

Colorectal Surgery Practice, Training, and Research in Low-Resource Settings

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Abstract

Colorectal surgery (CRS) practice, training, and research differ between low- and middle-income countries (LMICs) and high-income countries due to disparity in resources. LMIC CRS is primarily done by general surgeons due to the paucity of fully trained colorectal surgeons. The majority of colon and rectal resections are done using open techniques, and laparoscopy and robotic platforms are only available in select private or academic centers. Multi-disciplinary teams are not available in most hospitals, so surgeons must have a broad knowledge base, and learn to adapt their practice. Formal CRS training opportunities through accredited post-residency fellowships and professional colorectal surgical associations are limited in LMICs. CRS is less established as an academic field, and less data are generated in LMICs. There are fewer staff and less dedicated funding for CRS research. However, LMIC colorectal surgeons and researchers can contribute valuable clinical findings especially on conditions of higher prevalence in their settings such as anal squamous cell carcinoma and obstetric fistulas. Effective surgical care for colorectal conditions requires significant investment in infrastructure, training, and governance in LMICs. This is critical to improve access to safe surgical care for all.

Keywords

- ▶ colorectal surgery
- ▶ research
- ▶ training
- ▶ low- and middle-income countries

This article will focus on colorectal surgery (CRS) practice, training, and research in low- and middle-income countries (LMICs). Because of resource limitations, these aspects of CRS differ from high-income countries (HICs). Clinical care is directed toward treating the most common local colorectal conditions with available diagnostic and treatment modalities which may not be the same as those available in well-resourced settings. In LMICs, there are fewer CRS training options, and less time and resource capacity dedicated to colorectal research.

Colorectal Clinical Practice in Low- and Middle-Income Countries

CRS is provided mostly by general surgeons in LMICs due to the lack of colorectal surgeons.¹ LMICs may only have a few or no dedicated CRS units. Those that exist are private centers or located in urban tertiary academic hospitals. Rural patients have disparate access to these facilities especially if they do not have health insurance or financial means to travel long distances to access care. LMIC CRS units may also lack a full

complement of multi-disciplinary staff such as surgeons, fellows, stomatherapists, and pelvic floor physiotherapists. Therefore, surgeons who care for patients with CRS conditions in LMICs need adaptability in their practice, and a broad knowledge base.

Benign Colon Conditions

Benign disease such as traumatic injury, intussusception, and volvulus requiring colonic resections with or without stomas are typically done by general surgeons in LMICs. If primary bowel anastomoses are needed, they are often handsewn. The availability of linear and circular stapler and cutting devices is growing; however, the cost of the staplers and reloads can be prohibitively expensive, especially in public health systems that have limited budgets for consumables.

Traumatic injury in sub-Saharan Africa (SSA) is significant and the proportion of road traffic crashes that are fatal is higher than in other regions of the world.² To this end, the average general surgeon will have substantial experience with traumatic bowel repair and resections.

In some LMICs, sigmoid volvulus is common and can account for up to 70% of acute large bowel obstructions.^{3,4} In these settings, risk factors for sigmoid volvulus include male gender, younger age, high fiber diets, low body mass index, and long sigmoid mesenteries which are more predisposed to 360 degrees twisting.^{5,6} This condition will usually be diagnosed on history, physical exam, and abdominal X-ray. Confirmatory CT scan is less commonly performed than in HICs due to lack of availability of this radiologic test at many LMIC hospitals. Treatment is similar to that in HICs: sigmoidectomy with or without primary anastomosis depending on the viability of the bowel and the hemodynamic stability of the patient.

The incidence of inflammatory bowel disease (IBD) is significantly lower in LMICs than HICs. Notable exceptions include South Africa which has a population of Eastern European descent,⁷ and Brazil where incidence has been rising over time.⁸ A scoping review on Crohn's disease in LMICs reported studies from 21 (26.6%) of 79 LMICs.⁹ In most LMICs, complex operations for IBD such as total proctocolectomy with ileoanal pouch for ulcerative colitis are usually only done at select LMIC CRS academic units. In addition, the medical treatment of IBD is more limited in LMICs. Biologic agents are not always available or financially affordable.¹⁰

A meta-analysis from 49 LMICs reported a community-based prevalence for fecal incontinence of 8% in women.¹¹ Treatment for fecal incontinence can be limited to stoma formation in many settings. Some LMICs, such as South Africa, India, and Brazil, have centers for pelvic floor disorders either in the private health sector or as part of a CRS unit. Outside of these centers, diagnostic and therapeutic tools for fecal incontinence and pelvic floor disorders such as anal manometry, defecography, and sacral nerve stimulators are not commonly available.

Colorectal Cancer

The incidence of colon cancer is significantly lower in LMICs compared with HICs but is on the rise in LMICs in part due to

changes in diet and lifestyle.¹² Bowel resections and diverting stomas for colon cancer are mostly done by general surgeons. Since rectal cancer often requires adjuvant or neo-adjuvant chemotherapy and radiation, this disease is ideally treated by multi-disciplinary teams of colorectal surgeons, medical and radiation oncologists, and stomatherapists at CRS units if possible. Many persons with colorectal cancer (CRC) present with late-stage symptomatic disease including obstruction, perforation, or distant metastases compared with those in HICs.¹³ Often the operation is merely palliative.

Proctology

Benign anorectal disease is an important branch of CRS often treated in outpatient surgical practice. As such, general surgeons in LMICs manage straightforward proctological conditions. Complex cases and complications ideally should be managed by general surgeons with experience in proctology or colorectal surgeons. High prevalence of HIV in some LMICs such as Southern Africa can be a risk factor for certain anorectal conditions such as hemorrhoidal disease (HD) and anal condylomata.

Hemorrhoidal Disease

HD can account for one-third of anorectal complaints. Chronic constipation and low fiber intake are two common risk factors.¹⁴ In LMICs, parity can be high, so pregnancy is an additional risk factor. In addition, HIV-related chronic diarrhea can lead to HD.¹⁵ Conservative management with fiber supplementation and mitigation of risk factors is the standard treatment for all causes of HD in these settings. Since rubber band ligation can be done in the outpatient setting, this is a popular HD treatment although sourcing rubber bands can be challenging. The Milligan Morgan hemorrhoidectomy is the typical operation if surgery is needed. Newer techniques, such as hemorrhoid artery ligation and stapled hemorrhoidopexy use expensive disposables that may not be widely available in LMICs.

Anal Fissure

The initial treatment for anal fissure is also conservative management. Topical nitrates and calcium channel blockers are readily available in some LMICs; however, botulinum toxin is not. Most LMIC general surgeons can perform a lateral sphincterotomy to treat anal fissure. However, this procedure should be used with caution in women with high parity who may have weak anal sphincters from childbirth. The Lord's anal stretch is a procedure popularized in the United Kingdom (UK) and is performed by bimanual 3 to 4 finger dilation of the anus for 3 minutes. It was unfortunately popular as a treatment for HD and anal fissure in African missionary hospitals for many decades,¹⁶ but should not be used given its high rates of incontinence.¹⁷

Fistula in Ano

Fistula in ano is a common anorectal condition worldwide included in LMICs. Treatment of simple fistulas with anal fistulotomy is the standard operation, and assuming correct

assessment of the fistula, a reasonably successful intervention. Colorectal surgeons and expensive diagnostics are needed to manage complex fistulas. Availability of endo-anal ultrasound and MRI scanning in LMICs is often limited, so assessment of fistula anatomy and treatment planning is done clinically. Draining setons should be used judiciously to avoid permanent damage to the levator ani complex if the anatomy is unclear. Surgeons who work in countries with a high incidence of tuberculosis (TB) should consider tuberculous fistulas in the differential of any complex anal fistula. TB fistulas should be treated with anti-TB medication in addition to sepsis control.¹⁸

Anal Condyloma

Untreated HIV co-infection can result in extensive anal condyloma.¹⁹ This is best treated with fulguration. Care must be taken not to cause scarring and anal stenosis. To avoid this complication, removal of circumferential lesions should be done in a staged manner.²⁰

Recto-vaginal Fistula

Although eradicated in industrialized countries, obstetric fistulas in LMICs are still a devastating complication of childbirth. Risk factors include early parity and primigravida. Poor and vulnerable women are disproportionately affected.²¹ The World Health Organization (WHO) estimates that 50,000 to 100,000 new cases of obstetric fistula occur each year and there are more than 2 million women with fistulas in SSA and South Asia.^{22,23} While vesiculovaginal fistulas are more common, recto-vaginal fistulas (RVFs) are the most severe type and cause significant psychological and physical challenges. Local hubs of excellence to treat obstetric fistula have developed in several LMICs including Ethiopia,²⁴ Uganda,²⁵ and Rwanda²⁶ although more are needed to treat the large number of women afflicted with this condition. Advocacy groups such as the Global Fistula Hub also raise awareness and have created a knowledge-sharing platform which provides data on fistula repair and prevention, and opportunities for community engagement.²⁷

Stoma Formation

The formation of stomas after CRS is inevitable in certain circumstances. This can be challenging for ostomates (persons living with stomas) because there is less support in LMICs. Surgeons must be prepared to correctly site stomas and provide patient education around stoma care. Only some large academic centers have stomatherapists to assist with these tasks. A multi-country prospective study reported that the incidence of colostomy formation after left-sided colon resection was higher in LMICs compared with HICs and purported that the lack of subspecialist trained colorectal surgeons could be a contributing factor.²⁸ A center in El Salvador reported that out of over 400 patients with stomas, the majority were of poor quality.²⁹ Many were created too close to the flank, on or near bone, outside the rectus muscle, or too flat or prolapsed. Some LMICs such as India, Indonesia, and South Africa have ostomate or stomatherapy associations but these are rare exceptions.³⁰⁻³² Access to stoma



Fig. 1 Ostomates in low- and middle-income countries struggle to get stoma appliances. This person is using duct tape and a plastic bag from a loaf of bread to fit her stoma. Source: Photo provided by Sr. Nicci Petersen, head stomatherapist, Groote Schuur Hospital, Cape Town, South Africa.

supplies can be a challenge for many ostomates (→ Fig. 1). Permanent stomas therefore create a lifetime of difficulty.

Colonoscopy

In many LMICs, colonoscopy is done by general and colorectal surgeons rather than gastroenterologists. National screening programs for CRC only exist in HICs.³³ Screening colonoscopy for CRC is rare in LMICs due to the lack of human resources and equipment as well as financial constraints.^{34,35} A WHO report showed that only Antigua and Barbuda, and Colombia from the Americas region had screening colonoscopy in their CRC screening guidelines but these were only done opportunistically rather than through systematic population-based screening programs.³⁶ A study from South Africa reported that for an uninsured population of 50 million persons, only 70,000 colonoscopies were performed annually in the public health sector.³⁵ In Pakistan, a country with an average annual income of \$650 and no national health insurance system, a colonoscopy costs \$100 which is prohibitively expensive.³⁷

Laparoscopic and Robotic Surgery

Laparoscopic and robotic surgery have made inroads into some middle-income countries. Some South African hospitals, for example, perform laparoscopic CRC resections in limited private and public institutions. However, its use

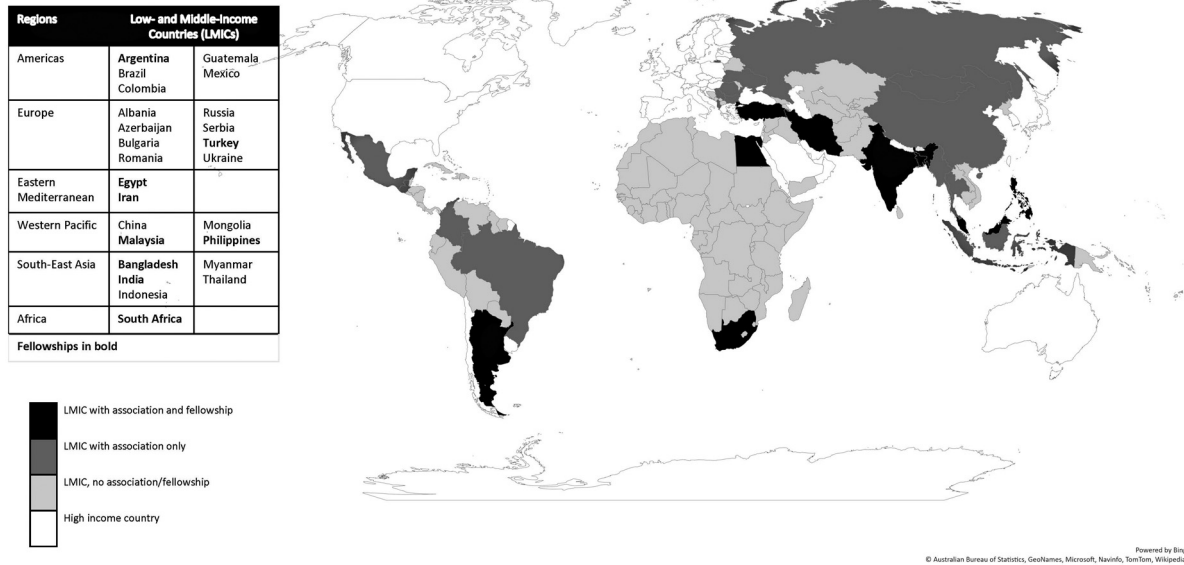


Fig. 2 Colorectal associations and fellowships in low- and middle-income countries.

especially for CRC should be selective. One concern is that general surgeons, who are doing the bulk of CRC operations, are not formally trained in total mesorectal excision (TME). Attempting to perform laparoscopic TME, without proper training, could result in poorer outcomes for patients. The demand for the latest surgical techniques, especially in the private sector, could be driving this market for expensive equipment and consumables, rather than demonstrated decrease in recurrence and mortality.³⁸ Therefore, while laparoscopic CRS should be taught in LMICs, it should be done within structured CRS fellowships by experienced trainers. Robotic surgery is also being introduced in select hospitals in Asia,³⁹ Latin America,⁴⁰ and Africa, in Egypt⁴¹ and South Africa.^{42,43} The cost-benefit ratio of these expensive platforms could be questioned given the limited budgets of most public health systems and the large backlog of CRS operations that can be performed using open techniques.⁴⁴

Colorectal Training in Low- and Middle-Income Countries

In the United States, 77% of general surgery residents continue on to subspecialist training.⁴⁵ In contrast, in LMICs, most general surgeons do not sub-specialize and are expected to perform a breadth of general surgery operations including CRS. Subspecialist fellowship opportunities are limited and are restricted to a few regional hubs. Out of 143 LMICs, only nine countries (Argentina, Bangladesh, Egypt, India, Iran, Malaysia, Philippines, South Africa, and Turkey) offer CRS fellowships.^a The number of

CRS fellowship programs in each of these countries are few. For example, there are 63 CRS fellowship programs in the United States and Canada,⁴⁶ compared with six in SSA, all located in South Africa (author personal knowledge). Trainees from countries without CRS fellowship programs also seek entry into established programs. One out of every five CRS fellowship applicants to U.S. programs is not a U.S. citizen.⁴⁶ In South Africa, a proportion of CRS trainees will be from other African countries. Local colorectal pathology, as well as diagnostic and therapeutic techniques, influences the content and operative techniques that are taught. This may not always be relevant for all trainees in their home country clinical practice. At publication, two of the South African CRS programs were in the process of acquiring robotic platforms at their teaching hospitals. Since few African hospitals have this platform available, the utility of learning this technique in training is limited for many.

Networking and continuing medical education for CRS practitioners in LMICs can be facilitated through local and regional CRS associations. Some of these include the International Society of University Colon and Rectal Surgeons (ISUCRS),⁴⁷ the Latin American Association of Coloproctology (ALACP),⁴⁸ and the Asia-Pacific Federation of Coloproctology.⁴⁹ These associations offer regular congresses and online content to learn up to date CRS management and operative techniques. For example, in 2019, ALACP held their 26th biennial congress in Mexico where over 400 participants participated in workshops and listened to lectures, debates, and panel speakers from both HIC and LMIC CRS faculty.⁵⁰ In addition, 25 (17%) LMICs have national CRS societies (► **Fig. 2**). Well-established CRS societies in HICs such as the American Society of Colorectal Surgeons (ASCRS), and the European Society of Coloproctology (ESCP) allow

^a CRS fellowships and associations in LMICs were identified through search via Google and relevant websites, and authors' personal knowledge.

international memberships for CRS surgeons from other countries, including LMICs. In 2021, ASCRS listed 245 LMIC members, the majority ($n = 158$, 64%) from Latin America. ASCRS and ESCP continue to offer significant online medical education opportunities. An increase in virtual conferences during the COVID-19 pandemic has increased these opportunities for knowledge exchange, and networking may be more equitable since travel to international congresses was financially prohibitive for many LMIC doctors.⁵¹

Surgical Simulation in CRS Training

Surgical simulators have become a key component of CRS training in HICs, especially to teach minimally invasive techniques such as laparoscopy and robotic surgery.⁵² A systematic review of laparoscopic simulators demonstrated that there are various low-fidelity, low-cost models that can be used to teach knot tying, tissue handling, and instrumentation.⁵³ Studies from Tanzania, India, and Botswana have demonstrated significantly better technical outcomes after laparoscopic simulation.^{54–56} However, laparoscopic simulation has not been widely rolled out to teach laparoscopic CRS in LMICs. Low-fidelity, low-cost simulation can also be used to teach open CRS procedures. In 2013, the University of Rwanda established the Faculty of Medicine Simulation and Skills Centre at the University Teaching Hospital of Kigali.⁵⁷ Using a tissue-based model made from locally sourced materials, general surgery trainees significantly improved their technical skills in creating end ileostomies after simulation training.⁵⁸

Colorectal Research in LMICs

Given the shortage of LMIC general and colorectal surgeons, most are full time clinicians, and few have the time or skills to conduct CRS research. In addition, general surgery and CRS training programs in most LMICs do not have committed time or training for research methodology. For example, more than half of U.S. general surgery residency programs have at least one year dedicated to research,⁵⁹ compared with none in South African programs.⁶⁰ Most CRS research produced by LMIC academics are limited to single center or national cohorts.^{61–64}

Not surprisingly, impactful CRS research disproportionately originates from HICs. Of the 100 most cited CRC publications, none originated from LMICs.⁶⁵ The majority of CRS research worldwide is on CRC epidemiology and outcomes.⁶⁶ One of the major limitations of CRC research in LMICs is the paucity of national cancer registries. Most CRC data are limited to single centers or is unpublished.⁶⁷ In Latin America, regional and national registries are maintained in some countries, and the epidemiology of CRC is better understood.⁶⁸ In SSA, only South Africa has a national CRC database, and this data is limited to pathology reports and does not contain data on stage or survival.⁶⁹

Most of the research on LMIC CRS conditions are conducted by or in collaboration with HIC researchers. For example,

outcomes after CRS across many LMICs are reported by large multicenter observational studies conducted through a United Kingdom grant-funded research collaborative, GlobalSurg.^{13,28,70} These found that surgical site infection and mortality are higher in LMICs compared with HICs for elective and emergency gastrointestinal surgery,⁷⁰ and stoma formation is higher for left-sided colorectal resections.²⁸

Some HIC researchers have worked toward strengthening local capacity of CRS research in LMICs. The Memorial Sloan Kettering Cancer Center-Nigerian collaboration⁷¹ is an HIC/LMIC partnership that has built research infrastructure in Nigeria with the formation of a recognized consortium, the African Research Oncology Group, with a focus on CRC.⁷² Achievements of the collaboration include the development of multidisciplinary teams to review and design treatment protocols in Nigeria, as well as several grants that have been awarded to Nigerian surgeons as co-Principal Investigators. Clinical practice was found to expand simultaneously with research efforts.⁷¹

Certain colorectal conditions are more common in LMICs compared with HICs. As such, publications from LMICs can significantly contribute to knowledge of disease burden and outcomes. Two such examples are anal squamous carcinoma (ASC) and RVF due to obstructed labor. ASC is common in Southern Africa due to the high HIV co-infection rate. Large series of ASC and their outcomes have been reported in a South African cohort.⁷³ Obstetric fistula including RVF is most common in certain Middle Eastern and African countries where poor antenatal care and young age at first pregnancy are common. A qualitative study from Iran demonstrated the complex social, individual, and familial issues resulting from this debilitating condition.⁷⁴

Conclusion

In conclusion, CRS practice, training, and research differ in LMICs compared with HICs (► **Table 1** for a summary of CRS in LMICs). General surgeons do most of CRS, and allied health professionals such as stomatherapists are not usually available outside of academic centers. This requires general surgeons to know how to site their own stomas and provide patient education. There are few CRS fellowship training opportunities in LMICs, but this could be expanded by creating knowledge hubs or training centers in LMICs to build local capacity of surgeons practicing there. There is also extremely limited resource capacity for CRS research in LMICs. Building understanding of colorectal conditions through increasing research capacity in local settings in LMICs could add great value globally to the field of CRS. To build CRS practice, training and research in LMICs would require significant investment in all components of surgical systems and would not be a simple one-size-fits-all solution. However, improving CRS capacity in LMICs is crucial to improving access to safe surgical care for all. Let this be a global call to strengthen CRS capacity in LMICs.

Table 1 Summary of CRS practice, training, and research in low- and middle-income countries

Practice	• Provided mostly by general surgeons.
	• Lack of stomatherapists.
	• Few dedicated CRS units, mostly located in urban areas.
	• Limited access to diagnostic and operative equipment, e.g., MRI, laparoscopy.
	• Paucity of screening programs for colorectal cancer.
Training	• Limited CRS training opportunities and fellowships, restricted to a few regional hubs.
	• Networking and continued medical education for CRS practitioners is limited, although expanding through online platforms and virtual conferences.
Research	• Impactful CRS research originates disproportionately from HICs.
	• Limited time and resources for research, and teaching of research methodology.
	• Lack of data on epidemiology and outcomes.

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