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# Emergency Relocation of a Cardio-Surgical Health Facility due to war

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## ABSTRACT

This article seeks to share our experience on the consequences of a poorly managed conflict and its impact on a healthcare institution. We further try to talk about what it takes to relocate, especially such a vital sector like cardiac surgery amid the socio-economic and socio-political context in which the hospital happens to be situated. Bearing in mind that the promptness of a patient's recovery in a healthcare facility depends immensely on how accurate the engineers were during the design and construction phase how precise international standards are implemented in the various engineering sectors of the hospital is of capital importance. Following the Cameroonian mindset, wherein division of labor and meritocracy are usually far fetch realities, it is therefore of prime importance to choose experienced and qualified contractors, architects, project managers to take part in the implementation of healthcare projects. The process of relocating either temporarily or permanently some health services from a crisis-stricken zone to a safer environment also demands a lot of tactfulness in decision making as well as personnel involvement. All personnel from the various sectors being relocated must work closely with the team leader such that all necessary equipment, consumables, surgical materials are put together to simplify logistics and even safeguard the logistical process.

**Keywords** – *Healthcare, Outreach, Crisis, International standards, Facilities, Emergency*

## INTRODUCTION

The St. Elizabeth Catholic General Hospital Cardiac Center Shisong is a hospital founded in 1936 as a dispensary by the Tertiary Sisters of St. Francis. The Tertiary Sisters of Saint Francis are a Roman Catholic Religious Congregation of Pontifical Right with motherhouse in Brixen, South Tyrol – Italy and General Administration in Rome – Italy. The hospital was recognized by the Cameroon Government in 1952. The hospital has several departments amongst which the Cardiac Center is our point of

interest in this article. The Cardiac Center Shisong is a state-of-the-art hospital constructed on a surface area of 12,500 m<sup>2</sup> in a remote area of Kumbo, Bui Division, North West Region – Cameroon between 2005 and 2009. It was officially inaugurated on November 19<sup>th</sup>, 2009 by the Cameroon minister of public health. This was done in the presence of the Italian ambassador to Cameroon amongst other top-ranking personalities. Following this inaugural ceremony, the Cardiac Center was recognized

as a National Referral Center for cardiovascular diseases in Cameroon. On November 4<sup>th</sup>, 2015, following Presidential Decree N° 2015/493, the Cardiac Center Shisong was recognized as a “Public Utility.” This hospital is the end product of a fruitful collaboration between 3 main partners (Non-Governmental Organization) which are: “Tertiary Sister of St Francis” (Cameroon), “Bambini Cardiopatici nel Mondo” Onlus (Italy), “Cuore Fratello” Onlus (Italy). These 3 partners signed an MoU in June 2010 to define management, responsibilities, and ownership of the Cardiac Center.

**RESPONSIBILITIES BEFORE INAUGURATION**

Table 1 summarizes some responsibilities of the 3 partners before inauguration.

**TABLE 1.** Responsibilities of the Various Partners before Inauguration

Tertiary Sisters of St. Francis	Cuore Fratello Onlus	Bambini Cardiopatici Nel Mondo Onlus
Selection of patients to be operated upon in Milan	Accommodation of patients and staff who travel to Milan	Training of chosen staff
Staff recruitment before sending to Milan for training	Technical assistance to site engineers	Carry out surgical interventions
Construction of new infrastructure to accommodate the new Hospital	Provision of medical, electrical and mechanical equipment	Provision of some medical equipment and surgical materials
Management	Sponsorship of surgical procedures for underprivileged patients	

Table 2 summarizes some responsibilities of the 3 partners after inauguration.

The following day after the inauguration ceremony, the first cardiac surgery was performed in the new infrastructure which was very successful.

**TABLE 2.** Responsibilities of the Various Partners after Inauguration

Tertiary Sisters of St. Francis	Cuore Fratello Onlus	Bambini Cardiopatici Nel Mondo Onlus
Selection of patients who cannot be operated upon in Shisong due to the complexity of the surgical intervention	Accommodation of patients and staff who travel to Milan	Training of chosen staff
Staff recruitment and management, selection of those needing supplementary training in their respective fields. Organization with foreign partners for possible training	Technical assistance to site engineers and help desk function. Connection with potential suppliers of spare parts. Follow up purchase and dispatch to Shisong.	Carry out surgical interventions in Shisong. Collaboration with other foreign healthcare practitioners for possible organization of pediatric surgical missions in Shisong
Facility management of the infrastructure	Donation of medical, electrical and mechanical equipment	Donation of some medical equipment and surgical materials
Management of hospital activities	Sponsorship of surgical procedures for underprivileged patients	

**PRESENTATION OF CARDIAC CENTER SHISONG HEALTH FACILITY**

1. Total bed capacity is 86 with 13 Intensive Care Unit (ICU) beds included
2. An outpatient department
3. Well-equipped ICU
4. Electrophysiology and hemodynamic (angiograph)
5. Two well-equipped operating theaters in which heart surgeries can go on simultaneously
6. Blood bank service
7. Pharmacy and procurement
8. Technical department

## METHODS

In November 2016, social unrest broke up in the 2 English speaking regions of Cameroon (North West and South West regions). The Cardiac Center Shisong happens to be situated in one of these regions that is the North West region. The crisis which initially started as a non-violent protest in which teachers and lawyers were demanding reforms of the educational and judicial sector, and were molested and chased from the streets. Some youths took upon themselves to retaliate and fight for their rights, a situation which transformed into violent and deadly confrontations. From thence, an extremist part of the population became radicalized and transformed the protest into a fight for independence (cessation).

The number of extremists grew and we started to observe a wide proliferation of arms of all sorts. There was chaos all over the Anglophone regions as the confrontation between separatist fighters and the military became deadlier, leading to the massive internal displacement of citizens. It was after the October 7<sup>th</sup>, 2018 presidential election that the confrontations gained grounds generally speaking (although some localities had already experienced severe and deadly confrontations). People fled from their homes into bushes with the hope of returning after a few days. They then fled from their hideouts into neighboring villages until some found themselves in neighboring countries while others settled in the French-speaking regions of the country. This situation forced many companies and hospitals to shut down. Some were even reduced to ashes.

The Cardiac Center Shisong, fortunately, was not reduced to ashes but suffered from a long period of inactivity. Some patients who were hospitalized just before the situation aggravated were stranded and couldn't return to their homes and some patients who had been booked for cardiac surgeries ended up dying. Due to the low patient turnouts, the hospital administration was forced to send about 75% of staff on technical leave.

### ACTIVITIES PERFORMED BY THE CENTER BEFORE OCTOBER 7<sup>TH</sup>, 2018

Table 3 shows medical activities performed between November 2009 and October 2018.

**TABLE 3.** Various Activities Performed Over 10 Years

ACTIVITY	NUMBER
Consultations	74,655
Echocardiograms	24,000
Diagnostic and interventional catheterization	515
Cardiac pacemaker	185
Open-heart surgeries	769

### SOME TECHNICAL FACILITIES FOUND AT THE CARDIAC CENTER SHISONG

Table 4 groups some of the biomedical, electrical and mechanical equipment found in the hospital.

**TABLE 4.** Various Activities Performed Over 10 Years

DESIGNATION	QUANTITY
Electricity generators (700 kVA, 900 A, 3 phases)	2
Voltage stabilizer (650kVA, 3phases, regulates between -35% and +15% of nominal voltage)	1
Voltage transformers 10KV-400V (630 kVA 3 phases)	2
Vacuum pumps for centralized suctioning (7 kW)	3
Medical oxygen production plant (6m <sup>3</sup> /h)	1
Syringe pumps	30
Infusion pumps	25
Patient ventilators	8
Multi-parameter patient monitors	18
Anesthetic machines	4
Coagulation analyzers	3
Blood gas analyzers	4
Chemistry analyzer	1
Portable ultrasound machines	3
Mobile ultrasound machines	2
Defibrillators	5
Surgeon's headlamp	1
Auto-transfusion pumps	2
Intra-aortic balloon pump	1
Heating/cooling machines	5
Air compressors (11 kW, 3 phase, 108 m <sup>3</sup> /h)	3

DESIGNATION	QUANTITY
Sternum saws	2
Electrosurgical units	4
Weighing scales	3
Measuring tapes	3
Blood warmers	3
Drug refrigerators	6
Extracorporeal circulation machines SIII	2
Mobile suction machine	1
Infusion stands	20
Drug trolleys	15
Electrocardiograph machines	2
Transesophageal probe	1
Oxygen flow meters	45
Negatoscopes	15
Patient's bedside tables	48

### **SOME IMPACTS OF THE CRISIS ON THE CARDIAC CENTER**

1. The growing cost of preventive maintenance due to prolonged shutdown of equipment.
2. Worries about the state of equipment containing internal batteries which had not been charged.
3. A long blackout period or lack of electricity leading to the possible deterioration of rechargeable batteries in equipment. In the event of a fault on the grid, workers from the electricity supply company would not be able to intervene unless a period of ceasefire was announced.
4. Increased expenditure on fuel for the electricity generators.
5. Travelling for distances of about 100 km during violent confrontations in search of fuel for electricity generators. This led to the rationing of the electricity supply. In a bid to economize fuel, the electricity generator would work for only 4 hours a day.
6. A growing number of patients on the waiting list needing prompt surgical interventions.
7. Expiration of drugs, surgical materials, valves, patches, and other consumables.

8. Loss of manual dexterity of the personnel due to the long period of technical leave.

It was following some of these points that studies were made to create an outreach program for the cardio-surgical unit of the hospital in a safer city. The challenges were numerous for this project to go operational and we had to keep in mind that not all pieces of machinery were to be transferred out from the Cardiac Center as surgical activities could resume in the Cardiac Center whenever the crisis was resolved.

There was a lot of discussion mostly between the surgeon and the technical coordinator seeking the most appropriate model of implantation to be adopted. Our first worry was the city in which we were to settle in. We had to choose between Yaounde, Douala, and Bafoussam. The criteria which guided our choice of city were:

1. The climatic condition of the city (temperature and humidity).
2. Level of pollution.
3. Population density.
4. Security and safety in association with urban disorder.

After carefully deliberating on these points, we realized that Yaounde, the capital of Cameroon, was the most suitable. We were convinced that our proximity to decision-makers (ministries, insurance companies, and Non-governmental Organizations) could increase our chances of integration and reaffirming our place in the healthcare sector. The next challenging task was to find either an appropriate piece of land to construct new facilities to accommodate the services or to collaborate with an existing hospital or clinic. Due to the unavailability of enough funds, the second option was chosen to raise another problem of which hospital to work with. This was very challenging knowing that we were to choose among close to 20 renowned government, private, and confessional hospitals.

1. Criteria for Choosing a Partnering Hospital
2. The close proximity to the center of the city.
3. An institution with lesser administrative latency.
4. An institution with similar religious perspectives.
5. An institution who puts patients' recovery as the main priority.
6. An institution with similar hygienic standards.

7. An institution in which workers and administrators are completely apolitical.

After visiting several health institutions both state and privately owned, our choice was made on a private clinic considering the above-mentioned criteria. It should be noted that Cardiac Center Shisong is the only center in Central African Sub-region where routine open-heart surgeries are performed. We have in Cameroon, the Douala General Hospital who also does open-heart surgeries, but patients are grouped and wait for foreign specialists to come once or twice a year for surgeries.

We had several challenges to kick-start activities in the chosen healthcare institution and we expected to meet these challenges knowing that hospitals not performing such levels of surgical interventions would not invest in upgrading facilities.

### **CHALLENGES ENCOUNTERED HINDERING THE SMOOTH TAKE OFF OF SURGERIES IN THE CHOSEN CLINIC**

1. There were 2 split-type air conditioners in the operating theater. Contrary to the conventional air-handling units with high-level filter management of air pressure in the rooms, we had a completely closed operating theater with no possibility of renewing the air. Among the 2 air conditioners, none was cooling to our satisfaction.
2. There was only 2 outlets for oxygen in the theater. The operating theater had no anesthetic pendant nor enough outlets for medical oxygen. We needed at least 3 outlets for our machines.
3. Piping for medical air in the operating theater was absent. Medical air (air containing 21% oxygen) is needed by the anesthetic machine and heart-lung machine.
4. There was an absence of piping for the anesthetic gas scavenging system in the operating theater.
5. Only 3 electrical sockets were present in the operating theater. Mindful of the number of appliances connected during heart surgeries and even general surgeries to a lesser extent, it was unworkable to have only 3 electrical sockets. We also noticed electricity distributors were being used with little knowledge about their electrical rating.
6. There was the presence of a very tight and poorly ventilated 2-bed ICU. We also had a slit-type air conditioner with no possibility of air renewal.

7. There was a poor disposition of oxygen cylinders and supply networks. The health facility was supplied with medical oxygen from a two-cylinder ramp. Knowing very well the role and importance of oxygen in heart surgery and hospitals with emergency units, we wondered how the patients survive during the process of replacing empty cylinders. Furthermore, the distribution network was composed of only one pressure reducer situated beside the ramp. It was reducing the pressure from 145 bar to 4.5 bar. Meaning that there wasn't any second stage reduction.
8. A centralized vacuum system was absent. We found only 3 mobile suction machines available in the hospital.
9. A medical gas alarm system was absent. We witnessed instances where oxygen ran out and no one knew about it.

With all these challenges in mind, discussions were scheduled with the CEO of the clinic. The aim is to present all the listed challenges hindering a smooth take-off and to propose recommendations according to international standards which would be taken into consideration while upgrading the facility. Bearing in mind the complexity of the task and huge financial constraints involved and the fact that all investments were to be borne by the CEO of the clinic alone, we were obliged to reshape or soften our recommendations while still trying to align with international standards.

### **RECOMMENDATIONS TO BE IMPLEMENTED WHILE UPGRADING THE HEALTHCARE FACILITY TO ACCOMMODATE THE CARDIO-SURGICAL SERVICE**

1. Due to financial constraints, we asked that the air conditioners in the operating theater be repaired and cleaned rather than purchasing an air-handling unit. This issue was to be reviewed after the first year of collaboration.
2. More oxygen sockets were to be added to the operating theater.
3. Installation of new pipeline for medical air in the operating theater.
4. Installation of piping and scavenging system for anesthetic gas from the machine in the operating theater.
5. To foster a continuous supply of oxygen to the hospital, we recommended the installation of at least 2 ramps with 2 cylinders each, having an automatic switchover

between both ramps. This new system should be linked to a medical gas alarm system to indicate ramp discharge, low, and high pressures. We also asked that a second stage pressure reducer be installed.

6. The purchase of more mobile suction machines to serve in the operating theater as well as in the ICU.
7. Owing to the very limited space in the existing ICU, we asked for a new location to be provided. The CEO instead promised to construct a new building to accommodate the ICU as he was about to embark on an extension project of his clinic.
8. Increase the number of electrical sockets in the operating theater and reevaluate the power rating of the UPS to make sure that it matches our demand of 15 kVA.
9. Review of the earthing system.

### **RECOMMENDATIONS FOR THE IMPLEMENTATION DURING THE CONSTRUCTION OF THE NEW ICU**

The ICU was to be constructed on a 35-square meter piece of land (7 m length and 5 m width). After careful analyses, we decided to design the room such that it could contain 3 adult patients' beds and 2 infants' or neonates' beds with warmers for a total of 5 head beds altogether.

1. Each bed should have 12 electrical sockets. All sockets including those in the operating theater were to be protected following the NFC 15 – 100. More specifically, the earthing system was to be the IT system.
2. The installation of 2 oxygen sockets per bed and one socket of medical air per bed.
3. The installation of rails on the wall for hanging medical fixtures and equipment.
4. The installation of an air-handling unit comprising recommended levels of air filtration (F5, F6, F9, and absolute filter) including the management of room pressure, temperature, and humidity.
5. The provision of a sluice room.
6. The installation of 2 small drawers on the wall for each bed.
7. The installation of a washbasin with a tap that has a lever mechanism or PIR sensor.

### **LIMITATION OBSERVED IN THE CONSTRUCTION OF THE ICU**

After handing over the recommendations for the construction of the ICU to the hospital's CEO and project coordinator, we were told that the entrepreneur was up to the task and would deliver the goods based on the recommendations.

One month after the kick-off of the project, a site visit was scheduled to understand the level of progress and to validate the implementation of our recommendations. To our greatest dismay, we had the following lapses which were immediately corrected while some other lapses were discovered in the course of using the facility.

1. There was a small number of electrical sockets (4) installed per patient bed contrary to the recommendations.
2. There was no provision for a sluice room. Nurses were asked to move completely out of the zone housing the ICU to empty waste.
3. There was a poor installation of water collectors on the roof. During rainfall, some walls were completely soaked leading to the proliferation of fungal growth.
4. There was poor anchorage of bedside cupboard/drawer on the wall which broke when syringe pumps or patient monitors were placed on them.
5. There was the poor demarcation of sterile zones, hence communication of construction site with the ICU.
6. There was the poor implementation of the oxygen distribution system which lead to frequent ruptures in the oxygen supply to the various services.
7. Contrary to requests, a split-type air conditioner was installed in the ICU.

### **CHALLENGES OR LIMITATIONS TO A SMOOTH TAKE OFF FOR THE CARDIAC CENTER**

While working closely with the partnering clinic, we faced many challenges that could equally delay if not addressed, the smooth take-off of surgical activities. They were:

1. The means of transporting required equipment, medications and consumables from Shisong to Yaounde amid the prevailing crisis. Many truck drivers were reluctant to travel to the area for fear of being killed or seeing their vehicle burned.
2. Regrouping all displaced workers who were to take part in the outreach activity.

3. Compilation of a list of needs (consumables, materials, and equipment) from the various sectors involved in heart surgery.
4. Negotiating and obtaining a balanced MoU between both institutions.
5. Discussion by the Cardiac Center administrator with staff to arrive at an optimum working condition in Yaounde.
6. The main technical coordinator, not being in Shisong, found a lot of difficulties in selecting medical equipment, spare parts, packaging, labelling, and transporting out of the hospital for onward transmission to Yaounde.
7. Establishing a list of medications and surgical consumables based on a predefined list of pathologies to be handled.

**INFRASTRUCTURE AVAILABLE FOR THE OUTREACH ACTIVITY**

1. Bed capacity:
  - ICU = 3 adult and 2 infant beds.
  - Pre-surgical ward = 2 beds.
  - Post-surgical ward = 2 beds.
2. An operating theater.
3. An office for pre-surgical consultation and post-surgical follow up.
4. Due to limited space in the hospital, the room for magnetic resonance imaging was used as an extended storage facility.
5. The point of care was performed in the ICU.
6. The blood bank hosted by the clinic.

**THE CLINIC’S LABORATORY WAS RESPONSIBLE FOR ALL TESTS. LIST OF DIFFERENT PERSONNEL CHOSEN TO TAKE PART IN THE OUTREACH PROGRAM**

Some of the personnel chosen to take part in the outreach program are detailed in Table 5.

**TABLE 5.** Personnel Chosen To Take Part in the Outreach Program

DESIGNATION	NUMBER
Administrator	1
Cardiac surgeon	1

Anesthesiologist	2
Cardiologist	1
Pharmacist	1
Biomedical engineer	1
ICU nurse	6
Perfusionist	2

**LIST OF MEDICAL EQUIPMENT, FIXTURES, AND OTHER APPLIANCES SUCCESSFULLY TRANSFERRED FROM SHISONG TO YAOUNDE**

Table 6 lists some of the equipment taken for the outreach program.

**TABLE 6.** Equipment Taken for the Outreach Program

DESIGNATION	QUANTITY
Syringe pumps	16
Infusion pumps	15
Patient ventilator	3
Multi-parameter patient monitor	9
Anesthetic machine	1
Coagulation analyzer	1
Blood gas analyzer	1
Chemistry analyzer	1
Portable ultrasound machine	2
Defibrillator	2
Surgeon’s headlamp	1
Auto-transfusion machine	1
Heating/cooling machine	1
Air compressor	1
Sternum saw	2
Electrosurgical unit	2
Weighing scale	1
Measuring tape	1
Blood warmer	1
Drug fridge	2
Extracorporeal circulation machine SIII	1
Extracorporeal circulation machine S5	1

DESIGNATION	QUANTITY
Mobile suction machine	4
Infusion stand	6
Drug trolley	4
Electrocardiograph	2
Transesophageal probe	1
Oxygen flow meter	5
Negatoscope	1
Patient's bedside table	3

### TIMELINE OF ACTIVITIES

Table 7 presents a visual timeline of activities leading to relocation or creation of outreach.

**TABLE 7.** Timeline

DATE	ACTIVITIES
October - November 21st, 2016	Anglophone lawyers and teachers began protesting. Gradual transformation of peaceful protest into violent confrontations after this date.
September 20th, - October 14th, 2018	Separatists groups ordered the complete lockdown of both North West and South West region in view of upcoming campaigns for the presidential election, including the day of elections and post-electoral activities.
October - November 7th, 2018	Discussions and underground works between the cardiac surgeon and technical coordinator concerning the possibilities of reviving surgical activities in a safer location.
November 17th, 2018	After sharing our thoughts with the hospital administrator, we performed the first site visit to the health facility which was our first choice.
November 20th, 2018	Sharing of an elaborated report of the visit with the Cardiac Center administration and cardiac surgeon. This report brought forward the state of the partnering healthcare facility, improvements to be made in the facility, how long it would take to upgrade before the kick-off of cardiac surgeries and the list of equipment not available within the healthcare facility but needed to be transported from Shisong. The target is begin surgeries within the second week of January 2019.
November 20th, - December 12th, 2018	Review of upgrading tasks to be accomplished at the Jordan Medical Services, review of the hospital's layout to understand and reorganize work flow. Proposal of a second healthcare facility as second choice. Sharing of idea to relocate with the several partners of the Cardiac Center Shisong including the Cameroon Ministry of Public Health.

December 12th, 2018	Second visit to our first choice partnering institution to see the level of work progress, organized meetings with the contractors responsible for executing the recommendations given the constructing a new ICU block. Equally paid a first and second site visits to a healthcare institution which was our second choice and was equally under renovation and restructuring.
November 2018 - January 2019	Sharing of an idea to relocate with the several partners of the Cardiac Center Shisong including the Cameroon Ministry of Public Health.
December 29th, 2018	Discussions after sharing reports of the last interventions. A decision was taken to collaborate with the Jordan Medical Services. Upgrading work was to last for 5 months.
January - February 2019	Prepared the list of various equipment, accessories, spare parts, and consumables to be transported from Cardiac Center Shisong to Yaounde.
March 2019	Third site visit to the clinic to follow up on the work progress and implementation of recommendations. In the course of the evaluation meeting, there was a change of location for the ICU. A new building was being erected to serve this purpose, more recommendations were given for this ICU block. Commissioning scheduled for mid-May. Preparation of storage space to safely pack all materials and equipment from Shisong. Investigations to understand the best moment to transport materials safely out of the hospital in Shisong.
March 2019	Holding of Technical Committee meeting (hospital's board of directors) to designate management and to elaborate a model/draft of the MoU between both healthcare facilities.
March - April 2019	Dismounting, packaging, and transportation of listed equipment, accessories, spare parts, medical as well as technical consumables, drugs, and surgical materials to Bamenda using an ambulance before onward transmission to Yaounde given that there were more security threats on the stretch of road Kumbo - Bamenda than Bamenda - Yaounde.
Mid - April 2019	After grouping close to 95% of the materials in Bamenda, we organized and transported them to the clinic in Yaounde. Received them in Yaounde and packed in the already previewed storage space.
April 27th, - May 8th, 2019	Commissioning of the new ICU and upgraded operating theater amid some adjustments and finishing touches to be made. Reception of remaining materials required to complete the list of items used to perform cardio-surgical activities. Unpacking, assembling, cleaning and testing of all equipment before sending them to their various locations.
May 18th, - June 6th, 2019	Signing of an MoU and the kick-off of first surgical mission with a total of 9 patients with cardiomyopathies operated upon.

## RECOMMENDATIONS

1. Diversification of production units is of key importance. This means that for a given healthcare institution performing open-heart surgeries, it won't be good to concentrate all investments in one city or town. They should divide the investment and implant of another healthcare unit in another town. Also recommended in bilingual countries like Cameroon or countries with 2 distinct groups of people or races, not locating both structures in the towns belonging to the same group of people or race.
2. When the relocating health facility is discussing with the partnering hospital, it will be good to take part in sharing the cost of renovation or upgrading work if any. This is because the partnering hospital may not have enough funds to put in place all the facilities necessary to carry out safe surgical interventions according to international standards or may simply be ignorant about international standards and by so doing not see the need to invest and implement all recommendations. To this effect, the relocating hospital once made aware of the importance of having all recommendations implemented, may decide to assist financially and later include in the MoU the terms to recover the investment.
3. The neutrality of the hospital trying to relocate must be made known to all conflicting parties or the different groups of activists engaged in the war. This neutral position is very important to the safety of materials when transporting them out of the war zone.
4. Before organizing any transport activity in the war zone, a good investigation must be carried out to understand the safest periods. This is to avoid being caught up in a cross fire during transportation leading to death or destruction of goods.
5. The implementation of the heads all of units involved in heart surgery for instance will go a long way to avoid forgetting important materials needed during the process knowing that transportation within the crisis hit zone becomes risky.
6. While planning and organizing the workflow in a chosen healthcare facility, emphasis must equally be paid on the reduction to near zero the transmission of nosocomial infections. This is because, a surgical procedure can be performed perfectly with the required instruments, equipment, and consumables, but because attention was not paid to the sterility of instruments and air, the patient, later on, develops severe complications or bacterial infections. This situation may couple with the patient's long stay in the ICU to produce bed sores aggravating the condition and even leading to death.
7. For those who want to relocate to a city where stable electrical supply is still a farfetched reality, care must be taken so that uninterruptible power supplies are installed, stand-by electricity generators installed, and a proper grounding system implemented.
8. The availability of enough medical oxygen for continuous activities is also very important knowing that the life of a cardiac patient in the operating theater and ICU depends primarily on it.
9. When both institutions meet to discuss the model of partnership, it is advisable to strive at maintaining autonomy in management. That is, personnel management, medical supplies, and billing must remain under the control and supervision of the visiting hospital or relocated healthcare institution.
10. For none profit-making healthcare institutions, a frank and sincere discussion should be held with all potential benefactors including the government for possible sponsorship. This assistance can go a long way to even acquire new or refurbished machines which cannot be easily displaced from the crisis-hit zone like an angiograph or computed tomography scanner. These are vital and supportive equipment used for pre-surgical diagnosis of the coronaries for instance, (in most aging patients above 45 years or younger patients presenting a higher risk factor of having coronary stenosis). Also, the angiograph can also be used in correcting some cardiopathies within the scope of minimally invasive procedures. If these discussions held before starting upgrading or renovating works, the problem of limited space can be handled by transforming the operating theater into a hybrid operating room.

## RESULTS

A glance through the results obtained after the creation of the outreach program may not be very encouraging vis-à-vis our capacity, but for those patients who survived through the period during which we were inactive, it is a success (Table 8). Irrespective of the several limitations encountered along the line with the construction of an ICU

within a short time, the threats to burn down equipment and consumables during their transportation out of the crisis-hit zone, we were able to perform successful open surgeries. The creating of this outreach program has given hope to some Cameroonians and beyond for a better life and health condition.

**TABLE 8.** Achievement Over 10 Months

SURGICAL MISSIONS	PERIODS	NUMBER OF SURGERIES
First surgical mission	May 18th – June 2nd 2019	9
Second surgical mission	July 16th – 28th 2019	8
Third surgical mission	September 23rd – October 8th 2019	8
Fourth surgical mission	November 12th – 18th 2019	5
Fifth surgical mission	December 6th – 15th 2019	7
Sixth surgical mission	January 17th – February 4th 2020	7
<b>TOTAL</b>		<b>44</b>



**FIGURE 3 & 4.** Staff at work in the ICU.



**FIGURE 1 & 2.** The staff at work in the operating theater during open-heart surgery.



## DISCUSSION

After the kick-off of surgical activities, notwithstanding the successes recorded, the Technical Department continued working hand-in-glove with the different sectors involved trying to know their level of satisfaction. We also sought to know those areas which needed improvement either by adding equipment to ameliorate working conditions or speeding up patients' recovery. In this line we were able to change the noisier and space-consuming mobile vacuum/suction pumps to a miniature less noisy, wall-mounted vacuum regulator using compressed air to generate a negative pressure (Venturi effect). Although while implementing this solution we created another problem (that of increase in the demand of compressed air), we have been working on possible fundraising to purchase a bigger air compressor to cover the entire needs during surgical missions.

The absence of an air-handling unit in both the operating theater and ICU has been one of our major setbacks in patient recovery and infection control. To that effect, while seeking funds to handle this issue, we intensified the use of an antiseptic spray for in-depth sterilization and antiseptic solution for cleaning of surfaces.

### **CONCLUSION**

The prompt and speedy recovery of patients after heart surgery are the driving forces that keep energizing medical and paramedical personnel to continue working harder to attain better results. These driving forces are also responsible for the quest to brainstorm and come up with lasting solutions which when implemented per international standards would step up the level of healthcare offered in the outreach setting. Mindful of the fact that the term outreach here does not mean working at the minimum level prescribed by standards, we are determined to put more efforts such that surgeries shall be performed under safer conditions and that the right health technologies are utilized. The hospital administration is working closely

with some benefactors who have opted to offer some equipment in a bit to meet up with the standard working conditions and patients' safety.

We are also determined to work closely with all parties concerned if asked to do so, towards the resolution of the pending conflict which has dispersed a majority of patients who were already living in a precarious situation before the escalation of peaceful protest into armed conflict.

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