Falola *et al. BMC Surgery* (2025) 25:129
https://doi.org/10.1186/s12893-025-02863-3

BMC Surgery

COMMENT Open Access

Orienting global surgery initiatives toward advancing minimally invasive surgery in Africa: a commentary based on continent-wide reviews

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Abstract

Surgical care has advanced with the introduction of minimally invasive surgery (MIS) techniques, which have resulted in a reduced length of hospital stay and improved patient outcomes with regard to morbidity, mortality, and aesthetics. Implementation in Africa remains limited due to economic, infrastructural, and training-related issues. Our previous reviews show that adoption of MIS in Africa has been highly variable. Only Egypt and South Africa, for example, have significantly reported robotic surgery programs. Despite present challenges, recent developments show that progress is being made. Advantages of MIS in resource-limited settings include fewer postoperative complications and shorter hospital stays, crucial for African patients who cannot afford unexpectedly extensive postoperative care and are also reliant on daily earnings. In the future, tele-robotic surgery can improve access to surgical care in under-served regions of the continent. Implementation barriers include the high cost of equipment, inadequate healthcare infrastructure, and limited training opportunities. Investment in the development of low-cost innovations, such as MIS equipment suited for resource-limited settings, local manufacturing or assembly of MIS equipment, and the establishment of training programs within the continent, is necessary to overcome these challenges. Policies supporting the integration of MIS into national healthcare plans are also required. The development of more robust MIS programs in Africa will not only enhance surgical care but will also contribute to the improvement of healthcare and economic outcomes across the continent. We present this commentary on the current state, challenges, and opportunities for the wider adoption of MIS across Africa, based on recent continent-wide reviews.

Keywords Minimally invasive surgery, Global surgery, Africa

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Introduction

Most global surgical initiatives in Africa have focused on trauma care and obstetrics services [1, 2]. This is important work; however, this approach unintentionally perpetuates a myth that minimally invasive surgery (MIS) is not a necessity for our region, and it does not take into account that MIS has many potential benefits for improving surgical care in Africa, through shorter hospitalizations, reduction in morbidity, and improved patient outcomes [3, 4]. While MIS has greatly enhanced surgical care throughout the world, there are certain economic and structural barriers that the continent faces, which make such clear advancements underutilized in Africa [5, 6]. Given the current barriers, the necessity and viability of MIS at this present time, especially robotic surgery in Africa, require critical assessment [6]. Indeed, the pursuit of cutting-edge modern technology must be balanced with economic realities, keeping in mind that the gold standard of care must be one that provides affordable and optimal care within the constraints of available resources [7, 8]. Global surgery collaborations that incorporate improving access to MIS on the continent will however improve surgical outcomes and further universal health coverage in Africa by addressing these challenges. This commentary reflects the current state and implementation challenges, based on the recently published continent-wide reviews, and also highlights opportunities for the wider adoption of MIS across Africa.

Current state of MIS in Africa

Access to advanced surgical care in Africa remains limited, with significant disparities between different countries [5, 6]. In many regions, especially in sub-Saharan Africa, a lack of infrastructure, resources, and trained personnel hinders the implementation of MIS [5, 6]. A recent systematic review shows that at least 15 African countries have implemented laparoscopy for general surgical purposes, with a wide range of procedures performed [8]. In the systematic review, we analyzed a total of 6,381 procedures done in African-based facilities performing multiple (≥ 2) laparoscopic general surgical procedures, which were done in 15 countries and over a 21-year period. A similar systematic review of the laparoscopic cardiac surgery done across the continent reported only 1,357 procedures performed in 4 countries [9]. These reports reflect that the number of laparoscopic procedures done in Africa is still significantly low compared to other regions. In the United States, a multi-center study reported 137,000 procedures performed in a 3.5 year period [8, 10]. In Japan, a nationwide analysis recorded 140,000 procedures done within a year [8, 11]. While laparoscopic surgery is relatively more widely available in Africa due to lower equipment costs and easier implementation, robotic MIS remains limited [8]. In a scoping review of the pioneering robotic procedures performed across the continent, a significant disparity was realized as only Egypt, South Africa, and Tunisia had reported utilization of the surgical robot [12]. However, in the review, we noted that implementation has been successful thus far, and wide adoption can still be achieved despite the current delay, based on the outcomes recorded which were similar to those in high-income settings, including comparable low rate of conversion to open surgery, and prevalence of morbidity and mortality [12]. In a comparison of outcomes between both approaches for colorectal cancer, robotic surgery had a longer duration and resulted in higher blood loss compared to laparoscopy, possibly due to less familiarity with robotic systems [13]. Robotic surgery was however associated with a shorter hospital stay, lower rate of conversion to open surgery, and lower prevalence of morbidity and mortality [13]. Regarding surgical specialties, in Africa, MIS has been applied for general surgery (including hepatopancreatobiliary surgery) [8, 12, 14], urological surgery [12], gynecological surgery [12], and cardiothoracic surgery [9, 12]. Global and local efforts have begun to focus on promoting MIS in Africa. An example is the recent partnership between the Government of Rwanda and France which facilitated the establishment of "Institute for Research into Cancer of the Digestive System (IRCAD) Africa", a dedicated MIS training center with state-of-the-art technology [15]. Ethiopia has also successfully begun a MIS program in thoracic and upper gastrointestinal surgery recently [16]. Additionally, significant efforts have been made regarding implementation in Egypt and South Africa [8, 12, 14]. Egypt was the first African country to introduce robotic surgery, reporting the first cohort of cases in 2003 [12, 17]. The country has well established training facilities offering MIS training and fellowships to local and international surgeons [18, 19]. South Africa also has a well developed MIS infrastructure with multiple hospitals utilizing robotic surgical platforms [20]. The country benefits from strong private sector investment. For example, the Netcare Group and Mediclinic hospitals are both private facilities that have pioneered robotic-assisted procedures in urology and cardiothoracic surgery [21, 22].

Benefits of MIS in Africa

Advantages are innumerable in resource-limited settings such as Africa; these include shorter hospital stay, reduced postoperative complications, and early return to daily activities [23–25]. These are important in most of the African settings where the hospital resources are limited and where patients need to go back to work early since the majority depend on daily earnings [26]. Moreover, MIS is associated with lower infection rates, which is considerably important in view of the high

postoperative infection rates, and financial implications of the resulting extended post-operative stay in Africa [27, 28]. In the future, the use of tele-robotic surgery in our healthcare system can improve access to surgical care in the under-served regions of the continent [29].

Barriers to MIS implementation in Africa

Various challenges must be overcome to implement MIS widely in Africa. A narrative review highlighted the implementation barriers associated with robotic surgery in Africa, such as economic and infrastructural constraints, along with systemic and training barriers, with specific recommendations to overcome these challenges [6]. The first barrier globally is the high cost of the equipment. For example, the majority of surgical robots cost over one million United States dollars, with an additional 3000–5000 dollars per-procedure cost, making it unaffordable for both healthcare facilities and the patient [6, 25]. Limited insurance coverage adds to the cost-related barrier. For instance, according to a 2021 survey, only four sub-Saharan African countries had more than 20% of their population with health insurance coverage [30]. In East, Central and Southern Africa, 76.9% of laparoscopic procedures were reportedly covered by health insurance in certain facilities [31]. Despite this, MIS is still limited in these regions because of the lack of laparoscopic consumables, inadequate number of skilled surgeons, limited equipment, absence of MIS services for complicated cases, inability of patients to afford the costs, procedures and consumables not being covered in full by insurance, and other challenges including inadequate anesthesia staff and equipment [31]. Lack of basic infrastructure is another issue. Most African hospitals, including apex facilities in some countries still suffer from insufficient supply of electricity and inadequate facilities needed to sustain a MIS program [32]. Implementing any healthcare advancement like MIS remains an uncertain possibility with the current situation [25, 32]. Other needed infrastructures include operation theatres capable of housing the equipment, facilities for storage and maintenance, administration, and personnel. Training is yet another huge challenge [6, 25, 33]. The use of MIS requires specialized training and skills, but courses and training programs are very limited on the continent [6]. Although international partnerships and fellowships create some opportunities for acquiring these skills for African surgeons, the number of surgeons trained remains low compared to needs [6, 25, 33]. Successful MIS implementation also requires advanced anesthetic proficiency [34]. Shortages of skilled anesthesiologists and necessary facilities are widespread challenges in the majority of African countries and can restrict safe expansion of MIS services [31, 35]. Closing such loopholes is thus key to widespread MIS adoption in Africa.

Opportunities and solutions for advancing MIS in Africa

Insights from our studies

Advancing MIS in Africa is a possibility, provided we can overcome the current challenges. To address the barriers, we have suggested recommendations in previous reviews [6, 8, 12–14]. These include development of cheaper MIS equipment affordable for resource limited settings. There should also be partnerships to achieve local manufacturing and assembly of surgical robots and other MIS equipment in Africa. As high-income settings transition into newer generations of surgical robots and other MIS equipment, the older models can be made available to resource-constrained African settings at reduced costs. This could facilitate initial access to the technology by reducing or eliminating the high initial investment costs, before more recent or sophisticated equipment is procured. Training and capacity building for surgical trainees are also important. Phased implementation where MIS is initially applied for high volume and less complex procedures can help drive adoption. Local and international collaborations can facilitate the establishment of MIS training centers within Africa, similar to the recently established center in Rwanda mentioned earlier. Partnerships between governments, international organizations, and the private sector are essential for these to be actualized. Governments must prioritize partnerships and funding for MIS programs, ensuring that they are part of national healthcare budgets.

The role of global collaborations

To make progress regarding implementing MIS in Africa, there should be an alignment of global surgical initiatives and needs relative to particular specific continental challenges. International organizations such as the World Health Organization (WHO) and various international surgical societies should therefore recognize the key role MIS would play in improving surgical outcomes in Africa and commit resources and partnerships to sustainable MIS programs with support and innovation to overcome the initial implementation and investment hurdle. The ability to build and train surgeons to use this technology locally is necessary for long-term success regarding MIS adoption in African countries [6, 25, 36]. These would be further aided through efforts and funding for research to confirm the cost-effectiveness of MIS techniques, especially robotics, in our environment. Finally, inclusion of benefits of MIS in broader global health goals set forth for Africa, such as Global Surgery Goals and Sustainable Development Goals will further the much-required support that such initiatives get for sustainability [1]. Increasing access to MIS in Africa should be seen as a part of an all-inclusive approach to strengthen health systems rather than a competing priority with other public

health initiatives [1, 37]. The WHO and the Lancet Commission on Global Surgery, for example, have emphasized that access to safe and affordable surgical care is a critical component of universal health coverage [1, 38]. Improved MIS will not only promote surgical care, but also help in general healthcare and economic development in African nations.

Financial implications and cost-effectiveness of MIS

Most important are the benefits of MIS in Africa, particularly sub-Saharan Africa, where health expenditure disproportionately affects individuals as a result of limited insurance cover and dominance of out-of-pocket payments [39]. This is because studies suggest that with MIS reducing postoperative complications, it therefore can significantly avert financial burdens on patients in the long term, since reduced complications reduce instances of expensive re-admissions, repeated surgeries, and prolonged postoperative care [40–43]. Besides, this will enable quicker return to economic activity, which is important in African settings where inability to work directly impacts household income and sustenance [26, 44]. Shorter hospitalizations will ease the burden on already limited healthcare infrastructure, optimizing the use of scarce hospital resources [25]. Furthermore, diagnostic laparoscopy has an advantage in cases of lack of advanced imaging modalities in order to give correct and timely diagnoses without additional cost for the patients [45, 46]. The high start-up cost of MIS programs and the need for special training are significant financial barriers in resource-limited environments [6, 25]. Though robotic surgery have been said to be more expensive, laparoscopy in studies have been noted to be more cost-effective in the long term compared to both robotic and open surgery because it offers lower postoperative costs as a result of shorter hospital stay and less complication compared to patients undergoing open surgery, which may offset the high initial expenses [47–49]. In a study done in Rwanda, laparoscopy was more expensive when low volume of procedures were performed and when the initial investment costs were high. However, with higher volume of cases and lower cost of initial investment, laparoscopy was found to be less expensive and more effective than open surgery [50]. The study revealed that in instances where MIS equipment and machinery can be obtained by donation or at an investment cost lower than $91,979, MIS was more favourable in terms of cost-effectiveness [50]. More innovative solutions are therefore needed to reduce initial investment costs to enable wider adoption in African settings. Such opportunities to procure laparoscopic equipment at investment costs less than $7,500 were noted to be available via some sources such as Indian suppliers [50, 51]. In Nigeria, the costs to patients undergoing general surgery procedures were lower for laparoscopy ($184) compared to open surgery ($217) [52]. In another multi-center study done in Nigeria, although laparoscopy was associated with lower costs of hospital stay, postoperative care, diagnostics, outpatient care, and reoperaion, it resulted in higher total healthcare costs ($355) compared to open surgery ($273) because of the significantly higher cost of surgery for laparoscopy ($312), compared to the open approach ($179) [44]. However, when societal costs such as income gained as a result of earlier return to work was considered, MIS was noted to be more beneficial [44]. The study notably highlighted that open surgery was opted for in 76% of cases because of lack of trained surgeons or laparoscopic equipment. This, together with some cost-analysis studies done in other settings which found laparoscopy to be associated with significant reduction of short- and long-term healthcare costs, indicate that the high healthcare costs may have been because laparoscopic surgeons and equipment were scarce [44, 53, 54].

Innovative and context-specific solutions

It has already been shown that laparoscopy is viable in our setting, since multiple strategies have been devised to surmount resource-related obstacles to its training and implementation [55]. These include the use of low-cost simulation to acquire skills, the recycling of surgical equipment, and the utilization of locally made tools such as endobags, knot pushers, and gasless laparoscopy systems [55]. Such innovations represent resource limitations not as insurmountable barriers but rather as challenges that call for tailored solutions suited to particular contexts [56]. Strategic investment in surgical training and capacity building is needed to address disparities in availability of MIS, a neglected domain of global health [1]. A multidisciplinary approach can help overcome some of the training issues since cross-specialty training has been observed to enhance MIS adoption [57]. General surgeons and thoracic surgeons, for example, can be trained by gynecologists [57]. With such an intervention encouraged, there will be optimal utilization of resources and various patients will benefit.

Lessons from successful MIS implementations in Africa

There are a number of regions within Africa that have successfully implemented MIS programs as earlier highlighted, and have served as valuable lessons and insights. Examples include the use of robotic surgery in both Egypt and South Africa, possibly as a result of early investment in robotic surgery training programs, favorable regulatory environments, and partnerships with industry stakeholders. Indeed, further research is needed to find out how these countries managed to achieve this to provide specific insights and recommendations to other countries. In the first report of robotic cardiothoracic

surgery in the continent [22], surgeons at the Netcare Christiaan Barnard Memorial Hospital, South Africa, teamed up with surgeons from Middlesbrough in the north of England [22]. Such international collaboration can be emulated by other countries to ensure successful implementation of a MIS program. The strong private sector investments pioneering robotic surgery in South Africa represent a model that can be adopted in other countries [21–23]. Private sector investments and public-private partnerships have also recently established robotic surgery programs in Angola and Morocco [58, 59]. Alongside partnerships with governments and insurance companies, private establishments can thus serve as entry points to bridge the gap regarding availability of MIS in African countries where these advances in surgical care are yet to be available.

Conclusion

It is urgent yet achievable to orient global surgery initiatives toward the advancement of MIS in Africa. There are indeed several formidable barriers; however, the potential benefits of such initiatives will be great. Through global partnerships, investment in technology and training, research, alongside favourable policies, substantial progress can be made with the adoption of MIS in Africa, thereby improving surgical outcomes and advancing health equity.

Abbreviations

MIS	Minimally Invasive Surgery
IRCAD	Institut de Recherche contre les Cancers de l'Appareil Digestif (Institute for Research into Cancer of the Digestive System)
WHO	World Health Organization

Acknowledgements

Not applicable.

Author contributions

[AF]: Conceptualization, Data curation, Project Administration, Writing - original draft, Writing - review & editing. [AN]: Conceptualization, Writing - original draft, Writing - review and editing. [AA]: Writing - original draft, Writing - review and editing.

Funding

Not applicable.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 3 February 2025 / Accepted: 20 March 2025

Published online: 02 April 2025

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