Initial submission

Gaps in Surgical Competencies of General Surgeons Deployed on Humanitarian Missions in Disaster Settings

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Abstract

Introduction:

As the access to surgery differs geographically, its disparity is even more pronounced in disaster settings. With the increasing interest of surgeons from high income countries (HIC) to respond to these surgical disparities, non-governmental organizations (NGOs) often send teams of health practitioners to provide healthcare aid to the most unstable regions of the world. However, surgeons participating in these missions rarely get the medical training necessary to face the large scope of procedures they can encounter in humanitarian settings. This research aims to create a framework of the necessary skills needed for surgeons to provide proper surgical care in disaster settings.

Methodology:

This is a descriptive qualitative study to outline the differences between the surgical procedures general surgeons in HICs are being trained on during their surgical training with the surgical procedures required in disaster settings. After identifying the main surgical procedures general surgeons are expected to be trained on before their deployment to a disaster setting in an LMICs, a survey was sent to participants to assess their competency level in these procedures and the likelihood of them performing these procedures in their home country compared to on the mission.

Results:

Participants indicated the high frequency of performing several surgical procedures from different surgical specialties on humanitarian missions. The most common of these procedures are cesarean section, fracture reduction, skeletal retraction, wound debridement, burn dressing, application of skin and graft, and performing emergency laparotomies. However, only wound debridement and emergency laparotomy were performed more than 10-20 times/ year by the participants in their daily practice in the past 5 years. The rest of the procedures in this list were never performed by the participants in their daily practice. Obstetrical and orthopedic procedures are from the most common procedures a general surgeon must perform when deployed on a mission in a disaster setting. However, they are rarely, if ever, performed by the surgeons in their daily practice.

Looking at the requirements to complete general surgery training in most HICs, it is clear that the focus has shifted to training in advanced procedures and away from surgical training in other specialty procedures such as obstetrics, plastic surgery, orthopedic and neurosurgery.

Discussion:

This study proves the perception that there is a gap in training of surgeons who engage in health missions abroad compared to the scope of practice expected of them during these missions. This gap is more present in subspecialties such as obstetrics, orthopedics, urology, and neurosurgery. This shows the importance of surgeons who participate in these missions to have a broad-based training that includes the most encountered surgical procedures in disaster settings. Acquiring skills in these life-saving procedures before being deployed on a surgical mission will improve the mortality and morbidity outcomes of these missions and create an ethical space where surgeons from high-income countries only perform procedures they have been adequately trained on.

Introduction and statement of purpose

Background to the study:

At least 4.8 billion people do not have access to surgery worldwide [1]. As the access to surgery differs geographically, its disparity is even more pronounced in disaster and emergency settings [2]. With the increasing interest of surgeons from high-income countries (HICs) to respond to these surgical disparities [3], universities, governments, and non-governmental organizations (NGOs) are sending teams of health practitioners, on short notice, to provide vital medical and healthcare aid to some of the most remote and unstable regions of the world. However, surgeons participating in these missions rarely get the clinical training necessary to prepare them for the large scope of practice they can encounter in disaster settings [4]. Therefore, establishing a framework of the necessary skills surgeons need to master before participating in a surgical mission has become a pressing issue.

Literature review: scoping review

A search of five electronic databases; Medline & Embase (via Ovid), Cochrane Library, Web of Science, and MEDLINE, was made in February 2020 for all relevant articles published from February 2010 to February 2020. The search strategy included the terms "surgeons", "neurosurgeons", "orthopedic surgeons", "obstetricians", "physicians" along with the terms "disaster", "hurricane", "flood", "earthquake", "typhoon", "mass casualty", "tornado", "wildfire" and the terms, "capacity building", "clinical competence", "skills". The terms were combined using "AND" or "OR" and the search was in all languages. The full search strategy can be found in *Appendix* A.

Titles of 145 articles were found in the literature search and screened using title and abstract. After the initial screening of the abstracts, 14 full-text articles were assessed. Of these, 9 were relevant to this research and used in the literature search. The grey articles used were 15 articles. Articles included were those studying the scope of surgical procedures performed by surgeons in disaster settings, or those comparing the surgical skills needed in fragile settings compared to stable and relatively stable settings. Studies on clinical competencies needed in emergency medicine in HICs were excluded as well as those focussing on the clinical skills of nurses, emergency doctors, and general practitioners.

There was a consensus in the article that general surgery, orthopedic and obstetrics care played the most vital role in humanitarian settings[5-7]. While having teams based on these three specialties is the recommendation for ideal humanitarian response, it is not always feasible. Articles reported that not all surgical missions to humanitarian settings have general surgeons, and only a few have obstetricians or orthopedic surgeons[8]. In the absence of an orthopedic surgeon and an obstetrician, the burden of their common and life-saving procedures falls on the general surgeon[3].

However, general surgeons face many challenges that make it harder for them to cover such a wide scope of procedures. The main challenge surgeons from HICs face is that surgical training is becoming very sub-specialized[9,10]. A comparative analysis of American surgical residents and humanitarian case logbooks showed that only half of the surgical procedures performed by surgical residents in the United States of America (USA) are applicable and relevant in humanitarian settings[9]. While general

surgery residents from American College of Graduate Medical Education (ACGME) spend more than half of their training performing advanced surgical procedures, less than 2% and 1% of the cases they perform are related to orthopedic and obstetrics respectively. Cesarean sections constitute 30% of the surgical procedures performed by organizations such as Doctors Without Borders (MSF), but the average graduating surgical resident in the USA reported not performing any during their surgical training[9]. An additional obstacle to the care delivery expected of surgeons from HICs in humanitarian settings is their use of advanced equipment for treatment and diagnosis in surgical care in their daily practice. This can make it harder for them to perform surgery in LMICs where this equipment is not available. Moreover, trauma surgeons from HICs do not have the same exposure to trauma cases compared to LMICs. A recent study concluded that it would take a trauma surgeon from Japan 124 years to obtain a trauma exposure equivalent to that in South Africa in penetrating wounds, and 252 years to obtain the same exposure in gunshot wounds. Operative procedures such as neck exploration, laparotomy, wound debridement and vascular exploration, would require over 17 additional years of training to acquire adequate exposure and experience[11].

Differences in pathologies of the conditions were also reported. For example, abdominal trauma in HICs is blunt 80% of the time. It is caused by road traffic accidents mostly and can be managed non-operatively. On the contrary, abdominal trauma in LMICs is mostly penetrating and seldom requires surgery[12]. Management of amputations and the rationale behind the decision making of this procedure is also different between daily practice in HICs and natural disasters or war settings[13].

Studies in LMICs have shown the preparedness of surgeons from some countries to perform a wide range of procedures in humanitarian settings. This preparedness was attributed to their training in both general surgery and non-general surgery procedures either during residency training or during community service internship that is mandatory in some countries before surgical residency. Their familiarity to work in rural areas or centers not necessarily equipped with the latest diagnostic tests and equipment has also strengthened their readiness to work in disaster settings[12]. This preparedness was not comparable in all LMICs. While surgeons from LMICs face a variety of surgical cases in their daily practice, they might not be able to work efficiently in case of a disaster that further overloads their health system and overwhelms their staff[14]. Even though exposure to a wide range of surgical procedures can differ between HICs and LMICs, there was a consensus in the articles that further surgical training, hospital preparedness, and improving trauma systems is a necessity to improve disaster management worldwide[14].

In efforts to reduce this gap and increase preparedness, some articles aimed to identify the most common surgical procedures in disaster settings. Most of the procedures were trauma-related and were performed on soft tissue and bone in the extremities. Studies showed that procedures such as neck exploration, fasciotomy, wound debridement, maxillofacial fixation, and thoracotomy were highly prevalent in military missions[11]. In humanitarian settings, the procedures that were the most prevalent in obstetrics and gynecology were episiotomy, dilation, and curettage, removal of ectopic pregnancy, cesarean section, and hysterectomy[12]. Common orthopedics procedures include fracture reduction, limb amputation, fasciotomy, and external fixation of fracture and crush injuries[15]. Urology procedures include suprapubic bladder catheterization and bladder repair[12]. Finally, the most common general surgery procedures were abscess drainage, wound debridement, chest tube insertion, burns dressing, skin graft, emergency laparotomy, repair or resection of bowel, liver, spleen, and kidney[12].

To address the disparities and gap in clinical competencies, organizations and universities have organized focused training courses for surgeons preparing for humanitarian missions. From cadaver-based courses to wet lab simulation and skills courses, there is conflicting data on the effectiveness of these training and the competencies they provide[16,17]. These courses are not mandatory and seldom not enough to fully prepare the surgeons from HIC to the wide scope of practices they will encounter. Guides on core humanitarian skills exist to help NGOs ensure the employees they deport to humanitarian settings have an adequate understanding of humanitarian contexts and application of humanitarian response[6]. Nonetheless, no unified framework still exists to guide the clinical preparedness of the surgeons they deploy to meet the broad demands made of them.

With the current unstable global situation, all countries, LMICs or HICs, are at increased risk to threats such as war, urban terrorism, natural disasters among others that will possibly create a burden the trauma systems cannot handle. With these threats comes the pressing need to train surgeons to efficiently manage an unexpected demand for trauma care.

Research question

What are the gaps in clinical competencies of general surgeons from high-income-countries participating in a surgical mission in low-and-middle-income countries in the setting of a natural disaster or armed conflict?

Hypothesis

There is an existing gap in surgical training of general surgeons from HICs when it comes to the clinical competencies required of them in humanitarian response in a disaster setting in an LMIC.

Aims and objectives

Aims

The purpose of this research is to identify the gaps in the training of general surgeons who are deployed to disaster and emergency settings. Identifying the gaps will help in the creation of a framework of the main surgical procedures a general surgeon must know before being deployed to a disaster setting.

Objectives

The objective of this study is to outline the differences between the procedures general surgeons in HICs are being trained on during their surgical training with the surgical procedures required in disaster settings.

This will be realized by:

1. Identifying the most common surgical procedures in disaster settings in LMICs
2. Describing the level of competency surgeons from HICs have regarding these procedures.

Methodology

Study design

This is a descriptive qualitative study to outline the differences between the surgical procedures general surgeons in HICs are being trained on during their surgical training with the surgical procedures required in disaster settings. After identifying the main surgical procedures general surgeons are expected to be trained on before their deployment to a disaster setting in an LMICs, a survey was sent to participants to assess their competency level in these procedures and the likelihood of them performing these procedures in their home country compared to on the mission.

Data extraction

A list of potential participants was extracted from the database of the Emergency Response Unit (ERU) of the Canadian Red Cross (CRC). This database is used to recruit surgeons for future missions. Data extracted was; names of surgeons deployed in the past 10 years, their medical training background, the number of missions they participated in, information about their mission such as; destination country, date and duration of the mission, and type of disasters they were deployed to. A letter of agreement from the CRC to access their database can be found in *Appendix 3.* Other potential organizations such as Doctors Without Borders (MSF) and other ERUs were also contacted to extract the list of potential participants from their databases as well. The potential participants from these databases were contacted for recruitment purposes by the roster managers only. The researchers did not have access to the names of the surgeons affiliated to these organizations.

Sampling strategy

The target population of this study is the surgeons who have been on a humanitarian mission. The estimated sample size for this study was 20 surgeons from the databases of the CRC and other ERUs as individuals who are known to participate in international missions.

Inclusion and Exclusion Criteria

Inclusion criteria are surgeons who have been deployed by the CRC and potentially other organizations to a fragile setting in the past 10 years. A fragile setting being a state of armed conflict or a natural disaster

such as an earthquake, typhoon, and flood. The surgeons should be general surgeons who participated in at least one mission of duration of more than two weeks. The general surgeons can be from a HIC or an LMIC. Exclusion criteria are any healthcare personnel who is not a general surgeon, general surgeons who have not been deployed to a surgical mission in a fragile setting in LMICs, as well as participants who refuse to participate in this study.

Recruitment

After receiving ethics Institutional Review Board approval from the Research Ethics Board at McGill University, the roster managers of the organizations participating in this study sent an email to the surgeons in their database, providing them with an introduction to the research as well as a link a survey to complete if they consent to participate in the research. Ethics approval can be found in *Appendix 4*. The online survey was done using an online survey tool (SurveyMonkey, Inc, Palo Alto, CA). Participants who agree to participate in the study had access to the link directly. The survey includes a section with a consent form that needs to be signed before completing the questionnaire. The roster managers did not receive access to the names of who answered the survey and who did not. That information is only accessible by the investigator. A total of three months was given to participants to fill out the survey. The response rate was predicted to be 60%, therefore, making the approximate sample size 12.

Informed consent and consent withdrawal

Participation in this study was completely voluntary and took consideration of the well-being, free-will, and respect of the participants, including respect for privacy. The informed consent form is shown in *Appendix 2*. It contains information and assurances that allow individuals to understand the implications of their participation and to reach a fully informed and freely given decision about whether to do so, without the exercise of any pressure or coercion. Participants had the opportunity to withdraw from the study if they did not feel comfortable sharing their experience during the missions they were deployed to. Participants could also withdraw from the study at any time, for any reason.

Data collection

Data was collected through the online survey. The first objective of the survey is to understand the demographics of surgeons participating in missions including their surgical specialty, country of citizenship, location of primary practice, different disasters they were deployed to, whether they were deployed once or more, and organization to which they are affiliated. The second objective focuses on clinical competencies and medical skills. A list of common trauma procedures was given to the participants to further specify their level of comfort as well as the likelihood of them performing these procedures in their daily practice compared to disaster settings. The list of the common procedures was adapted from studies that aimed to identify the procedures expected to be part of the skill set of any frontline surgeon in a humanitarian response according to surgeons with previous experience in humanitarian work[3]. For feasibility purposes, the list was then shortened by trauma surgeons with

extensive experience in disaster settings. The level of comfort in each procedure is rated according to the knowledge of the operation steps only, using the global rating of technical skills in surgery[18]. The third objective of the survey is to identify the most common barriers surgeons might face on their missions that can negatively impact the quality of their services, such as logistic, cultural, and linguistic barriers. The survey can be completed only once. Its duration is approximately 20-30 minutes. The key informal interview guide can be found in *Appendix 1*.

Data analysis

A descriptive qualitative design was used to estimate the frequency of performing each common surgical procedure in disaster settings in LMICs and in daily practice in HICs. The distribution of surgeons participating in this study was described in terms of their gender, organization they are affiliated to, where they trained, their level of training, the type and duration of missions they participated in and the type of training they received before their deployment. The frequency of encountering the most common surgical procedures in disaster settings was also described based on surgical specialty. The procedures in which the surgeons were least experienced were highlighted. The frequency distribution of these variables was depicted using central tendency and bar charts.

Data storage

The data is stored in the CRC health research database. CRC uses Microsoft web-based server supported by Citrix corp. The server requires specialized permission through Redcross email and password to log in, which is granted only to people working in the system. CRCs data security system is updated regularly and is compliant with Canadian standards and guidelines for data security. The server is also used by other Red Cross and Red Crescent movement societies; therefore, data transfer is easy and secure through this network. Additionally, access to health research data is limited to certain personnel only, who are working on program monitoring and evaluation and research projects**.** The main researcher has the responsibility of maintaining confidential participant demographics as well as the questionnaire responses. Participant information will remain confidential and access to the dataset will be reserved for the research team and CRC Global Health Unit research managers.

Data dissemination

Data will be used for this research only. It will be stored for 10 years then will be deleted permanently. Data will be used to create an article for publication and the master's thesis project.

Risk of the study

There are no anticipated physical risks to the participants by entering in this research. Study participants were not subjected to harm in any way and respect for their dignity was prioritized throughout the entire period of the study. Participants could have been subjected to psychological discomfort due to the personal nature of the topics addressed by the questionnaire. Therefore, the content of the survey and interview was created to be only related to the clinical experience of the surgeons. The participants were only asked questions that can further help in the understanding of the clinical capacities implicated in a disaster setting.

Timeline

A predicted timeline for the development of the study is shown in *Appendix 5*. This research will proceed to fulfill partial requirements for a master's degree and thus its predicted chronology is subject to adjustments due to intrinsic academic factors as well as any local unpredictable occurrences during implementation.

Results

Demographics

Of the 12 participants that clicked on the survey, 8 of them completed the survey completely, and 10 completed the survey partially.

The participants completed their surgical training in either Canada, the United Kingdom, India, Brazil, or Germany making those trained in HICs 80% and LMICs 20%. The average years of practice were 22.2. Only 2 of the participants completed a fellowship, one in trauma surgery and the other in vascular surgery.

Half of the participants were affiliated to either the International Committee of the Red Cross or Red crescent or the Canadian Red Cross and 70% of the participants were affiliated with Doctors Without Borders. The number of missions the participants were deployed to range from 1 mission to 10 missions in the past 10 years in contexts that varied from earthquake to war conflict and famine.

Less than half of the participants had training on cadavers before their deployment and less than 20% had wet laboratory training or surgical simulations. Of those, 100% said that wet simulation training and

surgical simulations were “somewhat beneficial to their mission”, and 50% said that cadaver training was “very beneficial to their mission”.

Subspecialty training

Obstetrics

All the responders indicated that there were no obstetricians on their surgical team during their deployment.

In obstetrics, participants were asked questions that will assess their level of comfort as well as their likelihood of performing procedures such hysterectomy, complicated vaginal delivery, episiotomy, cesarean section, dilation and curettage and removal of ectopic pregnancy, in their daily practice and on the missions they have been deployed to.

Only 2 participants performed cesarean section more than 20 times /year in their daily practice, of those, one trained in India. More than 60% of the participants answered “never” performing cesarean sections in their daily practice in the past 5 years. However, 80% of the participants mentioned performing this procedure “very frequently” on their missions.

Complicated vaginal delivery was considered by more than 30% of the participants as a common procedure in disaster settings. However, none of those who felt completely comfortable performing this procedure attributed their skills completely on their surgical training. Additionally, complicated vaginal delivery was considered different in disaster settings compared to the daily practice of all the participants.

More data on the frequency of performing the common obstetrics surgical procedures in the participants' daily practice and on their missions can be found in table 1.1 and table 1.2 respectively.

The familiarity of the general surgeons of these procedures can be found in table 1.3, the similarity of these procedures between the daily practice of the surgeons and the missions can be found in table 1.4. Participants who indicated having full knowledge in all the steps of the surgical procedure were asked to indicate where they received this knowledge, answers can be found in table 1.5.

Table 1.1

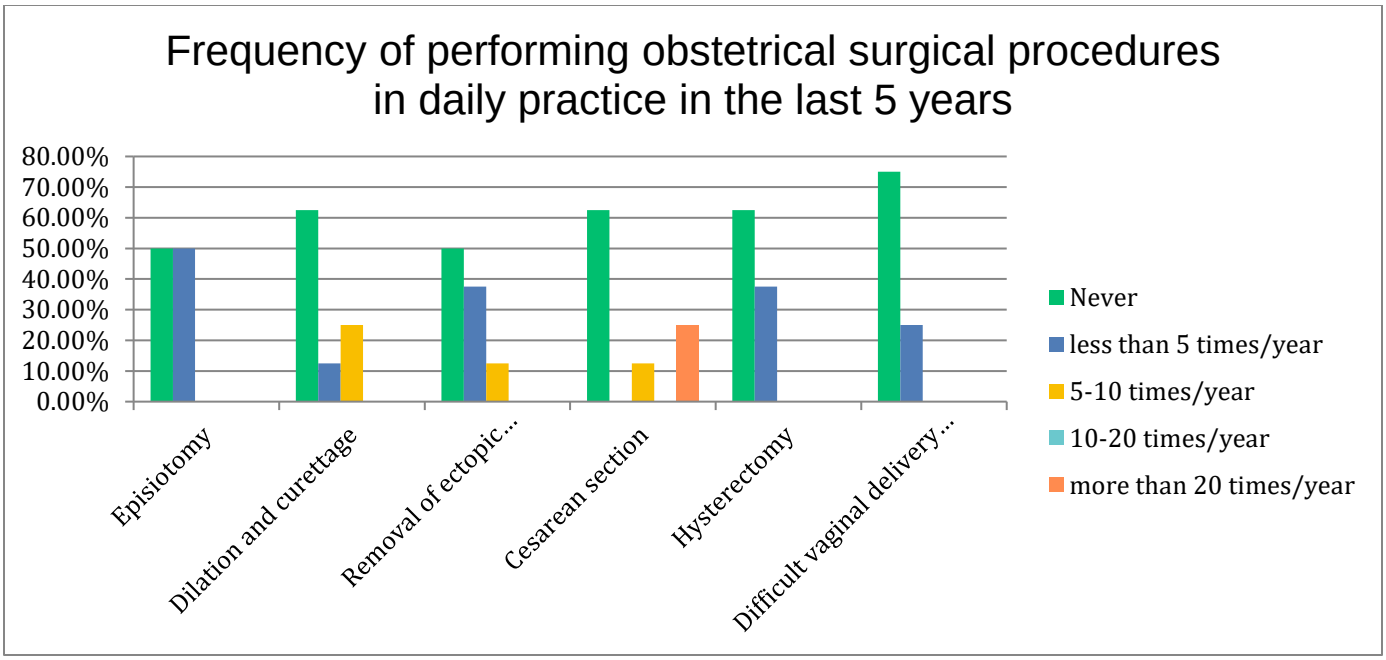
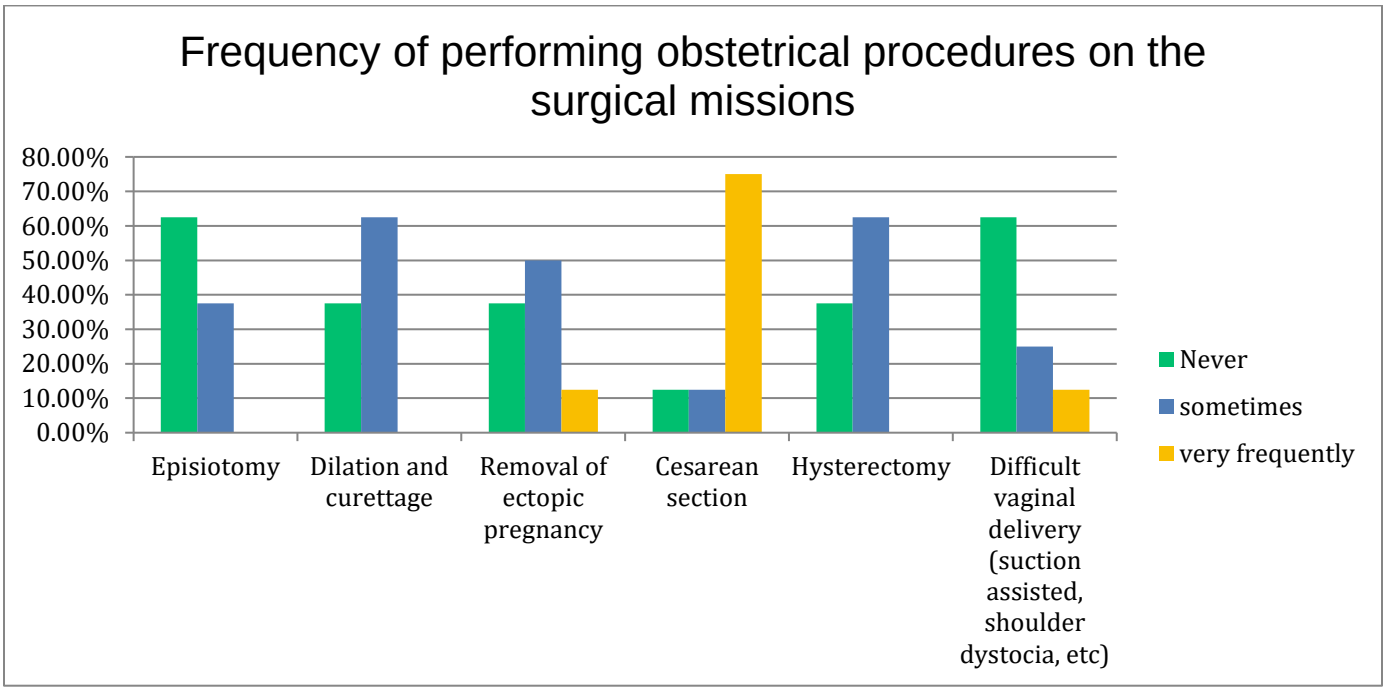


Table 1.2



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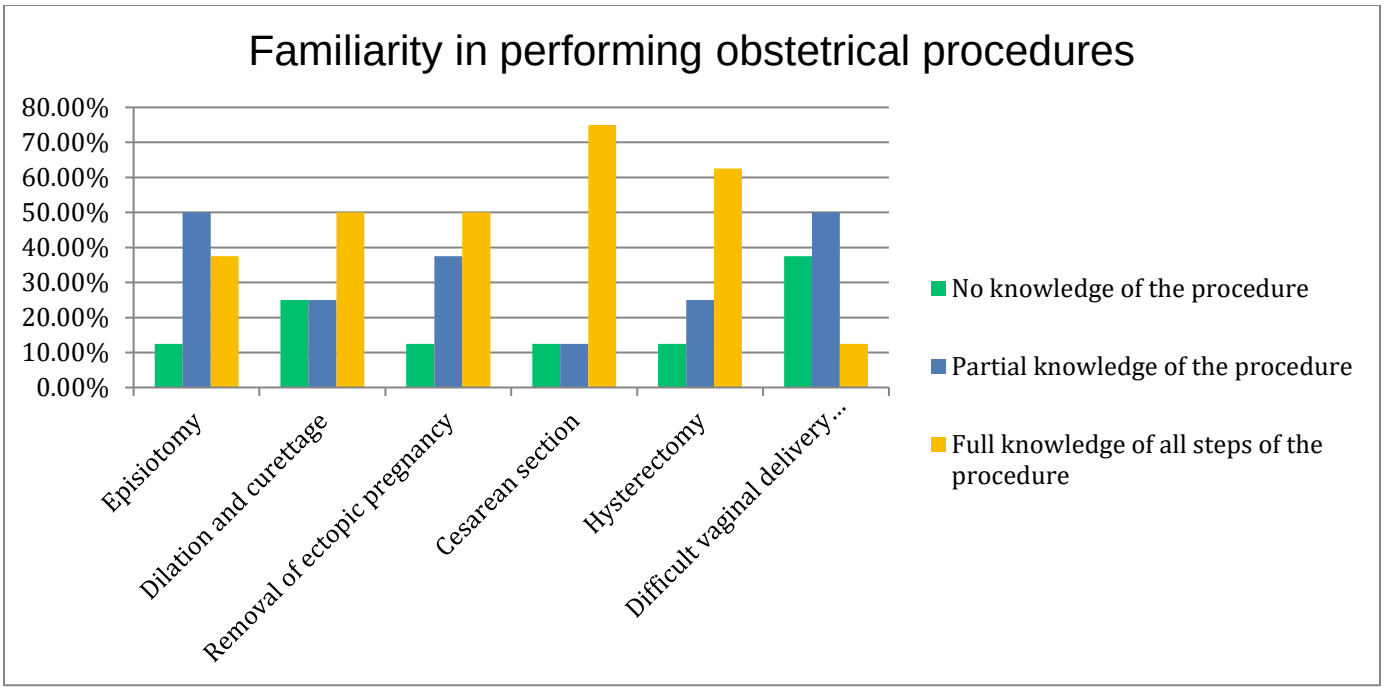

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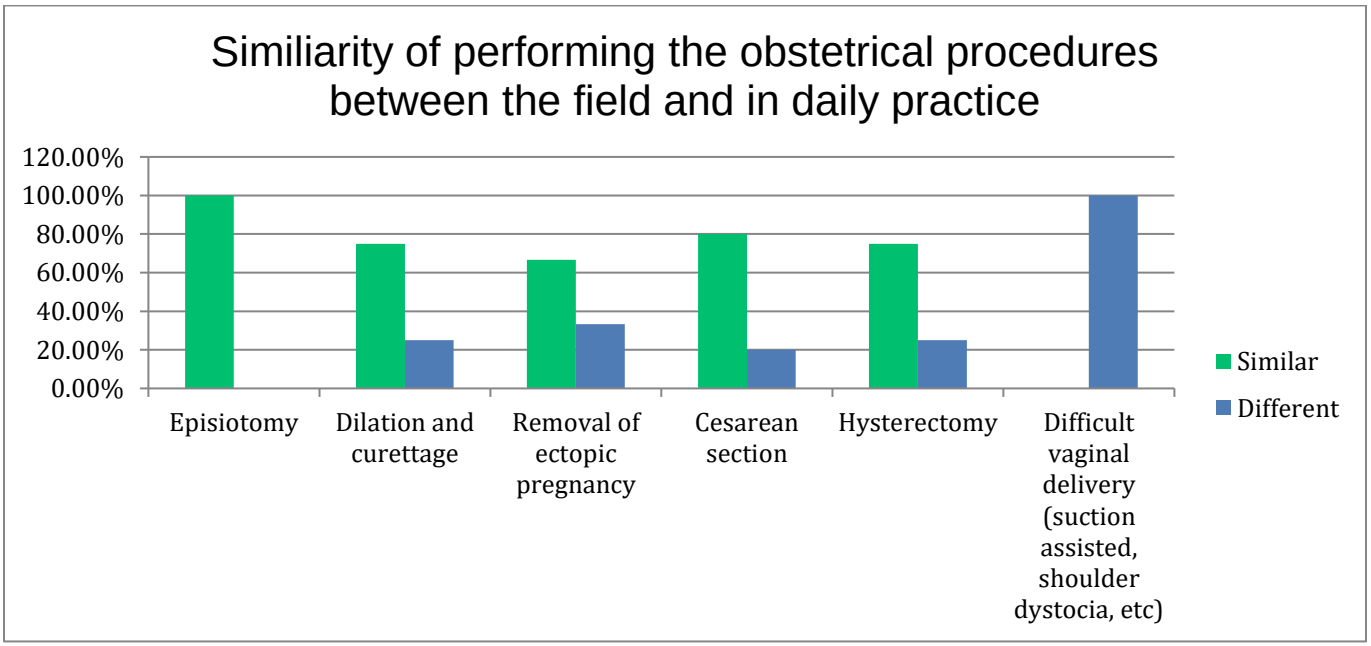

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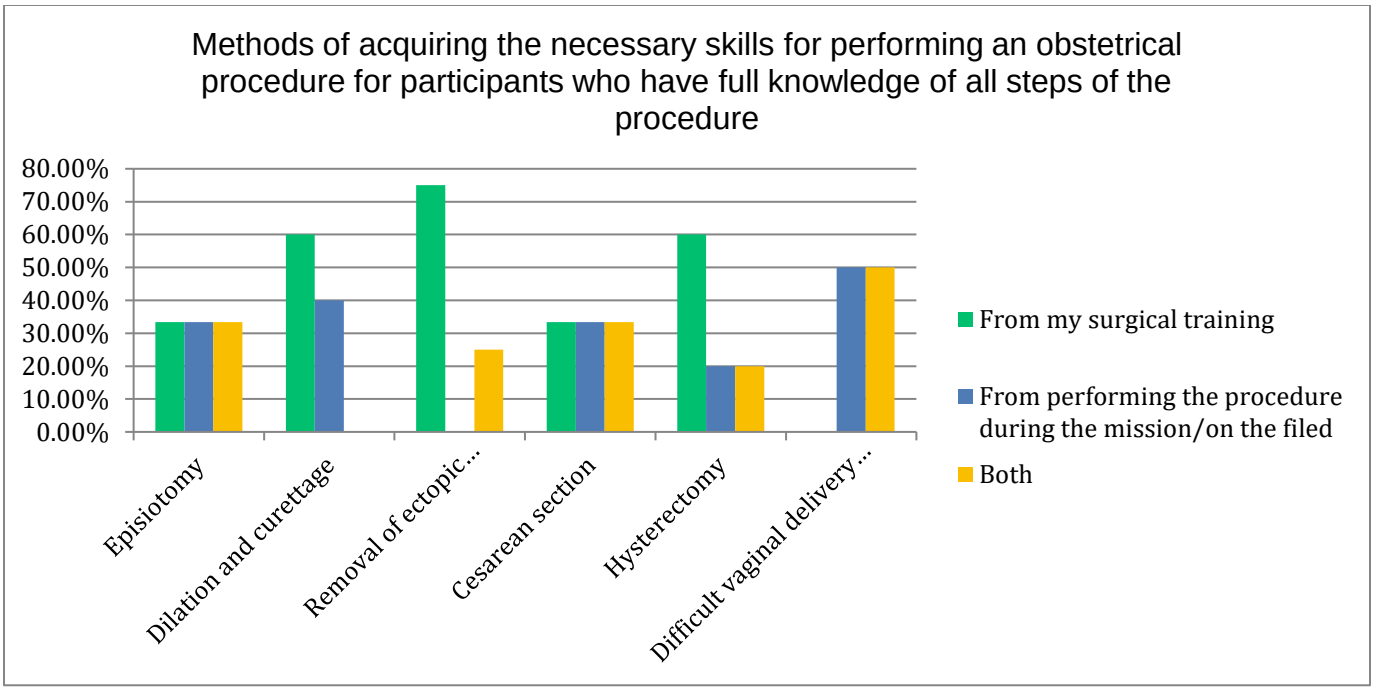


Orthopedic surgery

Of the 8 participants that completed the orthopedic section, one mentioned having an orthopedic surgeon on the surgical team during the missions and another participant mentioned their occasional presence, especially in recent years.

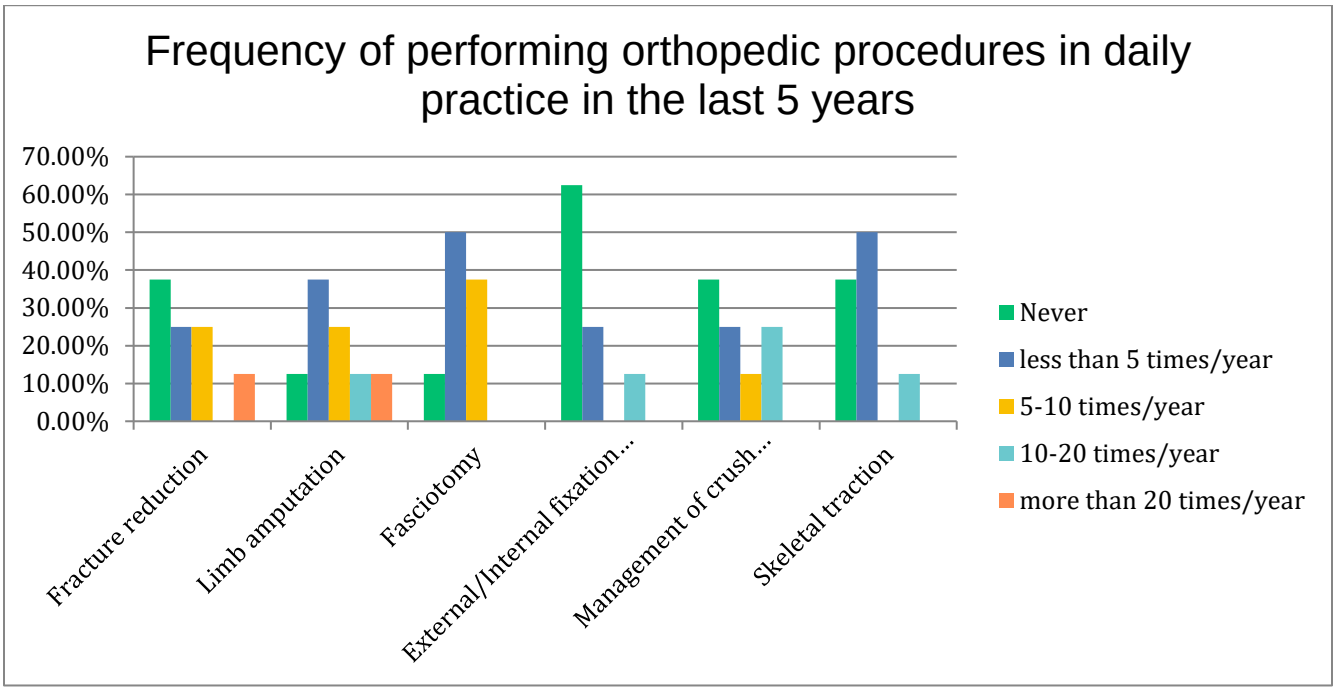
In this section, participants were asked questions on procedures such as fracture reduction, limb amputation, external/internal fixation, fasciotomy, management of crush injuries, and skeletal traction.

Among these orthopedic procedures, fracture reduction, skeletal retraction, and limb amputation were considered common in disaster settings. However, almost 40% of the participants never performed fracture reductions or skeletal retraction in the last 5 years of their practice. Only one participant performed limb amputation regularly in their daily practice. This participant is a general surgeon who trained in Brazil and has a fellowship in vascular surgery.
Despite skeletal reduction being a very frequent procedure in a disaster setting, less than 40% of the participants indicated having full knowledge with all the steps of the procedure.
Fracture reduction was considered by 60% of the participants to be different between disaster settings and their normal practice.

Data on the frequency of performing the common orthopedic surgical procedures in the participants' daily practice and on their missions can be found in table 2.1 and table 2.2 respectively.

The familiarity of the general surgeons of these procedures can be found in table 2.3, the similarity of these procedures between the surgeon's daily practice and in missions can be found in table 2.4. Participants who indicated having full knowledge in all the steps of the surgical procedure were asked to indicate where they acquired their knowledge, answers can be found in table 2.5.

Table 2.1



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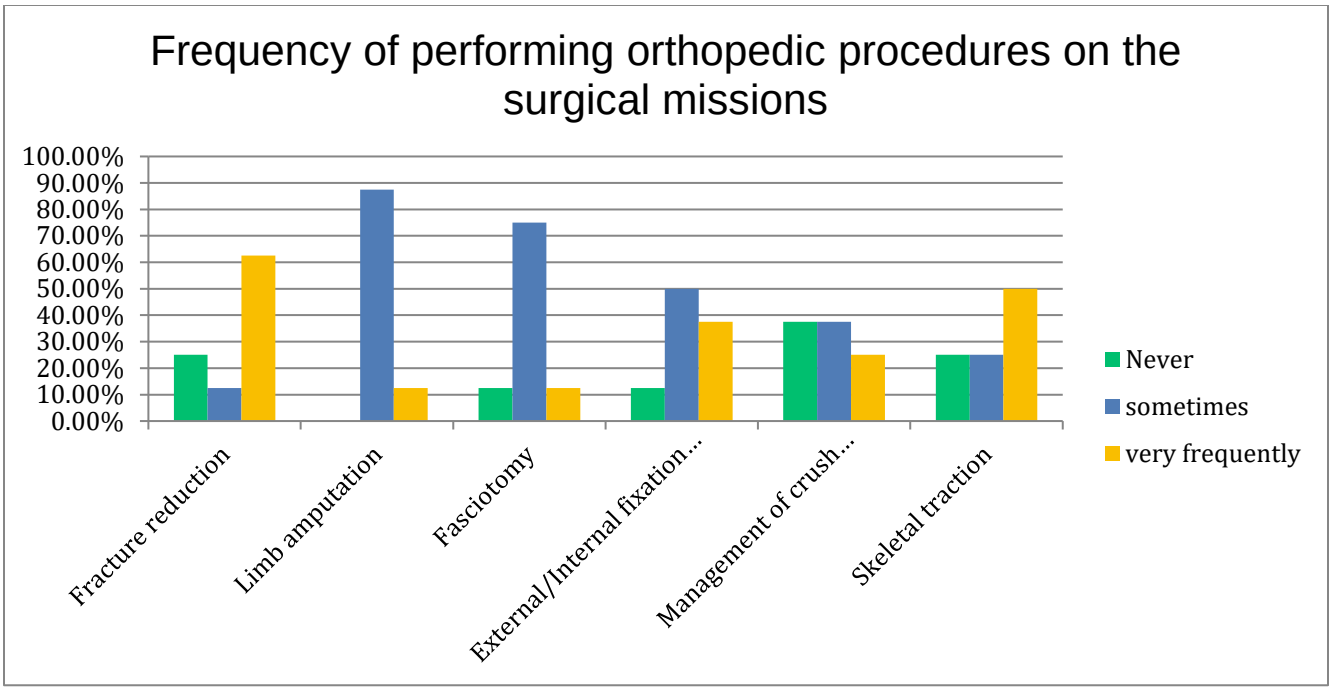

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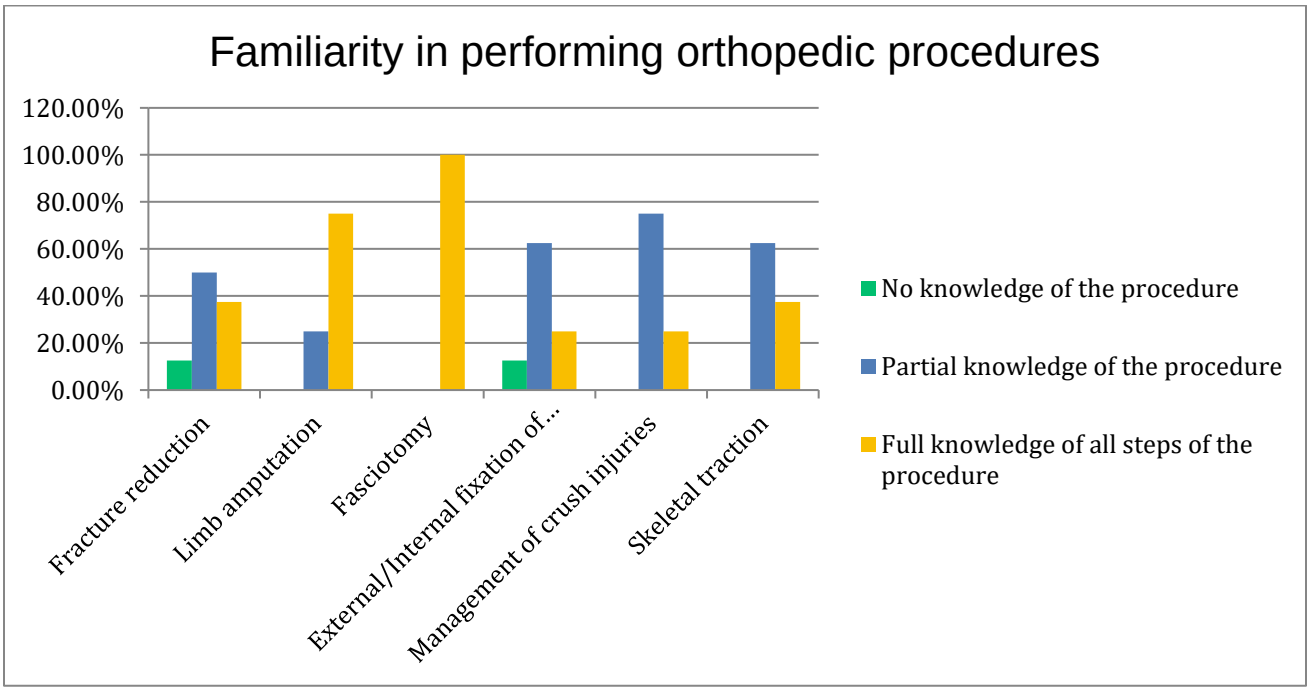

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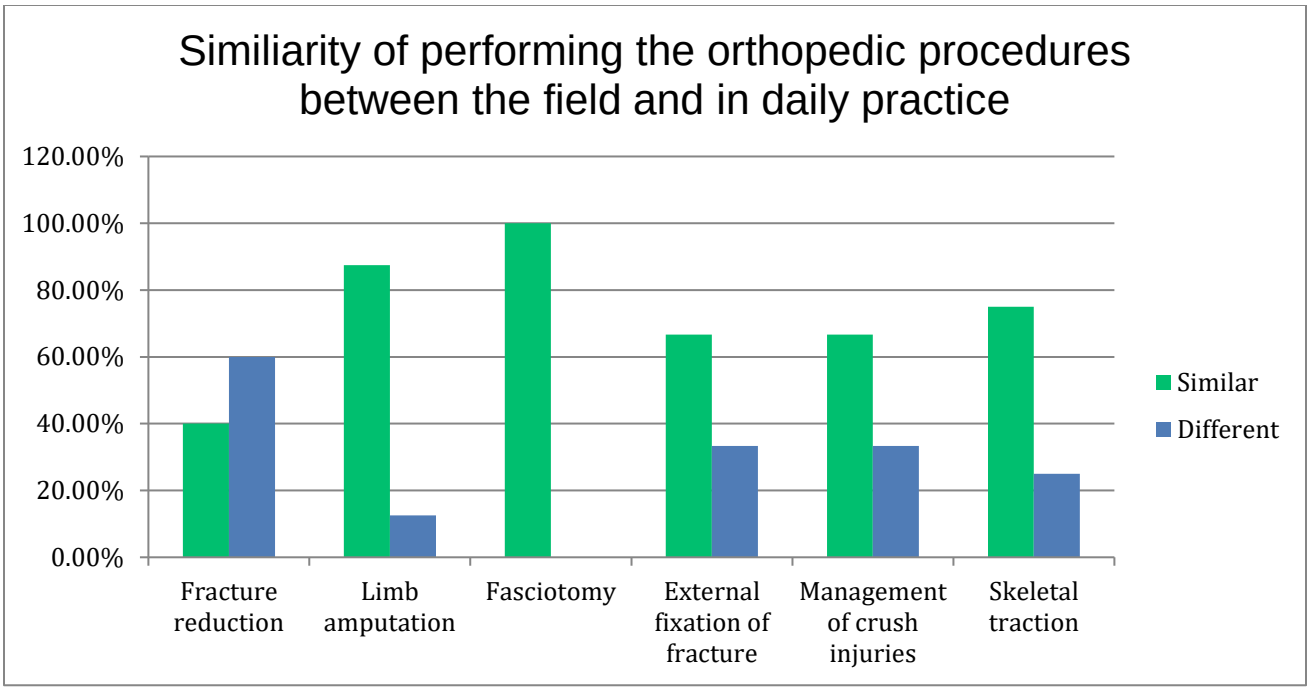
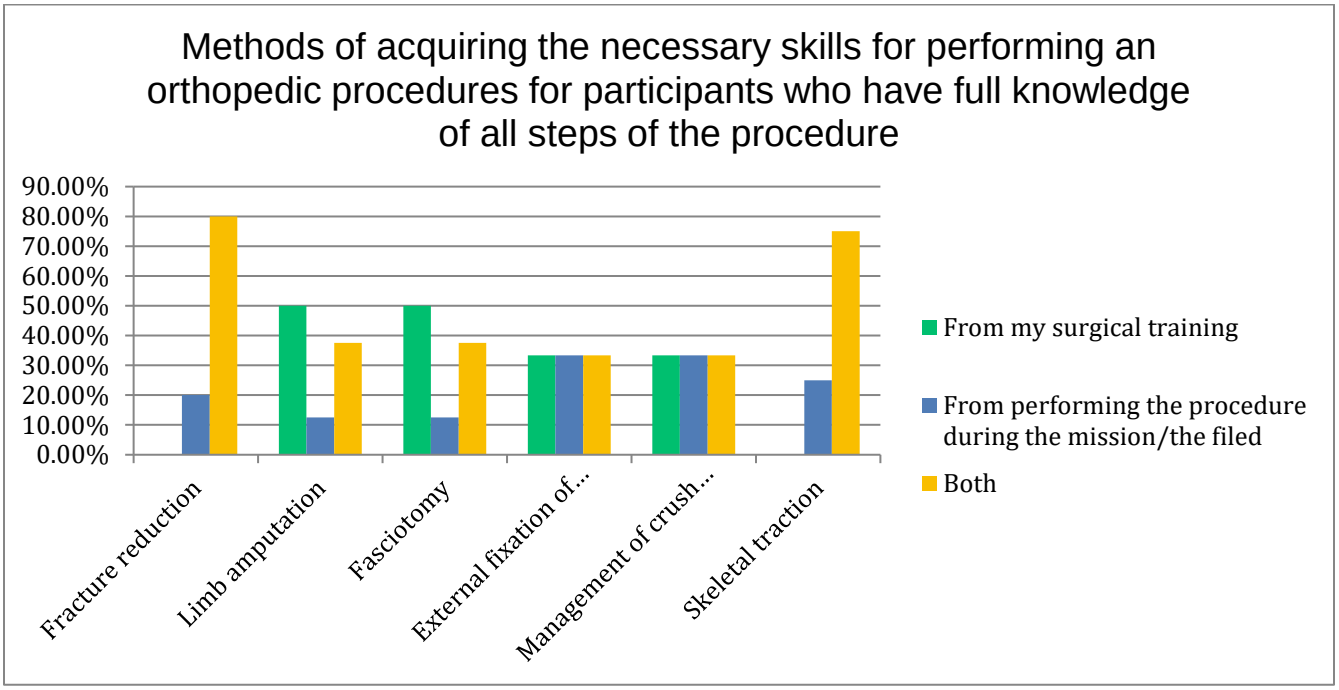

Similiarity of performing the orthopedic procedures between the field and in daily practice
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Fracture reduction
Limb amputation
Fasciotomy
External fixation of fracture
Management of crush injuries
Skeletal traction
Similar
Different

Table 2.5


Methods of acquiring the necessary skills for performing an orthopedic procedures for participants who have full knowledge of all steps of the procedure
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Fracture reduction
Limb amputation
Fasciotomy
External fixation of...
Management of crush...
Skeletal traction
From my surgical training
From performing the procedure during the mission/the filed
Both

Urology

Of the 8 participants that completed the urology section, all mentioned not having a urologist on the surgical team during their missions.

In this section, participants were asked questions on procedures such as bladder repair and suprapubic bladder catheterization.

For suprapubic bladder catheterization, 60% of the participants indicated that it is common in disaster settings. However, 75% of participants indicated performing this procedure less than 5 times per year in the past 5 years of their practice.
Similarly, for bladder repair, 70% of the participants indicated that it is a common procedure in disaster settings. Nonetheless, 50% of participants performed it less than 5 times per year in the past 5 years of their practice.

Data on the frequency of performing the common urology procedures in the participants' daily practice and on their missions can be found in table 3.1 and table 3.2 respectively.

The familiarity of the general surgeons of these procedures can be found in table 3.3, the similarity of these procedures between the surgeon's daily practice and in missions can be found in table 3.4. Participants who indicated having full knowledge in all the steps of the surgical procedure were asked to indicate where they acquired their knowledge, answers can be found in table 3.5.

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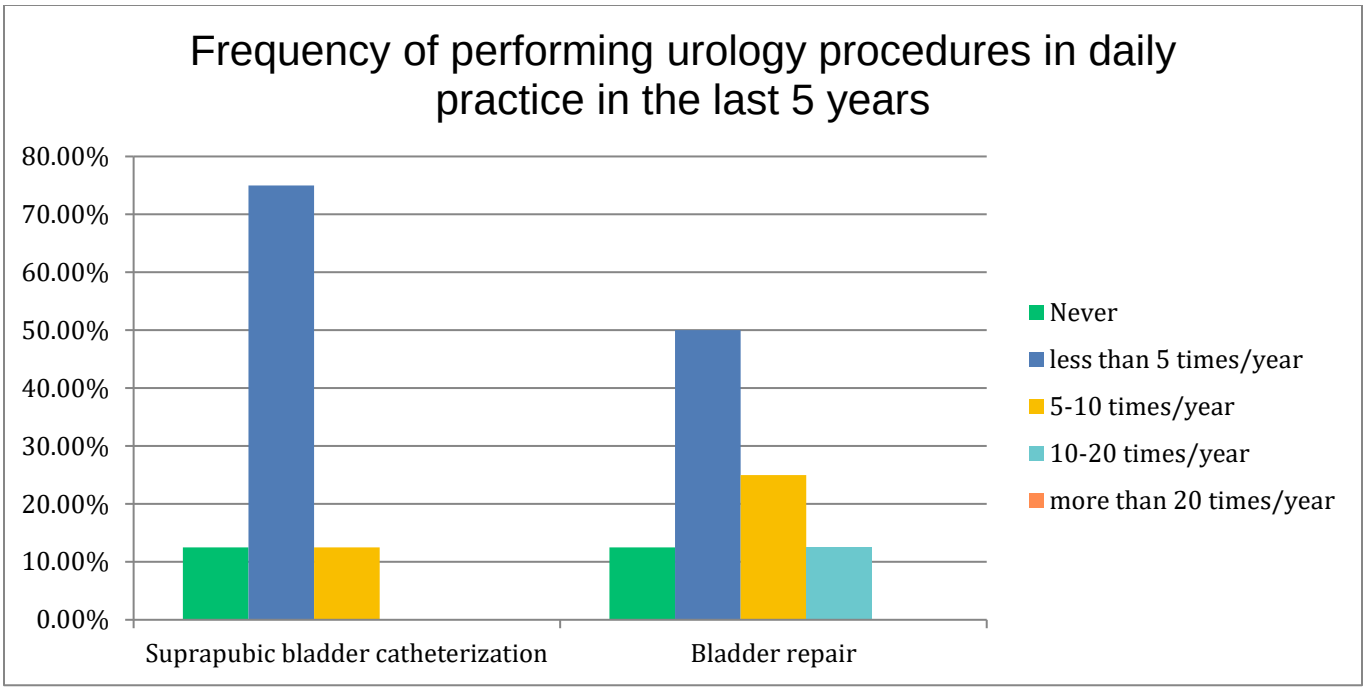

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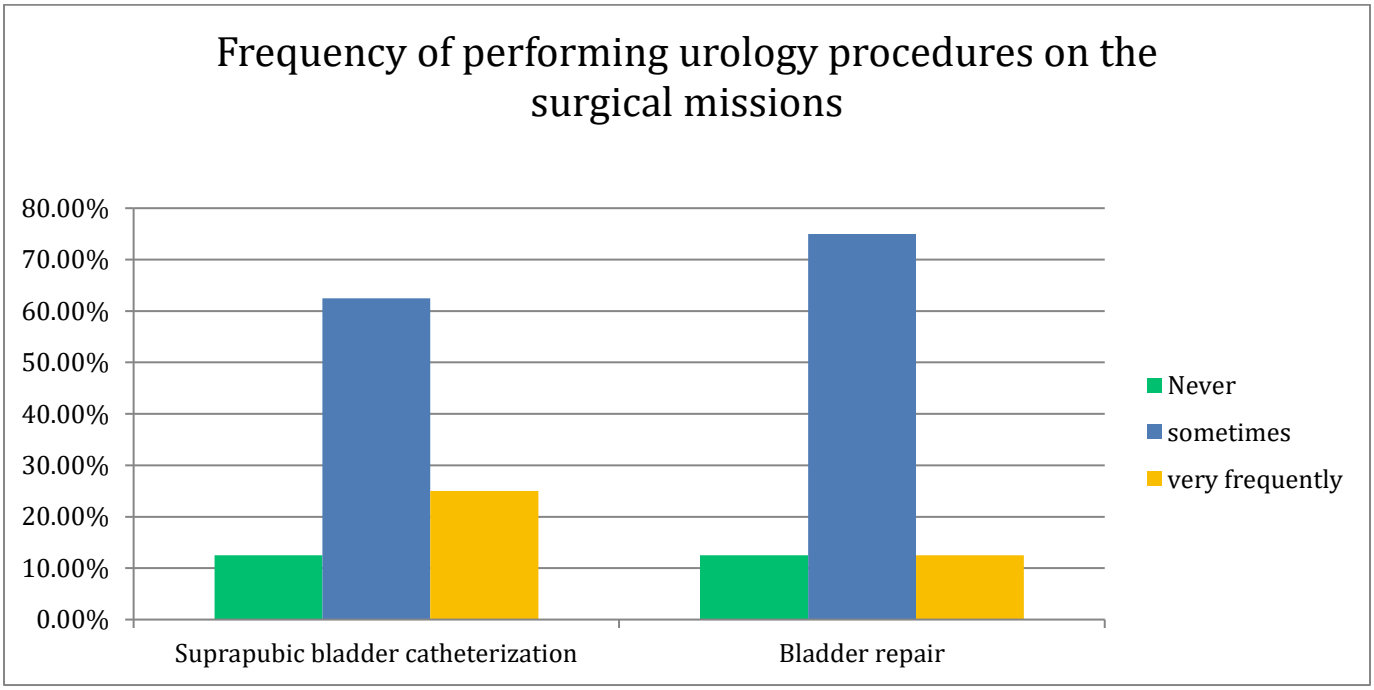

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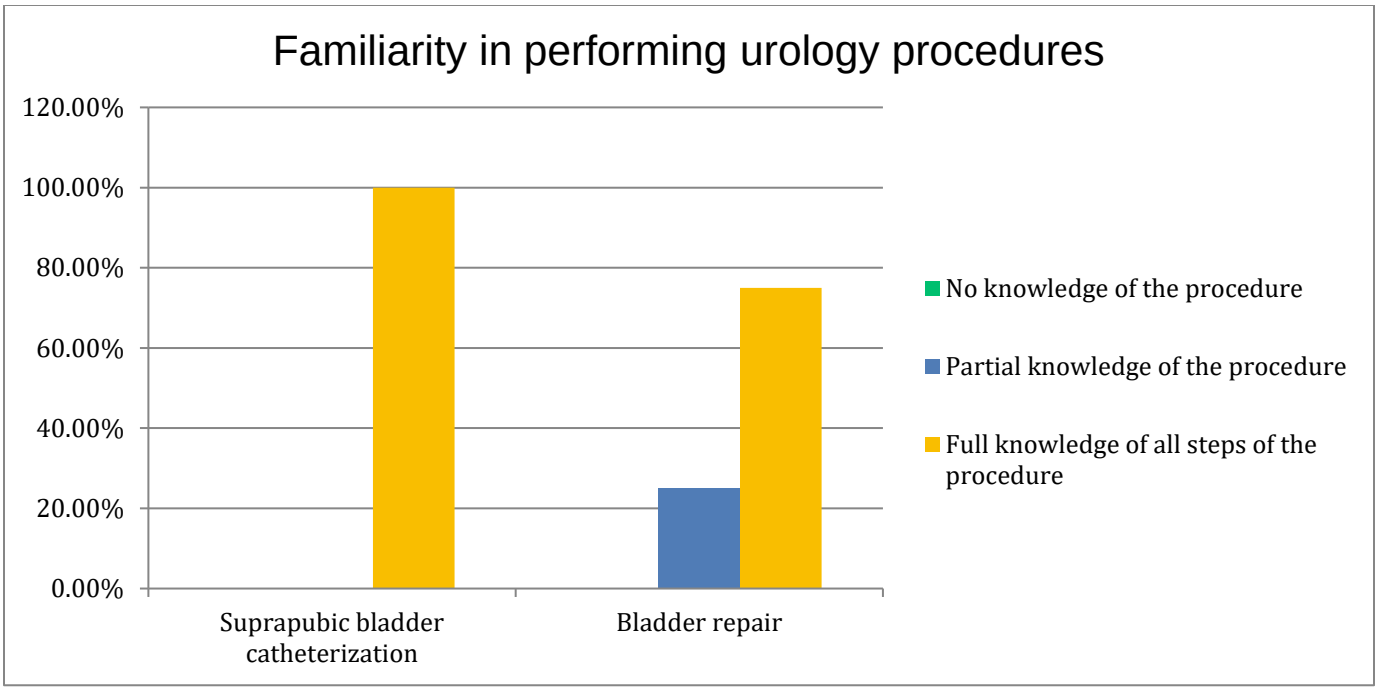

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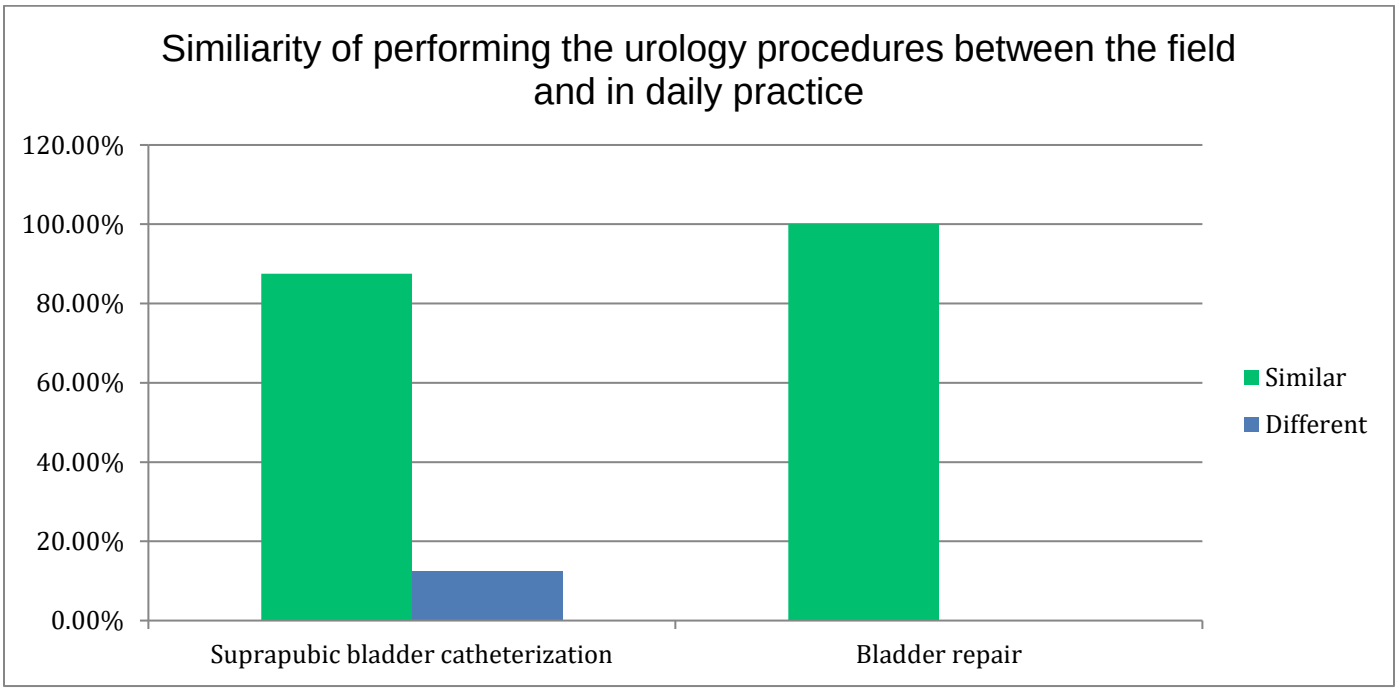
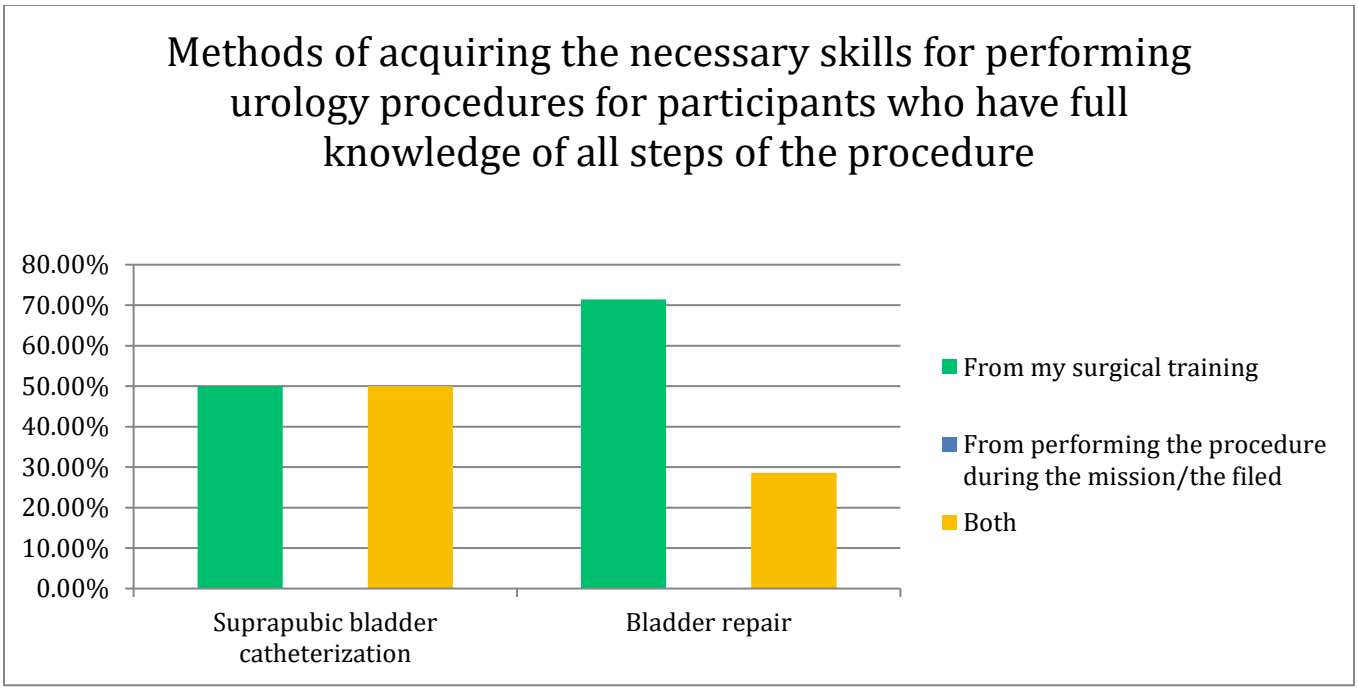


Table 3.5



General surgery

In this section, participants were asked questions on procedures such as wound debridement, skin graft, burns dressing, emergency laparotomy, neck exploration, repair or resection of bowel, liver, spleen and kidney, vascular repair, and complex hernia without mesh.

The most common general surgery procedures that the participants had to perform in disaster settings were wound debridement, burns dressing, skin graft, and emergency laparotomy.

Wound debridement and emergency laparotomy were performed more than 20 times a year by the participants in their daily practice in the past 5 years. This rate was reported by 60% of the participants for wound debridement, and almost 40% of the participants for emergency laparotomy.
However, 35% of the responders never did burns dressing in their daily practice in the past 5 years. Only one of the responders does skin grafts and burns dressing in their daily practice and that responder trained and is working in an LMIC.

Most of the participants had full knowledge of all steps of the general surgery procedures in this study. Responders indicated that the general surgery procedures were similar on the missions when compared to their daily practice except for vascular repair and complex hernia repair which were indicated by most participants to be different (57.14%).

Data on the frequency of performing the common general surgery procedures in the participants' daily practice and on their missions can be found in table 4.1 and table 4.2 respectively.

The familiarity of the general surgeons of these procedures can be found in table 4.3, the similarity of these procedures between the surgeon's daily practice and in missions can be found in table 4.4. Participants who indicated having full knowledge in all the steps of the surgical procedure were asked to indicate where they acquired their knowledge, answers can be found in table 4.5.

Table 4.1

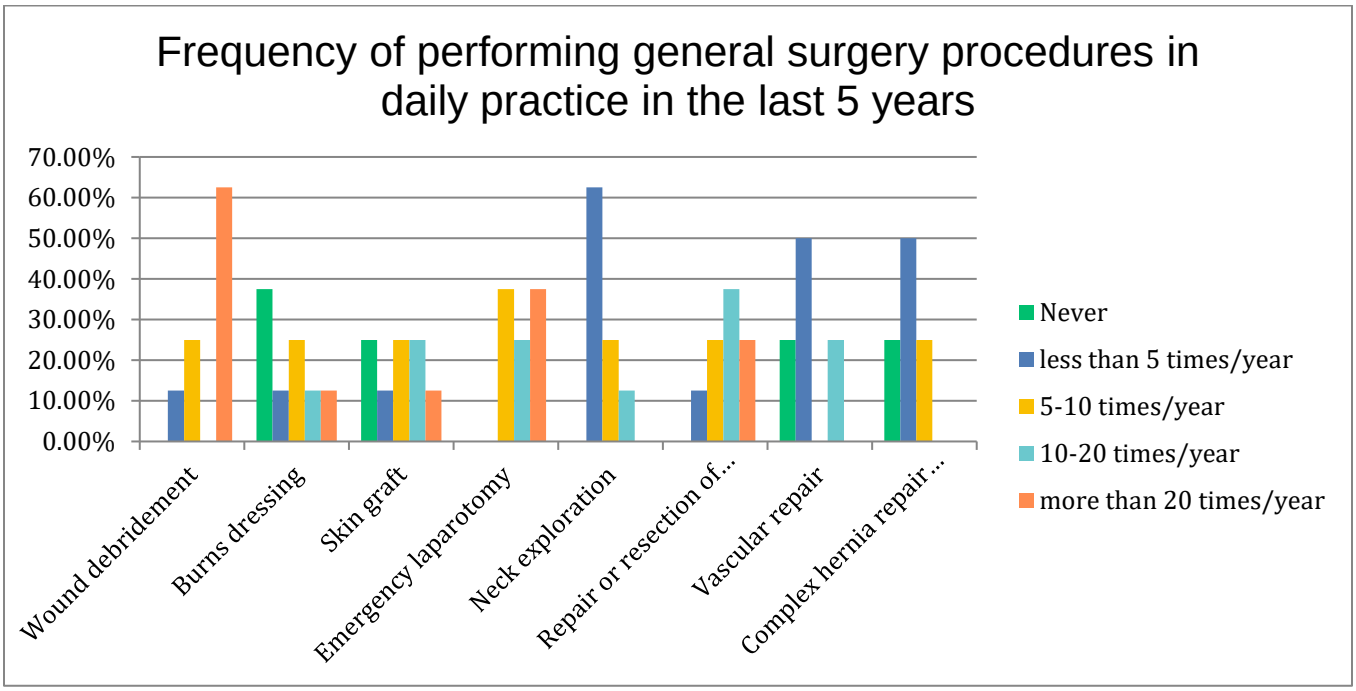


Table 4.2

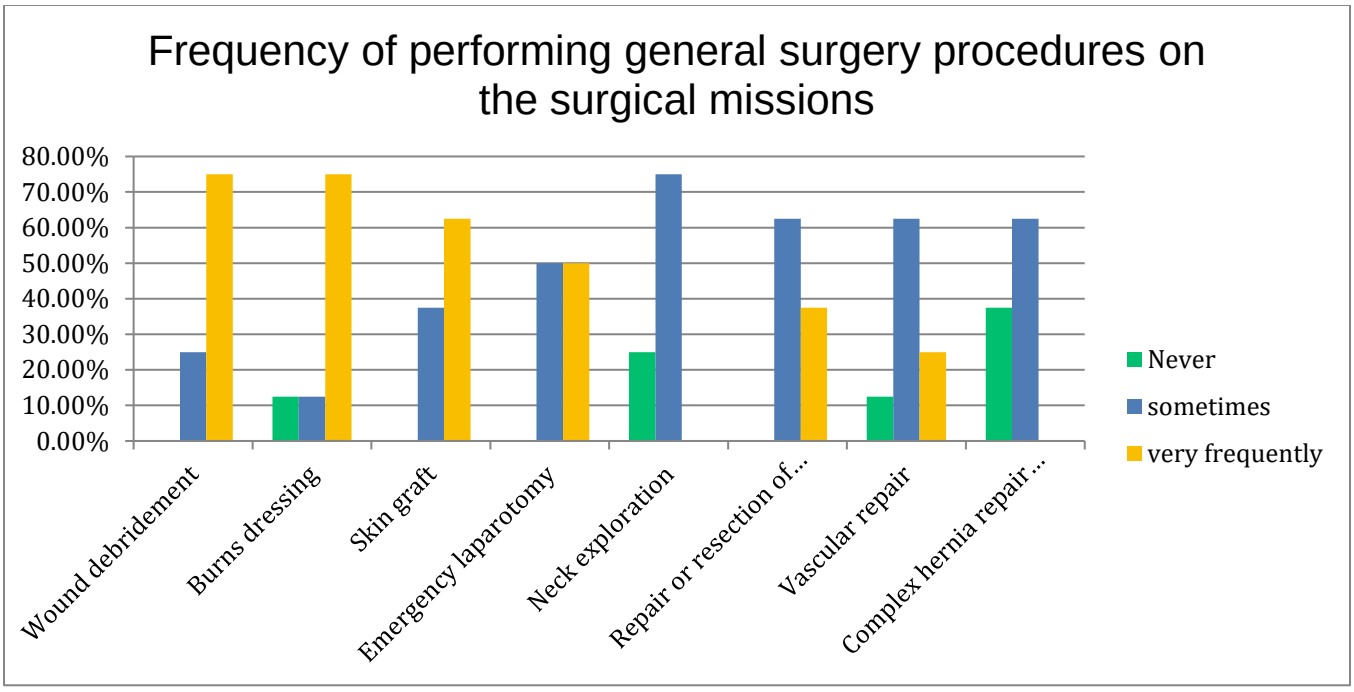


Table 4.3

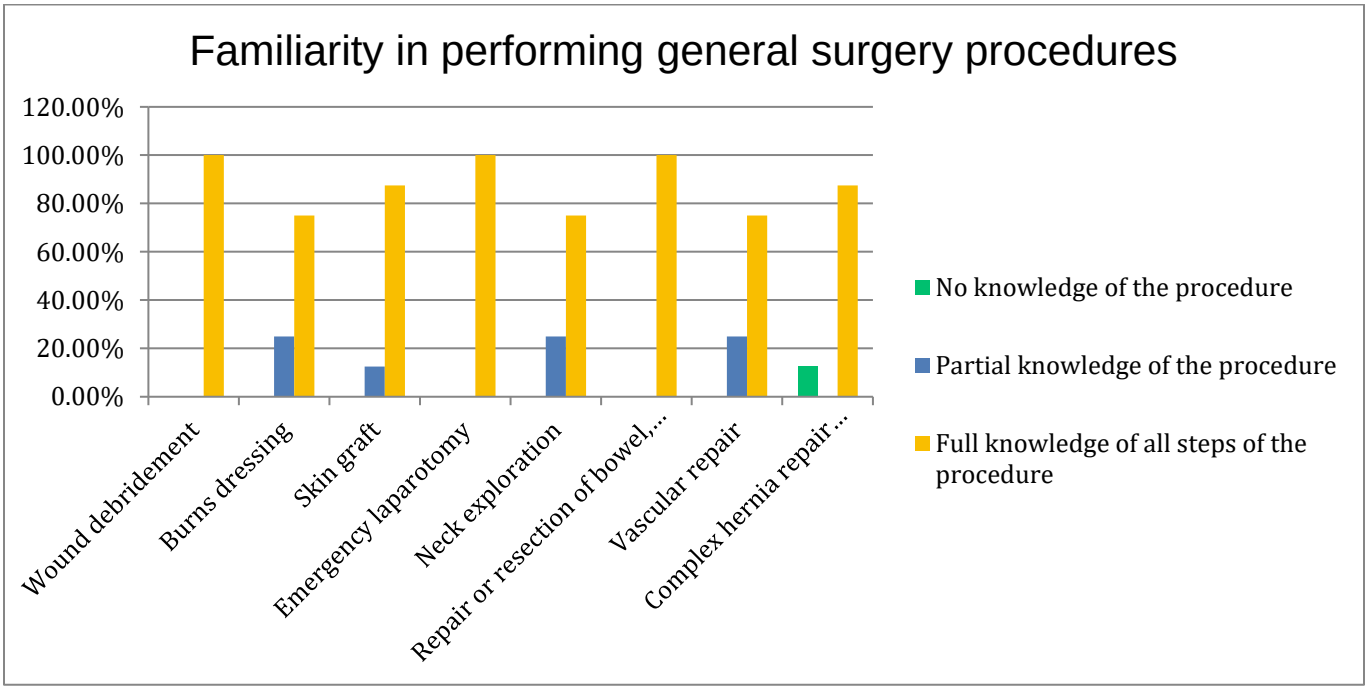


Table 4.4

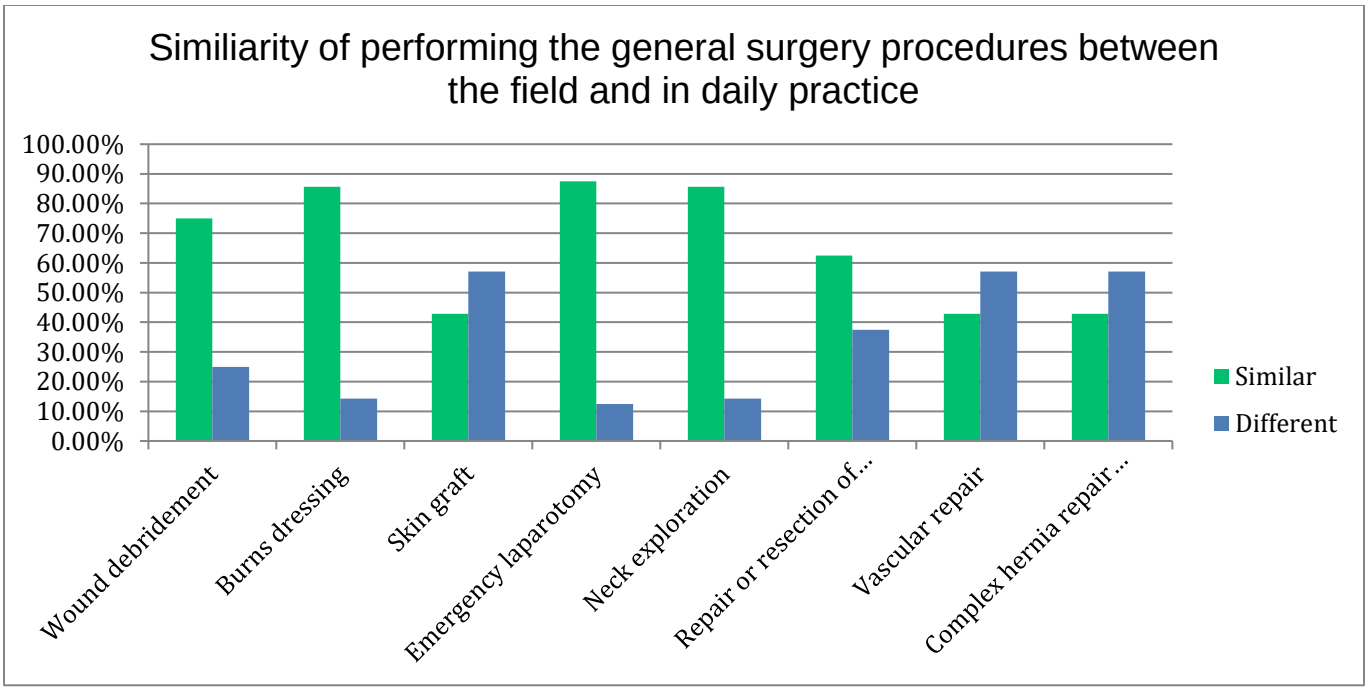
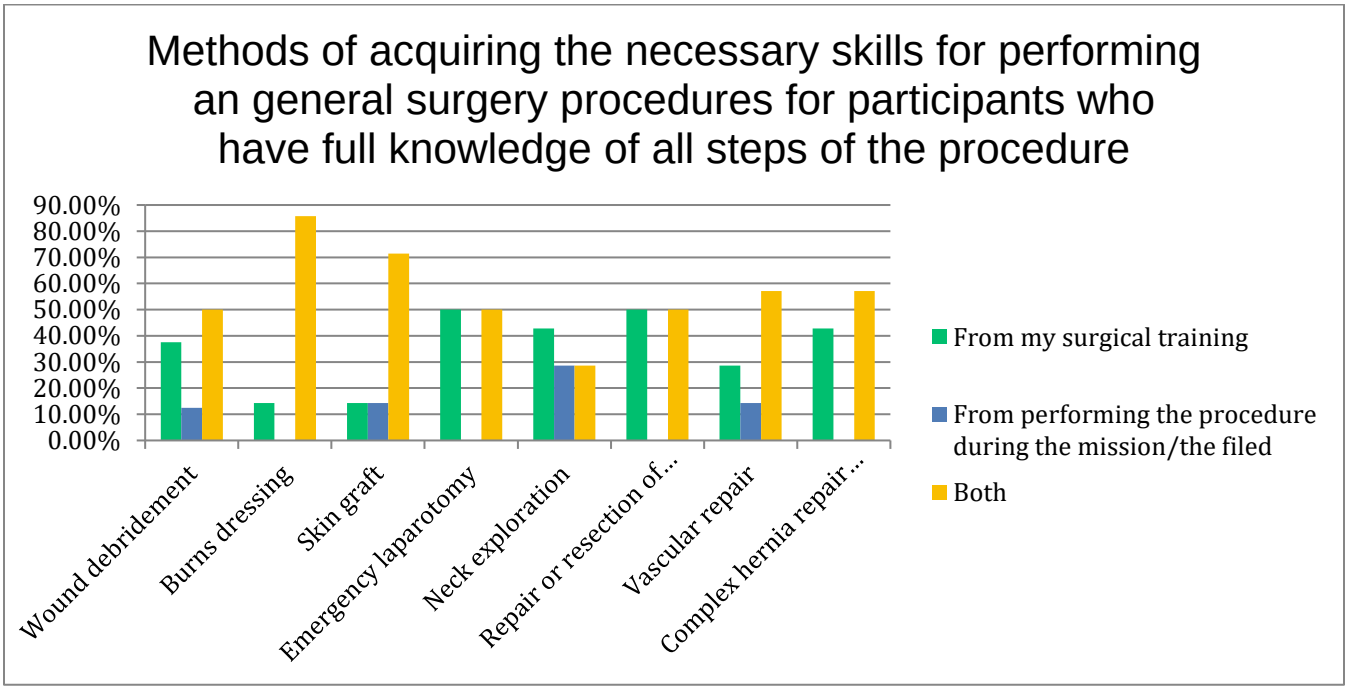


Table 4.5



Neurosurgery

Of the 8 participants that completed the neurosurgery section, all mentioned not having a urologist on the surgical team during their missions.

In this section, participants were asked questions on procedures such as burr holes and craniotomy.

Almost 90% of the participants never performed these two procedures in their daily practice in the past 5 years. Half of the participants reported having to sometimes do burr holes on their missions, and 30% indicated performing craniotomy either sometimes or very frequently on their missions.

Data on the frequency of performing the common neurosurgery procedures in the participants' daily practice and on their missions can be found in table 5.1 and table 5.2 respectively.

The familiarity of the general surgeons of these procedures can be found in table 5.3, the similarity of these procedures between the surgeon's daily practice and in missions can be found in table 5.4. Participants who indicated having full knowledge in all the steps of the surgical procedure were asked to indicate where they acquired their knowledge, answers can be found in table 5.5.

Table 5.1

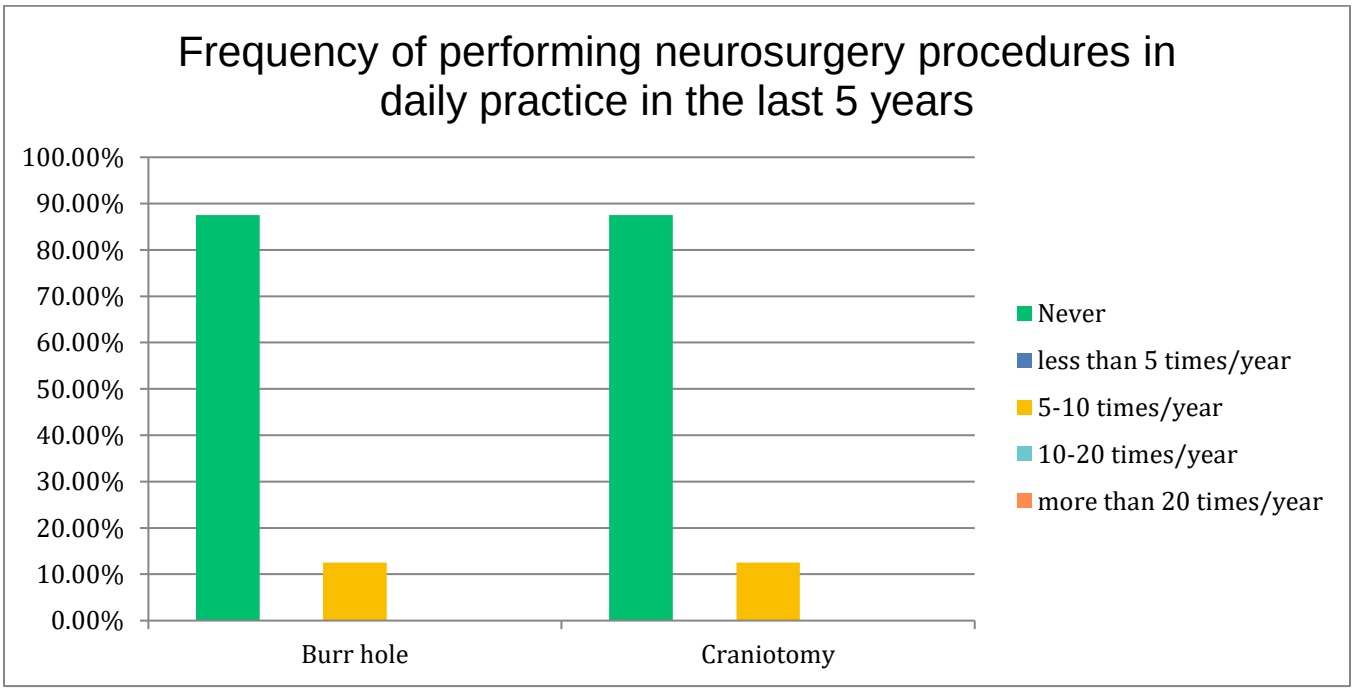


Table 5.2

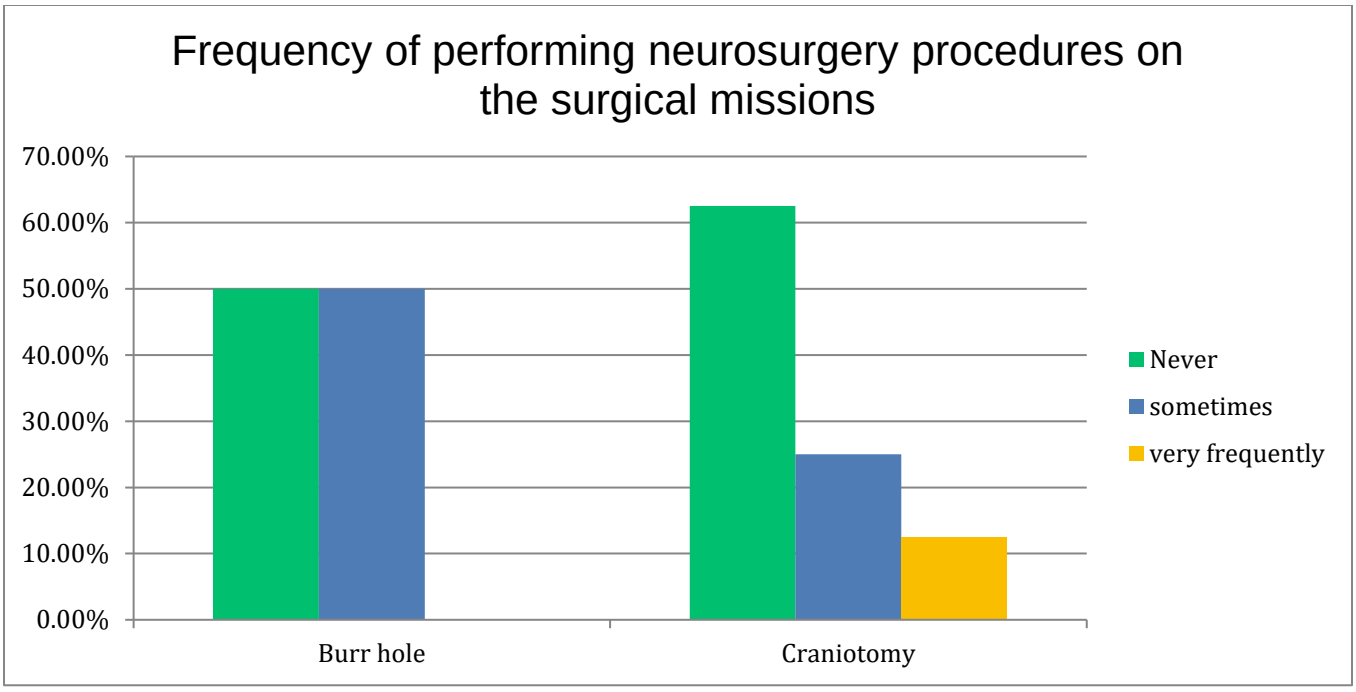


Table 5.3

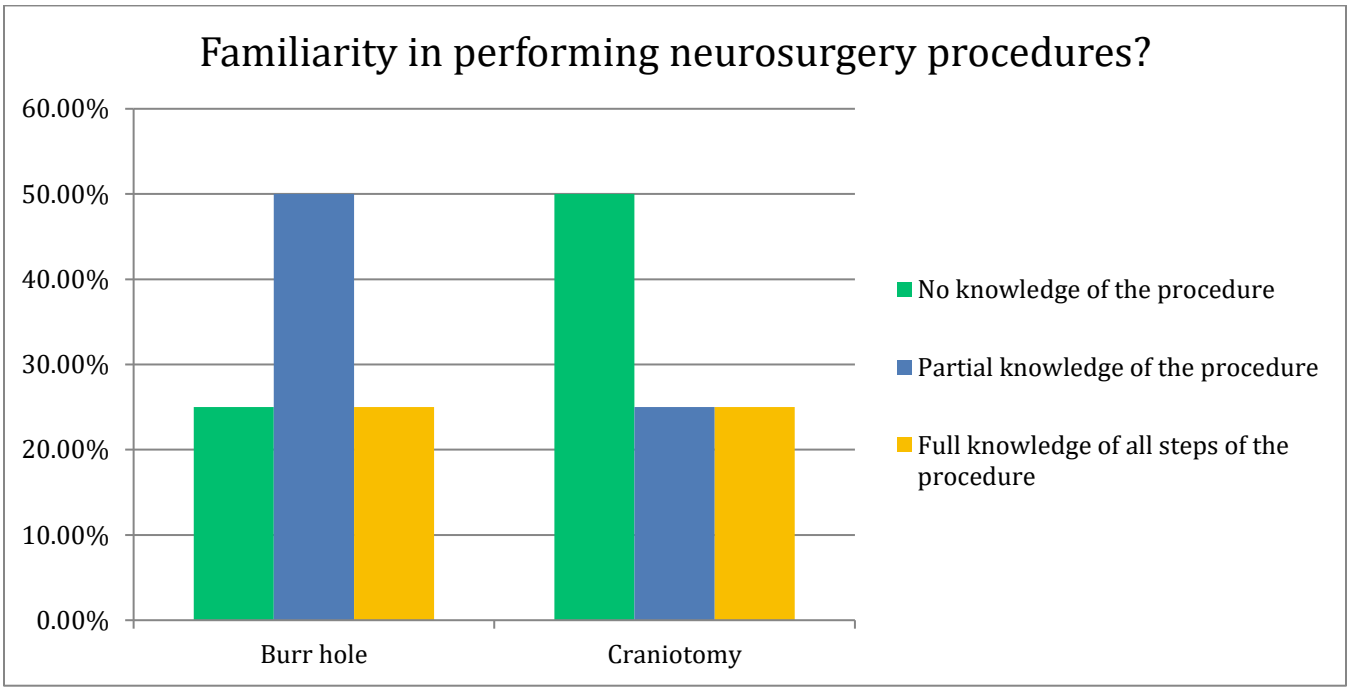


Table 5.4

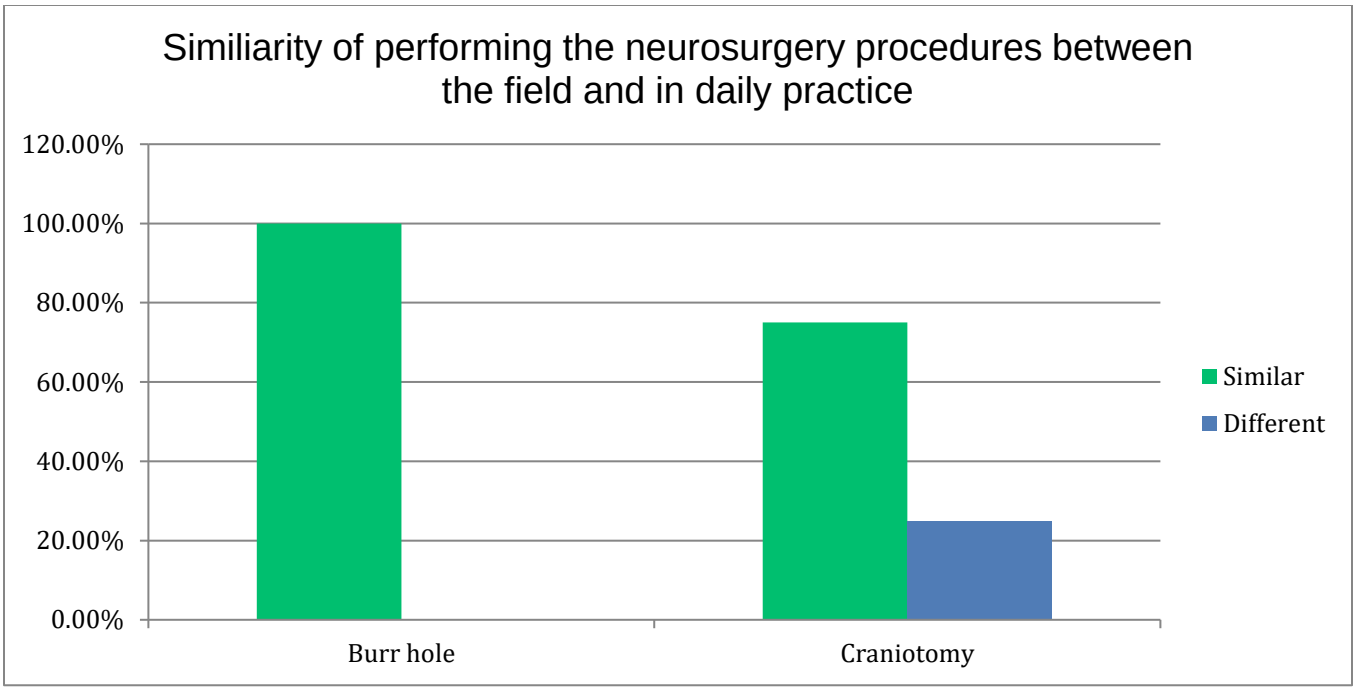
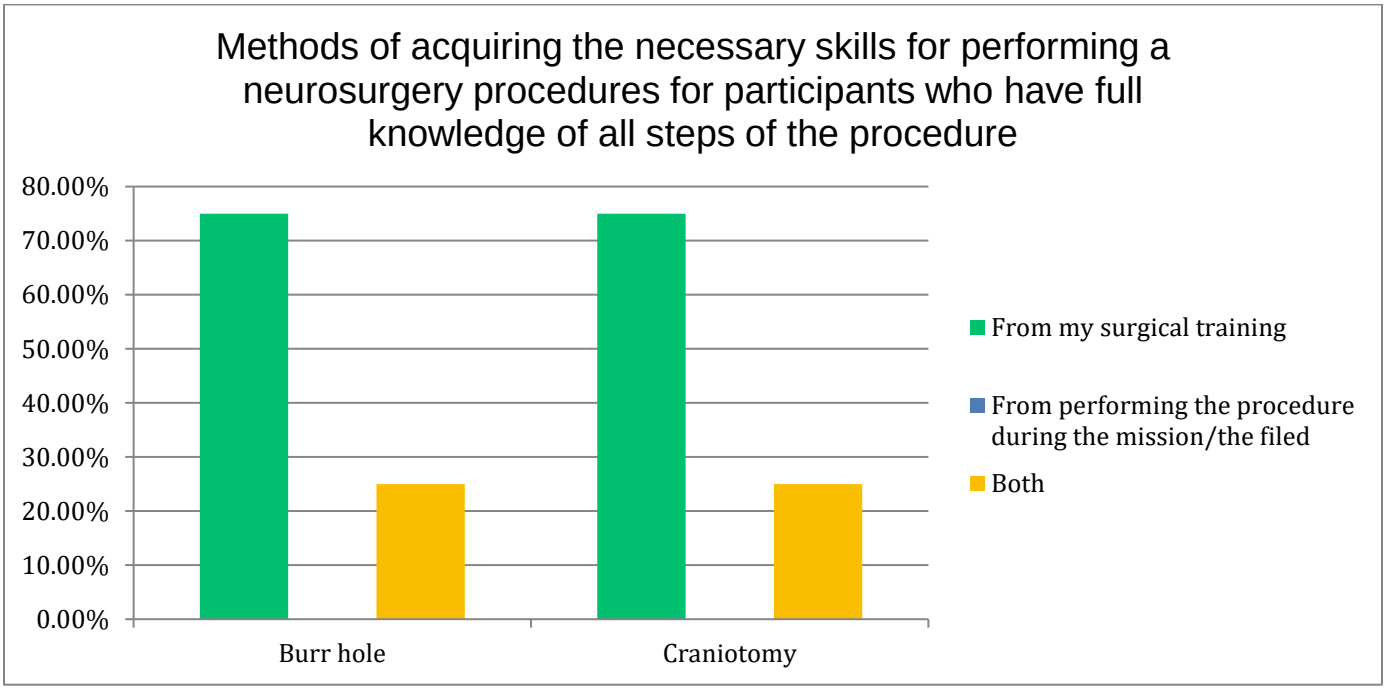


Table 5.5

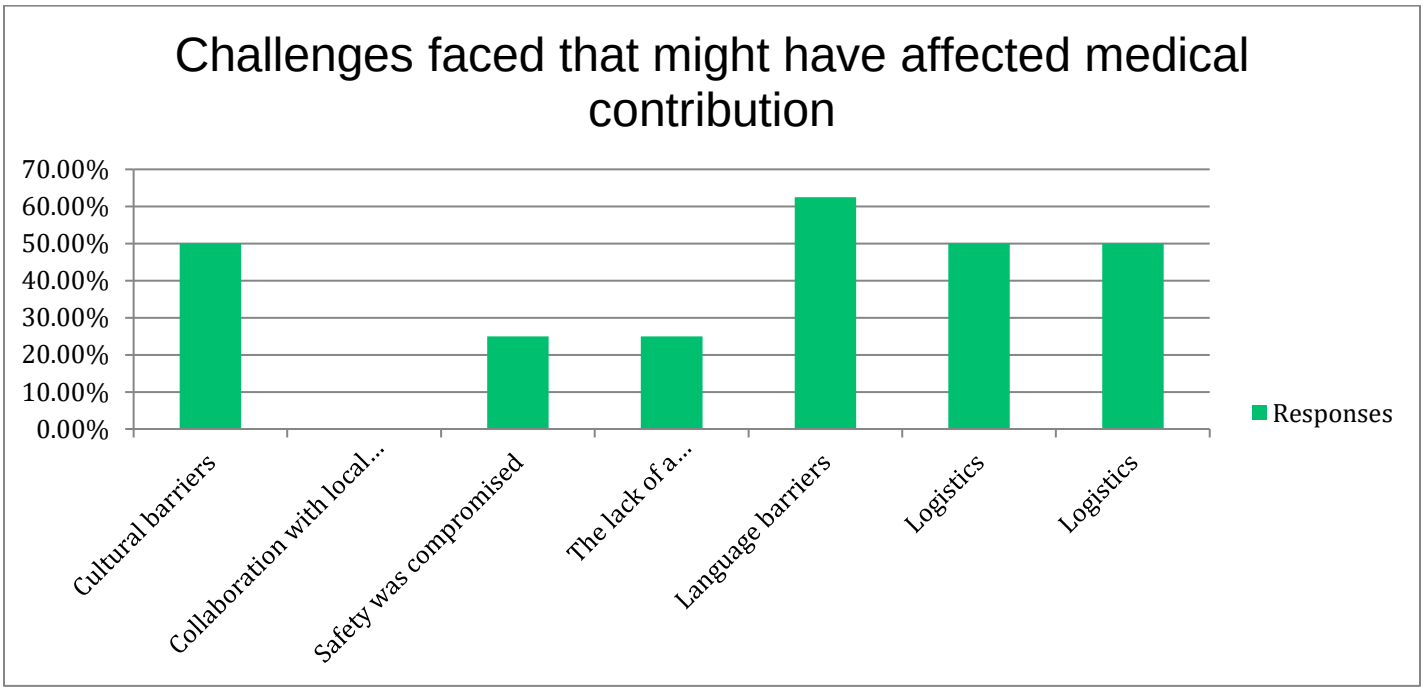


Other barriers to surgical delivery

More than 70% of the participants encountered difficulty with the equipment during their mission. Of those, 68% attributed the cause to the equipment being unavailable. The others to the fact that equipment was not functioning properly.

Some other challenges encountered by the participants can be found in **table 6**, such as cultural barrier, language barrier, logistics, security and safety, nature of pathology and limited options in diagnosis and referral are a real challenge.

Table 6



To have a better understanding of the surgical training requirements in Canada and the United States of America, we looked at the curriculums of the Royal College of Physicians and Surgeons in Canada and the American Board of Surgeons. The Objectives of training in general surgery in Canada are indicated in the table below based on the document "Objectives of Training in General Surgery in Canada, 2017 version 2.0"[19] and the " General Surgery Competencies- for residents who enter training on and after July 1, 2020"[20].

The list of procedures that are considered part of the core curriculum or the advanced curriculum in the Unites States of America can also be seen in Table 7. Based on the SCORE – curriculum outline 2019-2020 of American Board of Surgery.[21] As per the definition of American Board of Surgery, core procedures are "diseases and procedures encountered in general surgery for which a graduate of training will possess significant knowledge and be able to provide comprehensive care, including procedural competency". Advanced procedures or diseases are "not consistently part of general surgery practice for

which a graduate of training should have sufficient knowledge to make a diagnosis and provide initial management. In some instances, graduates will have sufficient knowledge and experience to provide comprehensive care."

Table 7

Procedure by specialty	Royal College of Physicians and Surgeons of Canada	American Board of Surgery
Obstetrics		
Hysterectomy	N/A	Core
Episiotomy	N/A	N/A
Dilation and curettage	N/A	N/A
Cesarean section	N/A	Advanced
Difficult vaginal delivery	N/A	N/A
Orthopedic		
Fracture reduction	Objective	Core
Skeletal traction	N/A!!	N/A
Fasciotomy	Objective	Core
Limb amputation	Objective	Core
External and internal fixation	N/A	N/A
Management of crush injuries	N/A	N/A
Urology		
Suprapubic bladder catherization	N/A	N/A
Bladder repair	Objective	N/A
General Surgery		
Wound debridement	Objective	Core
Burns dressing	Objective	Core
Skin graft	Objective	Core
Emergency laparotomy	Objective	Core
Repair or resection of bowel, liver, spleen	Objective	Core
Vascular repair	Objective	Advanced
Complex hernia repair	Objective	Core
Neurosurgery		
Burr hole	N/A	N/A
Craniotomy	N/A	N/A

Discussion

Participants indicated the high frequency of performing several surgical procedures from different surgical specialties on humanitarian missions. The most common of these procedures are cesarean section, fracture reduction, skeletal retraction, wound debridement, burn dressing, application of skin and graft, and performing emergency laparotomies. However, only wound debridement and emergency laparotomy were performed more than 10-20 times/ year by the participants in their daily practice in the past 5 years. The rest of the procedures in this list were never performed by the participants in their daily practice. Exceptionally, skeletal retraction was performed less than 5 times/ year in the past 5 years by the majority of the participants.

The participants encountered other conditions on the missions that they had to perform occasionally. These include dilation and curettage, removal of ectopic pregnancy, hysterectomy, limb amputation, fasciotomy, external and internal fixation of fractures, suprapubic bladder catheterization, bladder repair, neck exploration, repair or resection of bowel, spleen or liver, vascular repair, complex hernia repair, and burr holes.

Repair or resection of bowel, spleen, or liver was the only procedure performed more than 10-20 times/ year in the daily practice of the participants. All of the obstetrical procedures in this category as well as burr holes, and external and internal fixation of fractures were never performed by the participants in their daily practice in the past 5 years. The other procedures in this category were performed less than 5 times/ year.

Obstetrical and orthopedic procedures are from the most common procedures a general surgeon must perform when deployed on a mission in a disaster setting. However, they are rarely, if ever, performed by the surgeons in their daily practice.

The fact that surgeons who participated in this study have been deployed several times throughout their career to different regions of the world in different humanitarian contexts, helped them gain extensive knowledge of the procedures and the environments in which they are asked to operate. The extensive exposure helped surgeons from HICs gain the required skills to efficiently operate in these settings. These skills might have not been gained during the surgical training from either lack of training or insufficient exposure to a variety of cases from different subspecialties.

The question “how did you acquire better skills in performing this procedure: from your surgical training, from performing this procedure on the mission/field, or both”, was asked to the participants who indicated knowing all full steps of the procedures. In general surgery, the majority of the participants acquired their skills from both the mission and their surgical training. As for obstetrics, participants gained their skills in cesarean section, the most common surgical procedure in humanitarian missions in a similar manner. This indicates that surgical training alone was not enough for the surgeons to gain the skills needed to

perform these procedures efficiently. Consequently, newly graduated surgeons, who have not had previous experience working in a disaster setting, will not have the necessary skills to participate in such missions. This consolidates the concern of whether the surgical curriculum in HICs covers the most common surgical procedures in humanitarian settings and whether newly general surgery graduates from HICs are prepared to perform a wide scope of procedures.

Looking at the requirements to complete general surgery training in most HICs, it is clear that the focus has shifted to training in advanced procedures and away from surgical training in other specialty procedures such as obstetrics, plastic surgery, orthopedic and neurosurgery.

According to the surgical curriculum of the Royal College of Physicians and Surgeons of Canada in general surgery, surgical residency training includes a maximum of 6 blocks of the following specialty training; pediatric surgery, vascular surgery, and thoracic surgery[22]. Additionally, two blocks are required in trauma management such as plastic surgery, emergency medicine, trauma surgery, orthopedic surgery as well as 11 selective blocks that can be in general surgery or other non-surgical disciplines[22]. This variability in choosing the elective and selective blocks does not guarantee the exposure of the graduating resident to cases that will help them acquire the necessary skills in obstetrics, neurosurgery, orthopedics, and urology needed to work in disaster settings. Even if that exposure takes place to a certain extent, the presentation of these cases and the working environment in disaster settings is different than in HICs.

General surgeons in Canada might be trained in different specialty procedures depending on the size of the community they work in. A study in 2002 showed that only 15% of Canadian general surgeons perform procedures in orthopedic surgery and 28% perform procedures in urology but the majority of these surgeons work in a population of less than 50,000. [23]Surgeons working in these communities indicated that they received their training not from their fellowship, but from working with senior surgeons who have a broad-based training in these small communities[23].

As for surgical training in the United States of America (USA), the American Board of Surgeons requires surgical trainees to acquire experience in several subspecialties such as pediatric surgery, vascular surgery, surgical oncology, and trauma surgery.[24] However, they are not required to have experience in either orthopedics surgery, obstetrics, neurosurgery, or urology. As a matter of fact, in the SCORE Curriculum Outline of 2019-2020 by the American Board of Surgeons, procedures such as cesarean section and extremity injuries are considered “advanced” procedures, meaning that they are not consistently part of general surgery practice for which a graduating surgeon should have sufficient knowledge to make a diagnosis and provide initial management. In only some instances, graduating surgeons will have sufficient knowledge and experience to provide comprehensive care.[21]

The American Board of Surgeons in the USA does highlight the importance of acquiring the necessary skills in some of the procedures we identified as common and life-saving procedures in humanitarian settings. Among the list of essential surgical procedures in the American Board of Surgeons' curriculum are hysterectomy, management of ectopic pregnancy, amputation, fasciotomy, spine, and pelvic fractures, burn dressing, skin graft, wound debridement, emergency laparotomy, neck exploration.[21]
However other procedures are not considered part of the surgical training in the USA, such as vaginal delivery, episiotomy, dilation and curettage, cesarean section, crush injuries, suprapubic bladder catheterization, bladder repair, complex hernia repair without mesh, burr hole and craniotomy.[21]

The same applies to the surgical curriculum in the United Kingdom and Ireland. Even though the curriculum has a strong focus on trauma procedures, allowing residents to acquire skills while working in rural areas as well as through an advanced trauma surgery program for military surgery, it does not provide adequate exposure in obstetrics procedures, neurosurgery or urology[25].

Looking at the surgical curriculum's in the world, heterogeneity is clear. Migration of surgeons from LMICs to HICs increases the variability of surgical procedures performed in HICs by surgeons who trained in LMICs but also creates this disparity in access to care in LMICs. Therefore, surgical education becomes a key factor in improving quality of surgical care in both disaster settings and in times of peace.

Conclusion:

This study proves the perception that there is a gap in training of surgeons who engage in health missions abroad compared to the scope of practice expected of them during these missions. This gap is more present in subspecialties such as obstetrics, orthopedics, urology, and neurosurgery. This shows the importance of surgeons who participate in these missions to have a broad-based training that includes the most encountered surgical procedures in disaster settings. Acquiring skills in these life-saving procedures before being deployed on a surgical mission will improve the mortality and morbidity outcomes of these missions and create an ethical space where surgeons from high-income countries only perform procedures they have been adequately trained on.

Accepting that we need general surgeons with broader skills to serve both in Canada and internationally means that we need to tailor a surgical training program that will provide these surgeons the necessary skills. This program should focus on the most common life-saving procedures in each surgical specialty while acknowledging the logistical challenges that can be faced in humanitarian settings.

Study relevance

This framework of the core clinical competencies needed in disaster settings can guide training programs that aim to enhance the surgical skills of general surgeons before their deployment.

Since no HIC is immune to disasters and in a multi-casualty event or a disaster situation, even the busiest and most advanced trauma centers can become overwhelmed. The level of preparedness of a trauma center to mass casualties is not necessarily attributed to its status but the presence of physicians with experience in these settings[26]. Therefore, this study will help guide surgeons who wish to use the knowledge and experience they acquired during their missions to train surgeons in their home country as a means of preparedness against disasters and emergency states HICs might face in the future. From a Canadian perspective, this research will act as a framework that will guide the creation of a field academy that will allow the knowledge exchange between the Canadian health practitioners in the hope of reducing the knowledge gap. Moreover, it will also help training programs that aim to reduce the knowledge gaps physicians and surgeons face while working on indigenous lands.

Limitations

This study has limitations. It is a self-reported online survey, which limits our ability to validate credentials and experiences, and may be prone to recall bias. Furthermore, the personality traits of the surgeons might play a role in their adaptation skills and improvisation during surgical challenges which is an aspect that can affect the level of comfort surgeons have regarding procedures they do not perform in their everyday practice.

Although a trend can be seen from the pre-discussed results, yet the small sample size made it unreasonable for us to do a bigger statistical analysis that would have made our results more reliable. The already discussed analysis could have been expanded to include comparison between different variables by using ANOVA testing. The comparison could have been made between all the surgical procedures that are very common in disaster settings from different surgical specialties with the level of familiarity of the surgeon, or the way they acquired their familiarity for these procedures. Having a bigger sample size would have helped understand the distribution of the surgeons who participate in disaster settings in terms of where they trained; LMICs or HICs. Most of the responders were surgeons who trained in HICs, having a sample of surgeons who trained in LMICs would have helped better see whether these surgeons are trained on the common surgical procedures that the surgeons from HICs indicated having little knowledge in or no exposure to. Since most of the questions in the survey where dependent on each other, we were not able to compare between variables from different surgical specialties.

Most of the surgeons who participated in this study have been practicing for several years and have been deployed on missions several times. Therefore, it is very likely that they acquired cumulative skills in humanitarian response that can be hard to attribute to either their surgical training, their daily practice, or their performance in humanitarian settings specifically.

The comparison between the surgical capacities that need to be strengthened when working in armed conflict compared to natural disasters could have been done if we had a good sample size of surgeons who worked in armed conflicts. Having this comparison can also improve future training programs in global surgery.

Appendix 1: Key Informal Interview Guide- Semi-structured interview

Theme one: demographics:

1. Name
2. Sex
3. Citizenship
4. Country of licensure
5. Country of current practice
6. Surgical specialty
7. Affiliation to an organization(s): CRC, ICRC, MSF, Other
8. Country/countries deployed to and durations of mission:
9. Type of disaster: Flood, earthquake, typhoon, armed conflict, military mission, other
10. Did you have an orthopedic surgeon/ obstetrician on your surgical team?

Theme two: Clinical skills

11. Did you have any special clinical training (other than residency) to prepare you for the surgical procedure encountered in disaster settings before your deployment?
    - If yes specify; wet laboratory training, cadaver training, surgical simulations, other
12. What other surgical specialties were on your team during your mission(s)?

13. Please answer the next questions for the following procedures:

1) Did you receive adequate training in your post-graduate residency program to perform this procedure?
2) How often did you perform this procedure in your normal practice in the last 5 years?
    - Never, less than 5 times/year, 5-10 times/year, 10-20 times/year, more than 20 times/year
3) How often were you asked to perform this procedure on your mission(s)?
    - Never, sometimes, very frequently
4) How do you describe your knowledge in performing this procedure on your own?
    - Deficient knowledge required specific instructions at most steps
    - Knew all important steps of the operation
    - Demonstrated familiarity with all steps of the procedure.
5) If the answer was full familiarity, the follow-up question will be asked:
    - Did you find the experience of practicing this procedure in the field different/ similar to your regular workplace?
    - Did you acquire better skills to perform this procedure from your medical training or from performing them during your mission?
6) Have you been exposed to new or unique cases during the field missions that you had not seen during your regular practice?" If yes: Please list them

The list of procedures:

Obstetrics and gynecology:

1. Episiotomy
2. Dilation and curettage
3. Removal of ectopic pregnancy

4. Cesarean section
5. Hysterectomy
6. Difficult vaginal delivery (suction-assisted, shoulder dystocia, etc)

Orthopedics:

7. Fracture reduction
8. Limb amputation
9. Fasciotomy
10. External and internal fixation of a fracture
11. Skeletal traction
12. Crush injuries

Urology

13. Suprapubic bladder catheterization
14. Bladder repair

General surgery:

15. Wound debridement
16. Burns dressing
17. Skin graft
18. Emergency laparotomy
19. Neck exploration
20. Repair or resection of bowel, liver, spleen, and kidney.
21. Vascular repair
22. Complex hernia repair without mesh

Neurosurgery:

23. Burr hole
24. Craniotomy

Theme three: capacity building/ other barriers:

1. Did you encounter any difficulties using the equipment/supplies made available to you?

- If yes: please choose the reason:
- Equipment unavailable
- Equipment not working
- Equipment different from the ones you are used to
- Other

2. Please check the other challenges that you faced that might have affected your medical contribution:

- Cultural barriers
- Language barriers
- Logistics
- Collaboration with local teams was difficult
- Safety was compromised
- The lack of a multidisciplinary team to work with
- Other

Appendix 2: Participant Consent Form

Gaps in Surgical Competencies of General Surgeons Deployed on Humanitarian Missions in Disaster Settings

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Supervisor: Dr. Tarek Razek
Department of Experimental Surgery, McGill University
Email: tarek.razek@mcgill.ca

You have been invited to participate in an online survey that aims to identify the gaps in the clinical training of general surgeons who are deployed on a surgical mission to a low- or middle-income country in a disaster setting. You have been selected based on your previous experience in humanitarian missions and hence your deeper understanding of the wide scope of practices a general surgeon can face when working in disaster settings. This research aims to compare the clinical competencies of general surgeons who are deployed on a mission with the medical services they are expected to deliver in disaster settings. This will help in the creation of a framework with the necessary skills surgeons need to master before participating in a surgical mission.

Study procedure:

To participate in this survey, you need to be a general surgeon who has been deployed on a surgical mission to a low- or middle-income country. The survey will have questions on demographics, clinical competencies, and main barriers to surgical delivery in disaster settings. The length of this survey is 20-25 minutes and is in English only.

Potential Risks:

There are no anticipated physical risks to you by entering in this research. You may be subjected to psychological discomfort due to the personal nature of the topics addressed by the questions.

Potential Benefits:

Participating in the study might not benefit you, but we hope to learn how to enhance the pre-departure training of general surgeons before they go on their missions to improve the outcomes regarding care delivery and local capacity building.

Confidentiality:

Stating your gender, country of primary practice, and clinical skills will not be linked to your data. All data will be collected in a password-protected digital database. Participant information will remain confidential and access to the database will be available to the research team and the Canadian Red Cross (CRC) Global Health Unit (GHU) research managers only.

Voluntary participation:

Your participation in this study is voluntary. You may refuse to participate and may withdraw from the study at any time, for any reason. If you choose not to participate or to withdraw, all available information you had offered will be erased.

Questions:

In case of any questions or comments related to the study, please contact the main researcher as listed above. If you have any ethical concerns or complaints about your participation in this study and you want to speak with someone not on the research team, please contact "McGill Faculty of Medicine Ethics Officer at +1 (514) 398-8302 or ilde.lepore@mcgill.ca".

Please sign below if you agree with this statement: "I have read the above information, the study has been fully explained to me and all questions have been answered to my satisfaction. I agree to participate in this study. I do not waive any of my rights or release the researchers from their responsibilities by signing".

_____ _____

Participant Signature Date

Appendix 3: Letter of Agreement with the CRC

McGill

Dear Dr. Salim Sohani,

As per our meeting and the proposal attached, please accept this letter as a formal request for your permission to conduct my research entitled "Identifying the Gaps in Training of Surgeons Deployed on Humanitarian Missions in Disaster Settings", under the supervision of professor Tarek Razek from the Department of Experimental Surgery at McGill University with the collaboration of the Canadian Red Cross – Global Health Unit in Ottawa, Canada.

The collaboration between McGill University and the CRC will help in the development of this research through the following:

1. The approval to access the database of the names and medical background of surgeons deployed with the Canadian Red Cross to disaster settings as well as the locations and duration of surgical missions in the past 10 years.
2. The approval to contact the surgeons working with the CRC for the possibility to recruit participants for the research.
3. The approval to view the end of mission template, job descriptions and guidelines used by the CRC while recruiting surgeons.

As per the objectives, methods and techniques that will be used in this research, the following considerations are assured:

1. The guarantee of requesting and receiving clarification before, during and after the development of the research.
2. The guarantee that participant information collected will remain confidential and access to the dataset will be reserved for the research team and CRC GHU research managers.
3. The guarantee that there will be no expense for the CRC that is due to participation in this research.
4. In case of non-compliance with the above mentioned, the CRC has the freedom to withdraw their consent at any time of the research without any penalty.

Student: Leen Makki
Department: Experimental Surgery
Ottawa, February 19th 2020

Feb 19, 2020

Dr. Salim Sohani
Director, Global Health Unit
International Operations
Canadian Red Cross
Signature and Stamp

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