, at the correct doses, at the correct time.

First Level Hospital

While only minor surgery is performed at first level hospitals, any engagement in surgical procedures requires an escalation of quality assurance programming. As outlined in Table 2, regular data review and the use of protocols that can be regionally standardized are recommended to improve patient outcomes and ensure consistency in care delivery.

The importance of standardized protocols and checklists in improving surgical safety has been demonstrated in multiple settings. In 2008, the WHO launched the Safe Surgery Saves Lives program to promote adherence to proven standards in surgical systems across the globe. A direct result of this campaign was the widespread implementation of the Surgical Safety Checklist, a 19-item checklist designed to reduce morbidity and mortality in operating rooms across diverse socioeconomic settings. A prospective study compared complication rates in eight different countries prior to and after the implementation of the checklist and showed decreased complication rates across all sites and lower 30-day mortality, with particularly pronounced improvements in LMICs [35]. The WHO Surgical Safety Checklist remains a cornerstone of

surgical safety QI efforts in LMICs, with systematic evidence showing that its implementation is associated with reductions in mortality, all complications, and infectious complications [36]. However, variability in adherence persists with recent data demonstrating that fewer than one-third of checklists are fully completed in practice [37]. Successful nationwide implementations in countries such as Madagascar, Cameroon, and Ethiopia suggest that improved uptake is achievable through multifaceted strategies including training, leadership engagement, and ongoing support [38, 39].

Examples of protocols and checklists are provided in the Appendix but should be used with caution and modified for context specific needs. A working group within GICS is being established with the specific aim of creating adaptable templates for quality improvement programming. Once created, these will be widely available through the GICS platform.

Referral Level Hospitals

When creating a package for upscaling of a surgical center and seeking to meet minimum standards, it is to be expected that with increased complexity of procedures and human resources, quality assurance programming must also increase. Specifically, it is recommended that in addition to routine data collection and review, higher level centers should participate in regional, national, and at the National Children's Hospital level, international data review. A surgical quality improvement committee, consisting of not only surgeons but nurses and other health care specialists is essential to supporting these efforts.

While limited in scope, there are examples of successful implementation of quality improvement programs in LMICs. One such example, a multipronged quality improvement project for patients with gastroschisis in Uganda employed a quality improvement study team and formal methodology to monitor outcomes [40]. This project showed substantial improvement in patient outcomes and survival and serves as example of the importance of QI work. Ongoing data collection are needed to show sustainability of these practices and may even show the spillover of such work onto patients with other conditions. Similarly, quality improvement programming introduced in Brazil to a congenital heart surgery program yielded improvement in patient

outcomes [41]. While both programs benefited from HIC partnerships, the knowledge shared is expected and valuable, especially when supporting the development of sustainable, locally owned systems rather than fostering reliance on external resources.

Similar patterns are observed in outcome-oriented quality improvement initiatives such as morbidity and mortality (M&M) review. While M&M conferences are widely reported across LMICs, evidence indicates that their effectiveness is frequently limited by inadequate structural supports, including inconsistent data collection, low provider participation, and lack of standardized documentation and follow-up processes [42]. Emerging experience from multiple LMIC contexts demonstrates that when adverse event review is embedded within a systems-based framework, it more consistently identifies modifiable system failures and supports sustained improvement [43-45].

Building on these practices, emerging experiences from LMICs demonstrate that larger scale, targeted, context-specific quality improvement initiatives are capable of producing measurable and sustainable gain in care quality. Surgical site infections (SSIs) have emerged as a key quality indicator, occurring at substantially higher rates in LMICs compared to HICs, highlighting gaps in perioperative safety and infection control practices [46, 47]. Multimodal SSI prevention efforts exemplify how coordinated interventions across structural, process, and outcome domains can improve surgical quality in resource-limited settings [48] [49]. A multimodal SSI reduction initiative in Sub-Saharan Africa further reinforces this approach, demonstrating how targeted improvements in process measures, when supported by appropriate structural foundations, can translate into meaningful outcome gains, including reduced SSI rates [46]. By focusing on a limited number of high impact, standardized perioperative practices, the intervention achieved measurable improvements without reliance on costly technologies, underscoring that process reliability, data use, and systems organizations, rather than resource intensity alone, are central to sustainable and scalable quality improvement. Collectively, these external experiences align closely with our recommendations supporting a tiered, systems-based model in which structural readiness enables process standardization and continuous measurement drives durable improvements in surgical outcomes across LMIC health care settings.

Health systems in LMICs face unique barriers to consistent implementation of and adherence to quality improvement initiatives. Some of these barriers, such as constrained financial and human resources, represent key components to the delivery of safe surgery as outlined by the Lancet Commission on Global Surgery (LCoGS) in 2015 [50]. In addition to these tangible restraints, the other components for safe surgery such as infrastructure, service delivery, and information management are directly tied to sustainable quality improvement initiatives described above. One of the limitations of these recommendations is the need to address all the barriers to safe surgery in concert. Additionally, they must be addressed within the system and therefore no single protocol or guide can be used in every context. It is the goal of GICS to help develop LMIC specific tools for both quality improvement education and project realization at all facility levels.

CONCLUSION

Advancing the quality of children's surgical care in in LMICs requires moving beyond expansion of services toward systems that consistently deliver safer and effective care. The recommendations outlined above highlight the complementary roles of structural capacity, standardized processes of care, and routine outcome measurement in driving sustainable improvement. Aligning these measures with facility level and scope of practice enables scalable implementation while supporting continuous learning and accountability. Embedded in this tiered approach within children's surgical systems is critical to reducing disparities in outcomes and ensuring that gains in access translate into meaningful improvements in care quality.

AUTHORS CONTRIBUTION

SS: search, writing, review, final approval
KL, EA, MS: critical review, literature search, final approval
SC: conception, writing, critical review, final approval, and supervision.

ACKNOWLEDGMENT

GICS membership

CONFLICT OF INTEREST

None

FINANCIAL SUPPORT

None

REFERENCES

Reference List

1. Jumbam , D.T., et al., *The role of non-governmental organizations in advancing the global surgery and anesthesia goals.* Journal of Public Health and Emergency, 2020. **4**.
2. Ullrich, S.J., et al., *Pediatric surgical quality improvement in low- and middle-income countries: What data to collect?* Surgery, 2022. **171**(4): p. 1067-1072.
3. Livingston, M.H., et al., *Mortality of pediatric surgical conditions in low and middle income countries in Africa.* J Pediatr Surg, 2015. **50**(5): p. 760-4.
4. America, I.o.M.U.C.o.Q.o.H.C.i., *Crossing the Quality Chasm: A New Health System for the 21st Century*. 2001.
5. Davies, J.I., et al., *Global surgery, obstetric, and anaesthesia indicator definitions and reporting: An Utstein consensus report.* PLoS Med, 2021. **18**(8): p. e1003749.
6. Hamilton, S., A. Jennings, and A.J. Forster, *Development and evaluation of a quality improvement framework for healthcare.* Int J Qual Health Care, 2020. **32**(7): p. 456-463.
7. Horner, S.L., *The Health Care Quality Improvement Act of 1986: its history, provisions, applications and implications.* American journal of law & medicine., 1990. **16**(4): p. 455-498.
8. Hsu, C.-C. and B.A. Sandford, *The Delphi Technique: Making Sense Of Consensus.* Practical assessment, research and evaluation, 2007. **12**(10).
9. Jamison, D.T., et al., *Universal health coverage and intersectoral action for health: key messages from Disease Control Priorities, 3rd edition.* Lancet, 2018. **391**(10125): p. 1108-1120.
10. Surgery, G.I.f.C.s., *Global Initiative for Children's Surgery: A Model of Global Collaboration to Advance the Surgical Care of Children.* World J Surg, 2019.
11. Gelb, A.W., et al., *World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia.* Can J Anaesth, 2018. **65**(6): p. 698-708.
12. Organization, W.H. *Monitoring the Building Blocks of Health Systems: A Handbook of Indicators and their MeasurementStrategies*. 2010 [cited 2025; Available from: http://www.who.int/healthinfo/systems/WHO_MBHSS_2010_cover_toc_web.pdf?ua=1.

13. Higman, S., et al., *Designing interoperable health information systems using Enterprise Architecture approach in resource-limited countries: A literature review.* Int J Health Plann Manage, 2019. **34**(1): p. e85-e99.
14. Chutiyami, M., S. Wyver, and J. Amin, *Are Parent-Held Child Health Records a Valuable Health Intervention? A Systematic Review and Meta-Analysis.* Int J Environ Res Public Health, 2019. **16**(2).
15. Nations, U. *World Population Prospects 2022*. 2022 [cited 2026 1 February]; Available from: https://population.un.org/wpp/.
16. *WHO Surgical Safety Checklist*.
17. Rwanda. *National surgical, obstetrics and anesthesia plan 2018- 2024.* 2017; Available from: https://6cde3faa-9fe6-4a8d-a485-408738b17bc2.filesusr.com/ugd/d9a674_c5c36059456a416480fd58fd553ef302.pdf.
18. Ramsey, K. *Transfusions in Pediatrics*. 2025.
19. *American College of Surgeons: National Surgical Quality Improvement Program Pediatric*. 2016.
20. Gul, F., et al., *Surgical safety checklist compliance: The clinical audit.* Ann Med Surg (Lond), 2022. **81**: p. 104397.
21. Brennan, T.A. and L.L. Leape, *Adverse events, negligence in hospitalized patients: results from the Harvard Medical Practice Study.* Perspect Healthc Risk Manage, 1991. **11**(2): p. 2-8.
22. Luce, J.M., A.B. Bindman, and P.R. Lee, *A brief history of health care quality assessment and improvement in the United States.* West J Med, 1994. **160**(3): p. 263-8.
23. Kolesar, P., *The relevance of research on statistical process control to*
24. Berwick, D.M., *Controlling variation in health care: a consultation from Walter Shewhart.* Med Care, 1991. **29**(12): p. 1212-25.
25. Perla, R.J., L.P. Provost, and G.J. Parry, *Seven propositions of the science of improvement: exploring foundations.* Qual Manag Health Care, 2013. **22**(3): p. 170-86.
26. Best, M. and D. Neuhauser, *Joseph Juran: overcoming resistance to organisational change.* Qual Saf Health Care, 2006. **15**(5): p. 380-2.
27. Brookings, I., et al., *The impact of health insurance*
28. Sommers, B.D., A.A. Gawande, and K. Baicker, *Health Insurance Coverage and Health - What the Recent Evidence Tells Us.* N Engl J Med, 2017. **377**(6): p. 586-593.
29. Kruk, M.E., et al., *Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries.* Lancet, 2018. **392**(10160): p. 2203-2212.

30. Wimmer, S., et al., *Assessing the inclusion of children's*
31. Ethiopia., F.M.o.H.o. *National safe surgery strategic plan - saving lives through safe surgery (salts) strategic plan 2016- 2020*. 2017; Available from: https://6cde3faa-9fe6-4a8d-a485-408738b17bc2.filesusr.com/ugd/d9a674_229834ef81bd47ee9cd72f94be1739fe.pdf.
32. T he United Republic of Tanzania, M.o.H., Community Development, Gender, Elderly and Children. *N ational surgical, obstetric and anesthesia plan (NSOAP),*. 2018; Available from: https://6cde3faa-9fe6-4a8d-a485-408738b17bc2.filesusr.com/ugd/d9a674_4daa353b73064f70ab6a53a96bb84acepdf.
33. Peters, A.W., et al., *National Surgical, Obstetric, and Anesthesia Plans Supporting the Vision of Universal Health Coverage.* Glob Health Sci Pract, 2020. **8**(1): p. 1-9.
34. Republic of Zambia, M.o.H. *National surgical, obstetric, and anaesthesia strategic plan (NSOASP), 2017- 2021.* 2017; Available from: https://6cde3faa-9fe6-4a8d-a485-408738b17bc2.filesusr.com/ugd/d9a674_70f6813fe4e74c4d99eb028336a38745.pdf.
35. Haynes, A.B., et al., *A surgical safety checklist to reduce morbidity and mortality in a global population.* N Engl J Med, 2009. **360**(5): p. 491-9.
36. White, M.C., et al., *Implementation Strategies and the Uptake of the World Health Organization Surgical Safety Checklist in Low and Middle Income Countries: A Systematic Review and Meta-analysis.* Ann Surg, 2021. **273**(6): p. e196-e205.
37. Yaseen, S.J., et al., *Multicenter audit of operating room staff compliance with the surgical safety checklist: a cross-sectional study from a low- and middle-income country.* BMC Health Serv Res, 2025. **25**(1): p. 103.
38. White, M.C., et al., *Using the Knowledge to Action Framework to Describe a Nationwide Implementation of the WHO Surgical Safety Checklist in Cameroon.* Anesth Analg, 2020. **130**(5): p. 1425-1434.
39. White, M.C., et al., *Evaluation of a countrywide implementation of the world health organisation surgical safety checklist in Madagascar.* PLoS One, 2018. **13**(2): p. e0191849.
40. Wesonga, A., M. Situma, and K. Lakhoo, *Reducing Gastroschisis Mortality: A Quality Improvement Initiative at a Ugandan Pediatric Surgery Unit.* World J Surg, 2020. **44**(5): p. 1395-1399.
41. Miana, L.A., et al., *Quality and Safety Initiatives in a Pediatric and Congenital Heart Surgery Program in a Lowand Middle-Income Country: The Impact of International Collaboration.* Braz J Cardiovasc Surg, 2025. **40**(6).

42. Lagrone, N.L., et al., *Status of trauma quality improvement programs in the Andean region: What foundation do we have to build on.* Injury, 2017. **48**(9): p. 1985-1993.
43. Wong, Z.G., et al., *Standardization of Trauma, General Surgical Morbidity and Mortality Conferences: Development and Dissemination of a "Toolkit" in Peru.* World Journal of Surgery, 2023. **47**(1): p. 61-71.
44. Schwarz, D., et al., *Implementing a systems-oriented morbidity and mortality conference in remote rural Nepal for quality improvement: Table 1.* BMJ Quality & Safety, 2011. **20**(12): p. 1082-1088.
45. Abahuje, E., I. Nzeyimana, and L.J. Rickard, *Introducing a Morbidity and Mortality Conference in Rwanda.* Journal of Surgical Education, 2017. **74**(4): p. 621-629.
46. Allegranzi, B., et al., *Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis.* Lancet, 2011. **377**(9761): p. 228-41.
47. Biccard, B.M., T.E. Madiba, and S.A.S.O.S. Investigators, *The South African Surgical Outcomes Study: A 7-day prospective observational cohort study.* S Afr Med J, 2015. **105**(6): p. 465-75.
48. Forrester, J.A., et al., *Clean Cut (adaptive, multimodal surgical infection prevention programme) for low-resource settings: a prospective quality improvement study.* Br J Surg, 2021. **108**(6): p. 727-734.
49. Starr, N., et al., *Scalability and Sustainability of a Surgical Infection Prevention Program in Low-Income Environments.* JAMA Surg, 2024. **159**(2): p. 161-169.
50. Meara, J.G., et al., *Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development.* Int J Obstet Anesth, 2016. **25**: p. 75-8.