

Starting gastrointestinal endoscopy in a lower middle-income country in Africa: Training, creating an endoscopy facility and developing telemedicine



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ABSTRACT

Background and study aims The prevalence of digestive diseases seems to be high in African countries. Nonetheless, the human and material resources are scarce. The aim of the Portuguese volunteering project described in this report was to develop the specialty of digestive endoscopy in Sao Tome and Principe, a lower-middle-income country in Africa.

Methods Beginning by assessing the local needs and available resources and managing immediate issues related to this field, we aimed to provide the tools necessary to improve gastroenterological and endoscopic care in the country. The first step included training of the local teams, through the development and accomplishment of an adapted curriculum for a 3-year medical gastroenterological fellowship and a short-term nursing fellowship, both in Portugal, and the organization of regular gastroenterological and endoscopic theoretical and practical sessions in Sao Tome and Principe. Second, the endoscopy facilities of the unit were significantly optimized. Third, a web platform was designed to provide telemedicine incorporating real-time endoscopic imaging available remotely.

Results Through these sequential steps achieved in collaboration with Portuguese and local teams, this 5-year project provided the basis for gastroenterology care in this country.

Conclusions At the present time, Sao Tome and Principe has an autonomous, efficient and skilled team and unit to provide care for patients with gastrointestinal diseases who need endoscopic procedures.

Introduction

Sao Tome and Principe (STP) is an island country located in the Gulf of Guinea, off the western equatorial coast of Central Africa. It consists of two archipelagos around the two main islands of STP. It has a population of around 200,000 inhabitants [1]. It

is a former Portuguese colony which achieved independence in 1975. Ever since, STP has remained one of the most stable and democratic countries in Africa.

The prevalence of gastrointestinal diseases seems to be high in Africa and the most frequently observed pathologies in



► **Fig. 1** Dr. Ayes de Menezes Hospital, STP. **a** Main building. **b** Gastroenterology and General Surgery building, including endoscopy unit, Surgical Operating Room and Nursery.

endoscopy are portal hypertension due to hepatitis B and schistosomiasis, gastroduodenal ulcers due to *Helicobacter pylori* infection, and upper gastrointestinal malignancies [2]. Regarding lower intestinal tract, hemorrhoidal pathology, infectious colitis and lower gastrointestinal cancer are also a concern [3]. All of these diseases, if not adequately diagnosed and treated, can be responsible for significant morbimortality.

Nonetheless, in the sub-Saharan area of the continent, gastroenterology and digestive endoscopy are scarcely developed because the medical and technical resources are very limited. In STP, there are two hospitals, the main one being the Dr. Ayes de Menezes Hospital, in the capital (► **Fig. 1**) [4].

The healthcare workforce of physicians is estimated to be 107 medical doctors and 462 nurses (0.5 doctors and 2.3 nurses per 1000 habitants) [5], compared to 28,822 medical doctors and 45,444 nurses (5.4 doctors and 74 nurses per 1000 habitants) in Portugal (PT) [6]. Physicians with a medical specialty are rare in STP and, when this project started, there were no medical doctors specializing in gastroenterology.

The estimated high prevalence of digestive diseases and the human and technical scarcity justified the need to create an adequate endoscopy facility and healthcare staff capacity to focus on gastroenterology and digestive endoscopy.

Instituto Marques de Valle Flôr (IMVF) is a foundation for development and cooperation that began as a non-governmental development organization (NGDO) in 1988 in STP. Health is a priority intervention for IMVF and, of the several projects this NGDO develops, the “Health for All” is one of the key programs. This project aims to contribute to universal access to quality healthcare in the country, and, since 2009, its main goal has been to promote the improvement, autonomy, and progressive sustainability of the provision of specialized secondary and tertiary healthcare. Short-term missions are carried out regularly by Portuguese specialist doctors to solve problems locally and train healthcare staff in STP and accomplish the abovementioned goal [7].

Gastroenterology missions

The program “Health for All” has been made possible thanks to the joint efforts of various entities, with a significant role played by Central of Portuguese Cooperation through Camões – Institute for Cooperation and Language, IP and the Directorate General for Health of Portugal, as the main funders, and the support of several partners, as Santa Casa da Misericórdia de Lisboa and PT Innovation/Altice Labs, and the long-standing partnership with the Ministry of Health of STP.

In 2016, as part of the “Health for All” program, it was also possible to obtain funds to start organizing short-term gastroenterology volunteer missions in STP.

Each gastroenterology mission lasted 1 week. The Portuguese team started with two Portuguese gastroenterologists and one nurse with expertise in digestive endoscopy. To date, eight missions have been carried out (January 2016, November 2016, August 2018, January 2019, June 2019, October 2019, June 2021, September 2021). The organization of the missions was dependent on several factors, such as funding, personnel availability and some unpredictable problems such as the COVID-19 pandemic. The missions required participation of seven Portuguese gastroenterologists and five Portuguese gastroenterology nurses. In addition, a local team of three medical doctors, four nurses and one assistant with interest and growing knowledge in gastroenterology and digestive endoscopy participated.

The first mission aimed to provide education on the diagnostic approach and therapeutic guidance to care for patients with digestive symptoms who were to be screened as a priority and to assess the material and human resources in the country in the field of gastroenterology and digestive endoscopy. Progressively, goals have been established taking into account the real needs of the country: providing adequate training to physicians and nurses, optimizing the local endoscopy facility, and developing a structure to enable real-time communication between teams in PT and STP. Activities were then developed during subsequent missions to fulfill these goals and a significant im-

provement in gastroenterology and digestive endoscopy healthcare has been documented in STP. The essential steps and actions that have been taken to accomplish these goals are explained below (► Fig. 2).

Step 1: Assessment of local resources and needs and management of immediate issues

During each mission, the Portuguese IMVF team directed their efforts toward care of patients with gastrointestinal diseases.

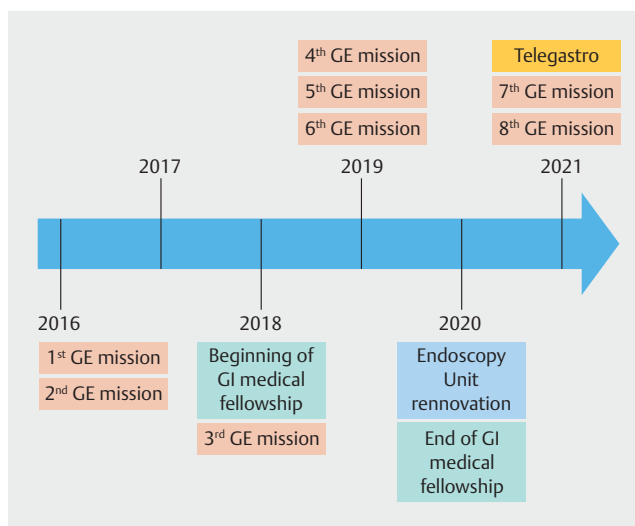
Flowcharts of triage, based on clinical history, were primarily developed to help the local general physicians identify more complex cases that needed to be addressed during gastroenterology missions, both for consultation or endoscopic procedures.

Critical local medical and non-medical personnel interested in gastroenterology were identified, and a local team was created to assist the IMVF team in completing their activities.

An average of 95 endoscopic diagnostic and basic therapeutic procedures (upper endoscopy, colonoscopy and proctology) were performed per mission. In addition, an average of 75 gastrointestinal consultations were also completed per mission. During the eight missions, 128 therapeutic procedures were performed (endoscopic variceal band ligation, endoscopic hemostasis of bleeding ulcers, polypectomy, sclerotherapy of hemorrhoids, and surgical treatments for anal fistulas and fissures). Therapeutic procedures were scheduled for the first days of each mission, to ensure due time for post-procedure surveillance. To date, no major complications have occurred.

Interventions performed during the gastroenterology missions are summarized in ► Fig. 3.

Endoscopy was mainly performed due to dyspepsia, heartburn and constipation and the major endoscopic findings were esophagogastric varices, gastroesophageal reflux disease, esophageal candidiasis, erosive gastritis, and peptic ulcer disease (sometimes complicated by bleeding or by pylorobulbar stenosis), colon diverticulosis, and polyps. In STP, very large ulcers and large esophageal varices with red signs requiring more than six bands during the first endoscopic treatment are still common.



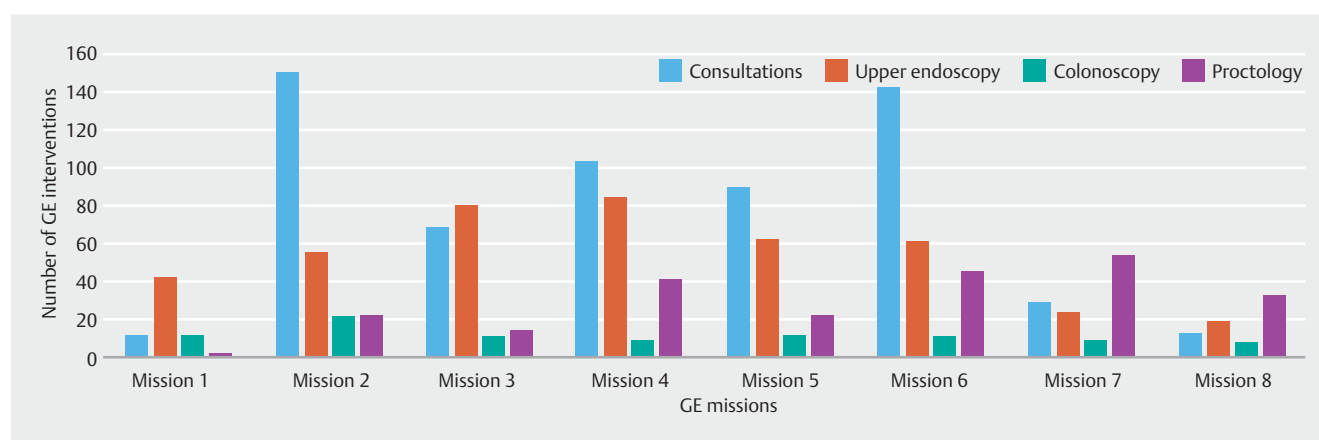
► Fig. 2 Summary of the activities performed during the project (2016–2021).

The principal reasons for consulting gastroenterology are similar to those in western countries: dyspepsia, gastroesophageal reflux, constipation, and benign anal pathology.

The number of procedures (with the exception of proctology) and consultations performed from the second to the sixth mission was more than that in the last two missions, both performed in 2021. The number of proctological evaluations has remained high, as it is an area that the gastroenterology team of STP is still developing.

In addition, the IMVF team was asked to accompany STP colleagues during ward rounds for gastroenterology patients and to exchange ideas on diagnosis and treatment. Given the shortage of medications in the country, donations from several pharmaceutical companies (e.g., Norgine, Jaba Recordati, Vitória Lab, Generis) were crucial to treat several patients.

Evacuations to PT were recommended for patients with more complex or severe diseases such as neoplastic disease so that appropriate treatment could be provided.



► Fig. 3 Number of gastroenterology interventions performed each mission.

Step 2: Training local healthcare personnel

After creating a team with interest in developing gastroenterology in STP and structuring the daily clinical practice of an endoscopy unit, focused complementary training in gastroenterology was crucial. Undeniably, the long-term sustainability of this project required development of permanent specialized support for gastroenterology care in STP.

A 3-year gastroenterology curriculum was developed, based on the Portuguese curriculum for gastroenterology, organized by the College of Gastroenterology of the Portuguese Medical Association, and adapted to the national needs. It focused in basic diagnostic and therapeutic upper and lower endoscopy and proctology, but also included daily work on a gastroenterology ward and regular attendance in the Emergency Department. Conducting and participating in clinical studies was also encouraged. This curriculum was then approved to serve as the platform for national certification in gastroenterology by the Medical Association of STP.

A medical doctor with great interest in the area of gastroenterology was selected for the fellowship, which was funded by IMVF and carried out in the Gastroenterology Department of Centro Hospitalar Universitário de Coimbra, a large academic hospital in PT. At the end of the fellowship, a final formal evaluation comprising theoretical and practical sections was performed by a jury of experts from both PT and STP.

In the field of nursing, intensive on-site, hands-on training and workshops were provided during the missions. In addition, a grant from IMVF for a 1-month internship was awarded to one of the nurses to go to a Portuguese unit dedicated to digestive endoscopy to deepen her knowledge about basic diagnostic and therapeutic endoscopy and endoscope reprocessing, and so that she could later share that information with the rest of the team.

During all missions, several clinical meetings were also organized to extend training in the field of gastroenterology to the rest of the healthcare teams and promote updating of knowledge in this area. Various topics were debated and algorithms for clinical practice were proposed, taking into account the characteristics of the country and the limitations of existing resources.

Step 3: Optimization of facilities with renovation of gastroenterology unit

Taking into account the high prevalence of gastrointestinal diseases and the gradual training of healthcare staff in this area, the reconstruction of the gastroenterology unit was deemed to be very important.

The existing endoscopy facility was built in 2003 (► **Fig. 4a**, ► **Fig. 4b**). It was a very limited space, characterized by one room in which endoscopy (► **Fig. 4c**) and endoscope reprocessing (► **Fig. 4d**) were performed. Only one old video gastroscop and a PENTAX EPK-700 videoprocessor were available. To accomplish these missions, endoscopes had to be rented and endoscopic material had to be bought. Some medical equipment companies, such as Boston Scientific, helped by donating endoscopy materials.

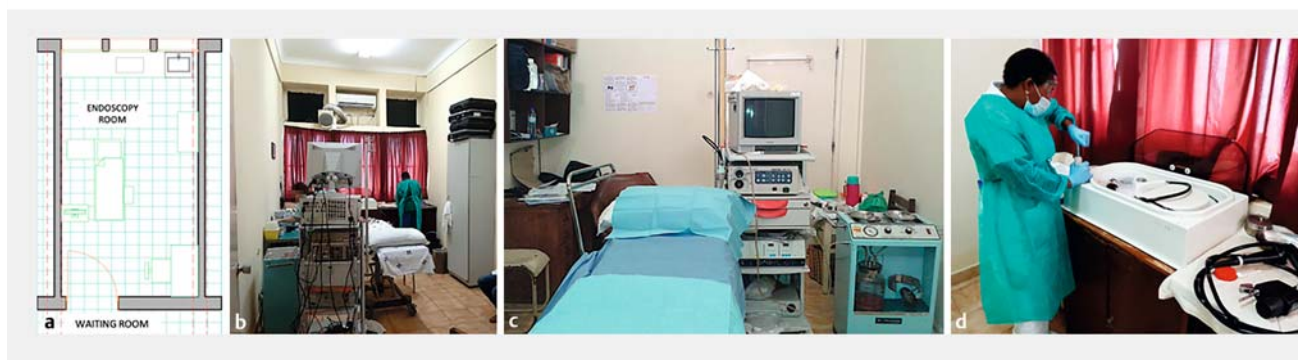
Although very limited, this endoscopy unit benefited from some positive features, such as its location. It was in the same building as the Operating Room and it had water, electricity and pipes for oxygen, vacuum and compressed air supply.

With an important financial contribution from IMVF's partners Santa Casa da Misericórdia de Lisboa and Central of Portuguese Cooperation, the unit was removed in 2020, after the condition of the space and needs were evaluated. The unit was renamed Gastroenterology Unit Dr. José Eduardo Pina Cabral in honor of one of the doctors who pioneered this project.

The unit was designed and constructed (► **Fig. 5a**) with the valuable contribution of a Portuguese architect to include an endoscopy room (► **Fig. 5b**), endoscope reprocessing room (► **Fig. 5c**), recovery room, toilet, consultation room (► **Fig. 5d**), storage room, and waiting room.

The new endoscopy unit was equipped with two PENTAX EG-2990i gastroscopes, one PENTAX EC-3890Li colonoscope, one PENTAX EPK i5000 videoprocessor, one Nds radiance video monitor, and one ERBE VIO200S 10140–400 electrosurgical unit. In addition, endoscopic devices were provided. Some cost savings were achieved by using reusable equipment. The supply of repaired scopes and accessories was made possible by IMVF and donations, allowing the unit to maintain its regular activity.

The existence of a separate purpose-designed reprocessing room is a basic requirement for any endoscopy unit to minimize



► **Fig. 4** Former digestive endoscopy room of the Hospital Dr. Ayres Menezes, STP. **a** Room plant. **b** General view. **c** Endoscopy area. **d** Reprocessing area.



the risk of infection and contamination and prevent exposure to chemicals used in cleaning and disinfection and cross-contamination [8]. This area was designed to have separate dirty and clean areas and a one-way flow from one to another. A specific protocol was developed for cleaning, disinfection, and reprocessing using an endoscope-washer-disinfector (Scope:Cleaner Endotechnik 7000-S10), drying and storage. The staff was fully trained to ensure appropriate and adequate endoscope reprocessing.

The consultation room also functions as a medical office.

Step 4: Maintaining capability – TeleGastro project

After optimizing the gastroenterology knowledge and endoscopic skills of the STP local team and updating the endoscopy unit, regular support by the IMVF team to local team had to be provided to build the local team’s capacity.

Telemedicine is one of the tools that can be helpful in these cases. Medigraf, from Altice Labs, is an integrated web platform for telemedicine that provides remote healthcare services, enabling communication between two institutions that are geographically distant, through videoconference and real-time sharing of images and clinical data for discussion and sharing of knowledge. Of the various characteristics of this equipment, the following stand out:

- Compatibility with any web environment computer, equipment or means of medical diagnosis;
- Low cost;
- Need for Internet with a bandwidth of only 2 Mbps;
- Incorporation of clinical files, including file of exams;
- Internal communication tools through internal email and chatroom;
- Possibility of sharing of consultations in various parts of the world simultaneously;
- Integration of equipment, transmitting real-time monitoring of vital signs, ultrasound exams, echocardiography, mammography, breast ultrasound, conventional radiography, among others.

For this TeleGastro project, Medigraf was adapted to transmit real-time endoscopy images (► Fig. 6), enabling gastroenterology teams from PT and STP to collaborate together remotely on the approach to gastroenterology patients. Since June 2021, this platform has been used regularly. In addition to collaborating on endoscopic procedures, use of a telemedicine platform also has facilitated completion of some educational workshops for the medical and the nursing teams.

With the availability of the technology in the unit, telemedicine now is being used on demand for support an average of 2 days per month. Patients initially are seen by the gastroenterologist in STP, and whenever there is a question about diagnosis or therapy, a telemedicine session is scheduled with the Portuguese medical team.

Step 5: Independent practice

Following training of staff and acquisition of necessary equipment and resources, the Endoscopy Unit began working autonomously at the beginning of 2021. Currently, STP local team consists of a medical doctor, three nurses and one assistant.

In 2021, 408 upper endoscopies, 46 diagnostic total colonoscopies and 184 proctological procedures were performed on the Unit, including those done as part of missions.

In addition, 130 therapeutic procedures were performed in 2021. The main indications were either gastrointestinal bleeding (16 cases of hemostasis of non-variceal upper bleeding and 14 cases of band ligation of esophageal varices) or proctologi-



► **Fig. 6** Example of a real-time video image taken during an endoscopy procedure via TeleGastro.

cal disease (80 cases of hemorrhoid sclerotherapy with polidocanol or rubber band ligation and 10 surgical cases of fissurectomy, fistulotomy and perianal abscess drainage). Seven polypectomies and three foreign body extractions also were performed.

Discussion

This report highlights the experience of starting an Endoscopy Unit in an emerging country. It summarizes a 5-year project of cooperation between PT and STP in the field of gastroenterology and digestive endoscopy with the main goals of teaching basic digestive endoscopy, targeted to the most prevalent diseases in the country, and creating an environment of autonomy through the development of a gastroenterology certification, the renovation of an endoscopy facility, and development of telemedicine. An extended period was needed to evaluate the local needs, find key personnel, involve national entities, ensure political support, evaluate funding sources, and build a realistic project that was appropriate for local healthcare resources and demand to fulfill the previously described goals.

The motivation for this project was the finding of a high frequency of digestive diseases in STP requiring an endoscopic approach. The prevalence of hepatitis B virus infection (HBV) in sub-Saharan African is among the highest in the World [9] and HBV and alcoholism are still major causes of liver cirrhosis and portal hypertension. In STP, it is estimated that 9.3% of men and 6.1% of women have contracted HBV infection [10]. Although HBV vaccination has been available to newborns since 2003, there are no established national screening or surveillance programs or access to antiviral therapy for HBV. *Helicobacter pylori* infection prevalence is as high as 80% in African countries, and gastritis and peptic ulcer disease are the most common manifestations [9, 11,12]. Although diseases with infectious etiologies are more prevalent in Africa, gastrointestinal neoplasia is being increasingly observed [9, 13,14]. Treating these diseases is a health priority because all of them are associated with significant morbidity and mortality. The associated gastrointestinal bleeding complications, in case of portal hy-

pertension and peptic ulcer disease, can be fatal, and timely diagnosis is vital for better prognosis in oncological cases. In this context, the use of gastrointestinal endoscopy has shown to result in improved clinical outcomes and savings in economic and human resources [15].

Success in an Endoscopy Unit is highly dependent on the experience and knowledge of both doctors and attending nurses and the availability of adequate equipment and facilities. A recent survey from the European Society of Gastrointestinal Endoscopy (ESGE) showed that many African countries have few gastrointestinal endoscopy centers with adequate resources and the shortage of endoscopy training, lack of national endoscopy societies, and deficiencies in equipment and basic infrastructure, as well as poor water and power supplies, are the probable reasons [9]. This is especially valid in sub-Saharan Africa [9, 16,17]. Mwachiro et al [17] recently analyzed gastrointestinal endoscopy volume in Eastern sub-Saharan Africa and showed a limited endoscopy capacity to meet the burden of digestive diseases. An overall capacity of 0.12 endoscopists, 0.12 gastroscopes, and 0.09 colonoscopes per 100,000 inhabitants was calculated. Adjusted maximum upper gastrointestinal and lower gastrointestinal endoscopy capacity were 106 and 45 procedures per 100,000 persons per year, respectively, which correspond to 1% to 10% of those reported from high-income countries.

A key aspect of this project was the selection of healthcare personnel committed to contributing to improving the provision of health care for the local population of STP.

Training was also a prominent feature of this project. PT medical and nursing volunteers were crucial to provide structured and adequate education in gastroenterology and digestive endoscopy. A gastrointestinal curriculum with adapted endoscopic competencies provided training and certification of the first gastroenterologist in STP. A fellowship was completed in a high-income country to acquire the basic skills more rapidly but the integration of the knowledge based on local conditions was crucial. This is the reason why the gastroenterology missions were maintained, to help adjust practice as resources became available. We can already see the results of having done these gastroenterology missions and this training and secured a gastroenterology team that provides permanent support to the population by observing the increasing numbers of diagnostic and therapeutic procedures performed over time. The decrease in procedures (with the exception of proctology) and consultations from the sixth mission to the last two missions, both performed in 2021, is reflective of the fact that, since the end of 2020, a stable gastroenterology team has been in place in STP. Since then, regular and specialized medical care has been available in the country and efficient screening is possible, which enables triage of the most complex cases during the PT missions. The number of upper endoscopies is much higher than the number of colonoscopies due to the higher rate of upper gastrointestinal diseases. The high rate of patients with proctological conditions seen so far is not only because of the high frequency of these conditions in the country, but also because of the valuable collaboration of Portuguese gastroenterologists who have proctological expertise.

Once the education had been completed, we had to ensure that the local team had the proper conditions in which to perform their work. It was possible to renovate the endoscopy unit and acquire new scopes and endoscopic devices. Endoscope reprocessing was an important consideration in the Endoscopy Unit. As already discussed, there is a high prevalence of transmissible viruses, such as HBV, and adequate disinfection and reprocessing of endoscopes and ancillary reusable devices was absolutely essential. In low-income countries, automatic washing machines often are unavailable [9], but an adaptation using semi-automated equipment was possible and a strict cleaning and disinfection policy, according to international rules, was instituted.

Telemedicine is a term used broadly to provide healthcare without the need for in-person encounters [18]. There are some reports of telemedicine in the field of gastroenterology, but mainly for postgraduate teaching, with case presentations, theory courses, and sharing of images [16], or for live demonstrations of procedures performed by experts [19] or televisits or teleconsultations [20]. In the endoscopy setting, telemedicine has been used to exchange endoscopic images or video-clips, but few reports exist of collaborative live endoscopy transmissions with tele-cooperation by experienced staff when carrying out more endoscopic procedures. There is an interesting report from Sweden [21] corroborating the role of having tele-guidance in low-volume centers from high-volume centers to improve the quality of endoscopy care and this benefit has even been proven in economic terms [22]. To the best of the authors' knowledge, TeleGastro enabling of live endoscopic image-sharing is a pioneering project worldwide that enabled real-time communication between two continents and it may be a promising solution for other countries facing the same limitations.

At present, STP has an autonomous, efficient and skilled team and unit for caring for patients with digestive diseases who need endoscopic procedures. To measure the success of the project, a strong indicator is the endoscopy activity performed since the beginning of this year.

This project has also been very positive for those volunteering. Indeed, despite not receiving any fees or honoraria from the project for their work, PT volunteers found it to be an extremely fruitful collaboration. Besides the possibility of contributing to training and sharing knowledge, these professionals also benefited from increased experience finding solutions for unforeseen problems, intercultural discovery and development of human relations. Most importantly, they made a significant impact in improving a country's health care.

The authors would be remiss if we did not acknowledge that this project was only possible thanks to IMVF which, through its availability, receptivity and strong commitment, provided all the necessary means for the development and implementation of this project.

This report was an excellent opportunity to reflect on what we have achieved and what we intend to accomplish in the future. With this project, this Endoscopy Unit is capable of providing Level II resources [9] because it has facilitated performance of basic diagnostic procedures and fundamental monitoring

abilities (Level I) and also minor endoscopic procedures, such as endoscopic hemostasis. The number and quality of endoscopic treatments such as polypectomy is progressively increasing with the availability of an anesthesia back-up and acquisition of an electrosurgical unit (Level III). Future goals include: transitioning to an enhanced level (Level III) [9], through the acquisition of resources and development of skills to perform advanced endoscopic procedures, such as endoscopic dilation and stenting, and biliopancreatic endoscopy; maintenance of communication, education, and autonomy through organization of TeleGastro conferences and gastroenterology missions; larger coverage of gastrointestinal bleeding; organization of missions to Príncipe, the second island in the country; reduction of costs over time due to the need for fewer evacuations; expansion of the medical local team; organization of short-term exchange gastroenterology fellowships between PT and STP; and promotion of research in the field.

Conclusions

In sum, this 5-year project, achieved in collaboration with PT and local teams, provided a foundation for gastroenterology care in this country and can serve as an example for developing this specialty in other countries under similar conditions.

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Competing interests

The authors declare that they have no conflict of interest.

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