



Appraisal of Pediatric Neurosurgical Outreach Missions in the Western Hemisphere

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Abstract

Background: While a number of outreach missions have been designed and executed to improve health care disparities in less developed countries, many of these efforts have been episodic with visiting surgeons performing operations, with little attention to local surgeon education. To impart real and durable advancement in surgical services in less developed nations, especially in specialties that require emergent care, such as pediatric neurosurgery, it is critical to design outreach missions with a didactic framework centered on improving the surgical armamentarium of local surgeons.

Methods: We propose a strategic design for enhancing the neurosurgical care delivered in institutions in less developed countries during surgical outreach missions in the Western Hemisphere. Focused on transferring modern surgical skills to local neurosurgeons, a selection criteria and structure for the targeted missions is a derivative of logistical and pedagogical lessons ascertained by previous missions by our teams in Peru and Ukraine.

Results: Medical outreach initiatives should be applied to hospitals in capital cities, which oftentimes serve as central referral centers and are situated amongst a large population, for maximum impact with fiscal efficiency. The host country should fulfill several criteria, including demonstration of a significant need for neurosurgical support and equipment, geopolitical stability, and the presence of academic neurosurgeons capable of learning advanced techniques and dedicated to providing high quality care to indigent citizens. The neurosurgical outreach model should involve a series of missions spaced out over a span of three to four years in which visiting and host surgeons collaborate on increasingly complex cases, with progressive transfer of skills over time.

Conclusion: A strategic approach for surgical outreach missions should be framed around collaboration and camaraderie between visiting and local neurosurgeons, with a mutual objective of cost-effective targeted renovation of surgical equipment and the skill repertoire. Complementing this design should be regular digital collaboration via video conferencing platforms in the years after the missions to sustain the impact, further enhance the skill set of the host neurosurgeons, and to allow visiting neurosurgeons to serve on standby in deeply complex cases.

Keywords: Central and South America; Medical Missions; Neurosurgery; Pediatric Neurosurgery; Targeted Renovation

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Introduction

Though the medical establishment has felt a series of clinical breakthroughs in the last century, with technology being fused more closely with the treatment process such that patient outcomes, hospital resource utilization, and quality of life have improved for millions, these developments have not been equally distributed. According to the World Health Organization, 5 billion people do not have access to safe, timely, and affordable surgical care and anesthesia globally [1]. In Low- and Middle-Income Countries (LMICs), 9 out of 10 individuals cannot even access basic surgical support [1]. This stems from the fact that in developing nations, the distribution of health care providers, health services, and infrastructure is constrained to urban regions, even when most of the surgical need is in rural areas [2]. The facilities that are situated in rural and suburban regions oftentimes have poor infrastructure and lack the necessary equipment for robust surgical care [3], resulting in a lower quality of care that sometimes falls short of international standards of care;

this is complemented by the fact that the faculty in rural regions are often less-trained, with their surgical outcomes trailed by a higher frequency of complications and adverse results [4]. In recognition of the global deficit in the provision of safe, timely, and high quality surgical support, a number of medical outreach models have been developed and led by charitable organizations, nonprofits groups, and academic facilities through international outreach missions to provide the much needed medical support. Certain models have been effective at delivering care that creates sustained improvement over time, such as immunization for disease prevention, improvement of infection treatment, and water purification [5-7]. However, while many of these surgical outreach missions are effective at delivering care that benefits citizens of the host country, far too many fail at refining host surgeon skills and institutional equipment; the impact of such models is episodic, rather than sustained and scalable [7]. Pediatric neurosurgery, unlike specialties where elective care is possible, is highly technical, led by a limited number of surgeons, and involves operations that are urgent and rarely performed on a scheduled basis [8,9]. For sustained, global improvement in pediatric neurosurgical care, it is essential to educate and equip global surgeons to carry forward newly acquired surgical techniques beyond the duration of an outreach mission. This requires an outreach framework centered around educating neurosurgeons in developing regions to more effectively tackle challenging cases through new surgical techniques, as opposed to solely providing patient care to citizens, for which a follow up may not be available once the mission is complete. While transferring skills to host neurosurgeons in charity hospitals is challenging due to the lack of adequate equipment and communication barriers, the impact of a didactic model has potential to be sustained and extended as the newly trained surgeons can serve their indigent citizens indefinitely. However, there is a double challenge to navigate when providing neurosurgical support to less developed nations in the Western Hemisphere: Firstly, to varying extents, the institutions may lack the equipment needed to provide modern care. Secondly, when skills are acquired, the surgeons may not be able to teach the techniques to colleagues and students for scalable, perpetual transfer of surgical skill - this may stem from a lack of equipment, a lack of administrative support, or even a lack of time in the face of a very high volume of patients. With organizations sharing finite resources and with philanthropic needs competing for limited funds, the prospect of realizing real and sustainable improvements in pediatric neurosurgical care requires a multilayered design that can navigate these challenges and sustain the impact so that the newly acquired techniques are not lost or forgotten over time. Ethical considerations - self serving aspects, financial advantages, informed consent, conflicts of interest, compromised care, and more - should be embraced so that both host and visiting teams can fulfill shared philanthropic objectives, both in ethos and in practice [10]. The design must take advantage of academic neurosurgeons that are dedicated to being a part of the process, and be structured so that efforts can target countries that are interested and committed to sustainable improvements [5,11]. Since 2004, a number of pediatric neurosurgical outreach missions have been designed, tested, and completed in many countries in the Western Hemisphere. Having dedicated tremendous attention during these missions to transferring operative skills and enhancing the neurosurgical care of institutions in the Western Hemisphere, as well as sustaining these impacts up until 2020, valuable insights have been gathered. In light of this insight, the intent of this paper is to describe the most optimal strategic design for international pediatric neurosurgical outreach missions to secure,

sustain, and extend an impact on the neurosurgical care of populated regions with efficient resource utilization, and to assess the efficacy of this model at transferring operative skill, the essential feature of sustainable global surgical care [12].

Strategic Approach and Rational Design of Pediatric Neurosurgery Outreach Missions

Most surgical outreach missions focus on the direct provision of elective surgery for nonfatal conditions, with minimal investment on surgical education. However, from a public health standpoint, the majority of preventable surgical deaths result from injuries, obstetrics, and other surgical emergencies [7], which local providers may not be equipped or trained to address. To manage pediatric neurological pathology that typically necessitates urgent intervention, the optimal model for neurosurgical outreach must have its core a dedication to teaching surgical skills such that local providers can continue to perform emergent operations [5,13,14]. In the past, bringing this goal to fruition required a deliberate selection and deployment of mission teams, with a long term focus on effective resource utilization. In fact, existing organizations have been criticized for suboptimal utilization of millions of dollars [15]. The impact was required to fit the needs of the community and not divert local resources that have potential to be applied with greater utility elsewhere [16,17]. To be fiscally responsible and effectively transfer operative skill, collaboration was facilitated with academic neurosurgeons who are able to perpetuate the newly acquired techniques to junior faculty, while also delivering the needed surgical support to their citizens [18-20]. Charity hospitals in capital cities were the primary target institution in recognition of the fact that medical care in less industrialized nations is often dichotomized: Private clinics exist for affluent populations, while government hospitals provide care to poorer citizens but are underfunded due to political influence and/or poverty [21]. Capital cities were prioritized as referral centers are predominantly situated in capitals where health care improvements have the greatest potential to impact large populations. From the neurosurgical outreach missions, it became apparent that various states guide indigent patients to central referral centers in the capitals [12,22,23]. For each of these missions, a need for improved pediatric neurosurgical care was an obvious criterion, but the determination of "need" was complex because it is nation, city, hospital, and population dependent [24]. To navigate this challenge when selecting countries for pediatric neurosurgical outreach missions, western hemisphere nations with less than 1 million residents in their capitals were not prioritized, in accordance with the limited resources available to the mission teams [25]. Countries were also excluded if it was apparent that they had modern facilities, equipment, and adequate care. An onsite evaluation to assess the "need" of modern pediatric neurosurgical care may have also been conducted. The factors that were taken into account for the strategic design thus included but are not limited to population density, geopolitical stability based on the opinions of the visiting neurosurgeons and the general travel advisory, and the presence of dedicated neurosurgery faculty capable and willing to host missions.

Site Evaluation

The first step to the pediatric neurosurgical outreach missions was to evaluate sites in person, after establishing contact digitally, to verify that the perceived "need" was significant enough to warrant an outreach mission. That said, preliminary communication was conducted in two forms: First, digital collaboration via email, telephone, and video conferencing services took place to assess

if there was a need for surgical support, suggested by the faculty members. From there, an in-person site evaluation was conducted to corroborate the need and to make sense of the severity of it, providing insight that influenced the design of the mission. Ethically, the site evaluation ensured that there was a genuine dedication of the host neurosurgical team to improving the quality of care delivered to indigent populations. During this evaluation, relationships were forged with host neurosurgeons as well as the hospital administration. Establishing administrative support was critical for the cooperation of other surgeons in relinquishing operating days and preparing nurses for the increased case volume and postoperative needs. Ultimately, the on-site evaluation and face-to-face meeting allowed personal and logistical elements to be assessed, founding a base that could be built upon in the subsequent neurosurgery outreach missions.

Strategic Pediatric Neurosurgical Outreach Mission(s) Design

The guiding intent of the missions was to improve neurosurgical care for underserved populations in a sustainable manner by teaching and cultivating a collaborative relationship through which long-term follow up data is obtainable to assess the model's efficacy at improving the neurosurgical care delivered to citizens over time. The total number of missions, not including the in-site evaluation, was limited to three to four 1-week visits [23]. The first (inaugural) visit established the mission foundation and demonstrated the host faculty's capacity to coordinate and execute the logistics of neurosurgical care, from patient selecting to post operative management. Focused primarily on less complicated neurosurgical cases, the visiting team performed operations interspersed with grand-round style case presentation and discussion. The second mission was more collaborative, with greater attention devoted to transferring skills and expertise. The host neurosurgeon and visiting faculty were paired as primary and assistant surgeons for the duration of this trip, with the host team taking on increased responsibility for operative cases from baseline, during which they played an observation role. In some cases, specific host surgeons began to function as the primary surgeon in some cases, in accordance with his/her level of skill. During the third mission, the host team members functioned as the primary surgeons in most cases. Throughout the three to four 1-week missions, a gradual increase in the complexity of cases took place in parallel with the increasing role of the host surgeons during the operations. These missions were spaced out to take place in a span of three to four years with one mission per year. This organization allowed operative techniques to be taught during missions, deliberately practiced and mastered by the host faculty after the mission, and built upon in the subsequent mission, ensuring adequate time to refine the surgical skill set of the host neurosurgeons significantly.

Past Pediatric Neurosurgical Outreach Missions in the Western Hemisphere and Lessons Learned

In accordance with the strategic design described above, pediatric neurosurgery outreach missions were conducted with institutions located in capital cities of the selected countries in the Western Hemisphere. In a few countries, it became apparent after establishing contact that the described "need" for surgical support did not warrant a pediatric neurosurgical outreach mission. With Mexico, collaboration was first facilitated through email and telephone, though communication first revealed that the capital city's medical centers were in need of neurosurgical support. By communicating

with the host neurosurgeons, and hospital leadership of the different institutions extensively, it became apparent that the institutions were effectively providing pediatric neurosurgical support for their citizens, and there was no need for neuroendoscopy equipment or an outreach mission. That said, this insight could have not been gathered without extensive discussion, and an in person site evaluation did not take place. With Panama, digital communication eventually led to an in person site evaluation, from which it became clear that there was adequate pediatric neurosurgical equipment. To ensure that the limited resources were most appropriately used, the team moved on to assess Ecuador; however, access to the hospital was not granted. In Chile and Brazil digital communication eventually led to an in person site evaluation; however, the institutions in the capital cities of both countries had sufficient pediatric neurosurgical equipment. The importance of the in person site evaluations should not be overlooked. Some of the institutions had demonstrated that there was a need for equipment and enhanced training over the phone; however, the visits provided objective insight, illustrating that caseloads were being effectively handled, equipment was present, and faculty were well trained. This measure demonstrated that the outreach resources should be devoted elsewhere, where they may have greater utility. With Caracas, Venezuela, contact was established digitally, but a series of political crises prevented an in-person site evaluation from taking place. With Managua, Nicaragua, it became clear from communication that there was a need for surgical support. Following a successful inaugural visit, the second visit during which the host surgeons took increased responsibility for cases was disrupted. Police appeared at the medical center and escorted the visiting team to the airport, requiring them to leave the country. From these two circumstances, the importance of geopolitical stability in the host country should be well understood. Without geopolitical stability, the resources devoted to the missions may go to waste if, as with Managua, the set of missions is not completed. To make the most of the latter visit, collaboration was maintained digitally, but the impact of the two visits could not be thoroughly assessed. After establishing contact with Honduras, the faculty advised the team to reach out to El Salvador. After it became clear that there was a need for support from preliminary collaboration, an in person site evaluation was conducted. However, the COVID-19 pandemic forced the established pediatric neurosurgery outreach plans to be cancelled and it is unclear when they will be taking place. Similarly, an in person site evaluation and the inaugural neurosurgical outreach mission was conducted with Colombia; however, the COVID-19 pandemic has put the future missions in jeopardy, as it is unclear when the rest of the missions can be carried out. Over the next few years, communication with both El Salvador and Colombia will be maintained via video conferencing services to ensure that the lessons on enhancing the logistics surrounding neurosurgical care (from the initial visits) are not lost over time; once the COVID-19 pandemic is addressed in both countries and the United States, a plan for the remaining neurosurgery outreach missions will be designed and executed. Contact will also be made with Paraguay to determine if there is a need for pediatric neurosurgical support. In Kiev, Ukraine; Lima, Peru; and La Paz, Bolivia, the results have been much more promising. In Lima, Peru and Kiev Ukraine, three outreach missions were conducted from 2004-2006 and 2005-2007, respectively, with one 1-week mission each year. Through these missions, the visiting neurosurgeons were able to sufficiently transfer operative neuroendoscopic technique to the host faculty, displacing the riskier ventriculoperitoneal shunting procedures that had been taking place routinely. The 5 and 4 year

follow ups captured promising data: in addition to both institutions taking on an increasing volumes of neuroendoscopy cases with very low complications in the subsequent years, a neuroendoscopy training program had been formally established, and the skills were being passed on and utilized for a range of diagnostic and treatment processes, including biopsies [12,23]. In other words, operative skill was transferred in a self sustaining manner in both Peru and Ukraine, and collaboration continues to take place digitally to further enhance the skill set of the host surgeons and to ensure that the provided equipment is in proper condition to serve the patient population. Neurosurgical outreach is ongoing in Bolivia, and it should be seen that the results have been promising; it is expected that as with Lima, Peru and Kiev, Ukraine, pediatric neurosurgical techniques will be transferred in a fashion that will be naturally perpetuated on behalf of the committed faculty. In all three of these countries, the strategic design described through this paper was utilized, illustrating its efficacy at transferring operative skill; sustainability of the impact is seen through the fact that the newly trained host surgeons were able to continue providing neuroendoscopic support to patients in need after the duration of the mission, and scalability is seen through the fact that a neuroendoscopy training program was formalized to pass on the acquired skills. Additionally, with the model having been used in both Lima, Peru and Kiev, Ukraine (with the two characterized by different geopolitical and medical challenges) the replicability of the model and its capacity to serve as a template for future endeavors is illustrated [12,23]. Based on the patient populations of the countries, long-term patient follow up has remained challenging, though qualitative and anecdotal feedback serve to demonstrate that the treated patients are relieved of hydrocephalus, a condition that warrants neuroendoscopic operation, for life. A limitation faced in the missions has been ascertaining whether technical skills are effectively transferred to surgeons in training, and whether newly trained surgeons are able to manage complications related to newly learned operations [14]. One possibility to improve data acquisition is to take advantage of the hyper digital nature of the post pandemic world to gather basic patient follow up results. The dialogue to stable continued digital collaboration should begin during site evaluation and efforts to provide guidance and gather information should persist after the missions.

Conclusion and Future Directions

Experiences with charity hospitals in the capital cities of Peru and Ukraine serve to indicate that the strategic design of this pediatric neurosurgery outreach model is effective. When the priority is to teach operative technique, as opposed to perennially performing operations by a visiting mission team, sustainable surgical care is achieved and perpetuated after missions. Data from the first five subsequent years and the last decade serve to indicate that the surgeons continued to perform newly learned operations after the missions [12,23,26]. This endeavor can be carried out with limited capital and rests on the academic collaboration between the visiting and host teams by yearly missions over 3 to 4 years, avoiding pitfalls of sporadic missions while also providing ample time for didactic efforts to be deliberately practiced, extended into mastery, and built upon over time [14,18,17]. By complementing outreach missions with routine video conferences, and by allowing institutions in industrialized nations to glean insights into first world neurosurgical care digitally, the quality of care delivered internationally can be enhanced, reducing the deficit in international surgical care. Based on the model proposed, we hypothesize that the strategic renovation

of charity hospitals is an achievable goal, and can be accelerated if the medical establishment takes advantage of the hyper digital era to connect surgeons and provide digital learning opportunities to reduce the global disparities in surgical care.

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