The initial experience of InterSurgeon: an online platform to facilitate global neurosurgical partnerships

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OBJECTIVE Despite general enthusiasm for international collaboration within the organized neurosurgical community, establishing international partnerships remains challenging. The current study analyzes the initial experience of the InterSurgeon website in partnering surgeons from across the world to increase surgical collaboration.

METHODS One year after the launch of the InterSurgeon website, data were collected to quantify the number of website visits, average session duration, total numbers of matches, and number of offers and requests added to the website each month. Additionally, a 15-question survey was designed and distributed to all registered members of the website.

RESULTS There are currently 321 surgeon and institutional members of InterSurgeon representing 69 different countries and all global regions. At the time of the survey there were 277 members, of whom 76 responded to the survey, yielding a response rate of 27.4% (76/277). Twenty-five participants (32.9%) confirmed having either received a match email (12/76, 15.8%) or initiated contact with another user via the website (13/76, 17.1%). As expected, the majority of the collaborations were either between a high-income country (HIC) and a low-income country (LIC) (5/18, 27.8%) or between an HIC and a middle-income country (MIC) (9/18, 50%). Interestingly, there were 2 MIC-to-MIC collaborations (2/18, 11.1%) as well as 1 MIC-to-LIC (1/18, 5.6%) and 1 LIC-to-LIC partnership. At the time of response, 6 (33.3%) of the matches had at least resulted in initial contact via email or telephone. One of the partnerships had involved face-to-face interaction via video conference. A total of 4 respondents had traveled internationally to visit their partner's institution.

CONCLUSIONS Within its first year of launch, the InterSurgeon membership has grown significantly. The partnerships that have already been formed involve not only international visits between HICs and low- to middle-income countries (LMICs), but also telecollaboration and inter-LMIC connections that allow for greater exchange of knowledge and expertise. As membership and site features grow to include other surgical and anesthesia specialties, membership growth and utilization is expected to increase rapidly over time according to social network dynamics.

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KEYWORDS global neurosurgery; InterSurgeon; education; global health; telemedicine

THE growing role of global surgery has only recently been recognized as an essential priority in the broader realm of global health.^{9,10,19} Recent landmarks such as the Lancet Commission on Global Surgery¹³ and focused efforts by the WHO¹⁵ have demonstrated a growing momentum in efforts and advocacy for providing surgical care within the global health arena. Indeed, it is estimated that an additional 143 million surgical procedures are needed each year, with approximately 15% of

those cases being neurosurgical.¹⁴ Several recent studies have estimated the burden of untreated neurosurgical disease, finding that in many cases the majority of neurosurgical pathology occurs in locations with the lowest access to neurosurgical care.^{1,6,7,17} This disparity of care has significant implications for the economic and overall quality of life for patients, their families, and their communities.

International neurosurgical development has gained significant attention in the global health discourse as great-

ABBREVIATIONS AFR = Africa; AMR = Americas; EMR = Eastern Mediterranean region; EUR = Europe; HIC = high-income country; LIC = low-income country; LMIC = low- to middle-income country; MIC = middle-income country; NGO = nongovernmental organization; SEAR = Southeast Asia region; WPR = Western Pacific region.

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er understanding is achieved regarding the burden of untreated neurosurgical disease^{2,17} and the need for a greater neurosurgical workforce.^{3,6} In recent years the trend for such development has moved away from high-volume surgical mission-type trips and toward focused educational endeavors between surgeons and institutions in high-income countries (HICs) and neurosurgical partners in low- to middle-income countries (LMICs).¹⁸ Despite enthusiasm for international collaboration by members within the organized neurosurgical community, establishing international partnerships remains challenging for many reasons. Recent work suggests that one of the largest barriers to establishing these collaborations is the identification of potential partners, previously mediated by incomplete, cloistered databases and word of mouth within existing national and international neurosurgical organizations.⁵

In order to lower the barriers to information access and better facilitate global surgical partnerships outside existing siloed organizations, the core concept of an independent, internet-based social network platform was formulated by a group of pediatric neurosurgeons at the AANS meeting in Los Angeles in April 2017. Initial funding support was provided by the International Society for Pediatric Neurosurgery, the University of Alabama at Birmingham School of Medicine and Department of Neurosurgery, the Pediatric Section of the AANS/CNS, and private donors. InterSurgeon was established as a nonprofit organization, has been awarded UK charity status, and depends on donations from organizations and individuals. In close cooperation with Novagram Design (London, UK), the InterSurgeon website (www.InterSurgeon.org) was developed based on principles of popular social network platforms like Airbnb, Yelp, and Uber to allow intuitive browse and search functions, image posting, site reviews, and links to other popular social media platforms like Twitter and Facebook.

Through this free online platform, physicians are able to create profiles of their institution, languages spoken, surgical practice, expertise, equipment availability, training needs, and academic interests. These profiles may then be browsed and searched, with a matching algorithm that allows appropriate automated matching of mentor and learner surgeons for international collaborations, with specific emphasis on clinical assistance, education, equipment, research, or training program development. Initially launched with a single module dedicated to pediatric neurosurgery, InterSurgeon has expanded to include adult neurosurgery and urological surgery. This year, InterSurgeon has partnered with the G4 Alliance (www.theg4alliance.org), an international consortium of more than 80 nongovernmental organizations (NGOs) dedicated to improving access to surgical, obstetric, trauma, and anesthesia care, and in late 2019 a new version was launched that includes modules that cover the entire spectrum of surgical and anesthetic subspecialties.

After the initial proof of principle and rapid growth in membership, the authors believed it was necessary to more formally assess the actual effectiveness of the site for facilitating neurosurgical partnerships based on a survey of the membership. The current study analyzes the first 18 months of experience of the InterSurgeon website

to better quantify matching success and to better understand the strengths and weaknesses of this novel approach to increasing international neurosurgical partnerships.

Methods

Web Data

The data analytics function of the website was used to obtain the number of website visits, average session duration, total numbers of matches, and number of offers and requests added to the website each month. Limited demographic data were obtained to determine country of origin and type of device used to access the website. Descriptive statistics were used to determine trends in membership, email matches, and number of offers and requests over time.

Survey

All members of InterSurgeon were surveyed in order to better understand the subjective experience of InterSurgeon users and to obtain details of any partnerships that occurred after a match email was received. A 15-question survey was designed using the EQUATOR (Enhancing the Quality and Transparency of Health Research) criteria.¹² An email invitation for the survey was sent out to all users on March 26, 2019. Two reminder emails were sent to encourage further participation. Details regarding country of participation, characteristics of partnership, barriers to collaboration, and subjective assessment of the website experience were obtained. Descriptive statistics were used to summarize user responses. The user responses were then used to generate maps using the Tableau Public (version 2019.3.0) software for visualization of geographic response rate and partnership formation.

Results

Web Access and Usership

Since launching in March of 2018, there have been a total of 3851 visits to the website by 360 unique visitors. There were a total of 727 user sessions, and on average 54.2% of website visitors stayed more than 1 minute and navigated to additional screens beyond the home page. The average session duration was 3 minutes and 31 seconds. The most common means of access were computer (426/727, 58.6%), mobile phone (275/727, 37.8%), and tablet (26/727, 3.6%). There are currently a total of 321 members with a mean and median of 14 and 8 new members per month, respectively (range 1–66 new members). The membership represents 69 different countries and all global regions. There are 100 users from the Americas (AMR), 90 from Europe (EUR), 49 from Africa (AFR), 37 from the Southeast Asia region (SEAR), 32 from the Western Pacific region (WPR), and 13 from the Eastern Mediterranean region (EMR) (Table 1). The most common country of membership is the United States with 63 members, followed by the UK with 40, India with 24, and Nigeria with 14 (Fig. 1).

The majority of members are trained pediatric neurosurgeons (169/321, 52.6%), followed by consultant neurosurgeons with pediatric interest (67/321, 20.9%), adult neu-

TABLE 1. All InterSurgeon users by WHO region and surgical specialty

Variable	No.	%
Users by WHO region		
AMR	100	31.2
EUR	90	28
AFR	49	15.3
SEAR	37	11.5
WPR	32	10
EMR	13	4
Users by specialty		
Trained pediatric neurosurgeon	169	52.6
Neurosurgeon with pediatric interest	67	20.9
Adult neurosurgeon	48	15
Urological surgeon	37	11.5
General surgeon	3	0.9
Member type		
Individual surgeon	186	57.9
University academic department	60	18.7
Clinical department with teaching program	57	17.8
Clinical department	23	7.2

Data obtained from InterSurgeon. Please note that some users listed multiple specialties and member types.

rosurgeons (48/321, 15%), and urological surgeons (37/321, 11.5%). There were a total of 311 automated match emails sent to users, with a mean of 22.5 and a median of 13 new matches made each month. Additionally, there have been a total of 78 unique offers or requests set up by users with a mean of 4.6 and a median of 3 new requests or offers per month. Figure 2 summarizes the cumulative growth of membership, matches, and offers and requests since the website launched. The users who received the most matches were from diverse global regions, with the single most highly matched user being from SEAR and having received 26 automated matches, followed by a user from EUR with 21, AMR with 21, WPR with 20, and a user from AFR with 20 matches received.

Survey Data

There were 76 respondents to the survey from the 277 members at that time, yielding a response rate of 27.4% (76/277). Nearly all global regions were represented in the survey response with 19 from EUR, 22 from AMR, 16 from AFR, 11 from WPR, and 8 from SEAR. The only unrepresented region was EMR. The majority of respondents were faculty pediatric neurosurgeons (36/76, 47.4%) or faculty adult neurosurgeons (22/76, 28.9%). The remainder of respondents were neurosurgical trainees or students. Fifty-one participants (51/76, 67.1%) indicated that they had neither received a match email nor set up a partnership independently via the website. Twenty-five participants (25/76, 32.9%) confirmed having either re-

FIG. 1. World map demonstrating locations of InterSurgeon membership by country density. Data obtained from InterSurgeon.

FIG. 2. Line chart demonstrating the increase over time of InterSurgeon membership, numbers of matches, and offers/requests placed via the website. Data obtained from InterSurgeon.

ceived a match email via the website (12/76, 15.8%) or initiated contact with another user via the website (13/76, 17.1%). Of these, 13 users gave specific details on the geographic locations and characteristics of their 18 matched partnerships. As expected, the majority of the collaborations were either between an HIC and a low-income country (LIC) (5/18, 27.8%) or between an HIC and a middle-income country (MIC) (9/18, 50%). Interestingly, there were 2 MIC-to-MIC collaborations (2/18, 11.1%), as well as 1 MIC-to-LIC (1/18, 5.6%) and 1 LIC-to-LIC (1/18, 5.6%) partnership formed via InterSurgeon (Fig. 3).

Eight of the 18 partnerships (44.4%) originated in Western Europe and 3 originated from the United States (16.6%). Seven of the partnerships (38.9%) occurred without European or United States involvement, and in 5 (27.8%) both partners were based in the same or neighboring geographic regions (Fig. 4). Eleven (61.1%) of the described collaborations were relatively recent, having been matched less than 3 months prior to survey participation. Another 4 (22.2%) had been matched between 6 and 9 months prior, and 3 partnerships (16.7%) had occurred between 9 and 12 months prior to survey participation.

At the time of response, 6 (33.3%) of the matches had at least resulted in initial contact via email or telephone. One of the partnerships had involved face-to-face interaction via video conference. A total of 4 respondents had traveled internationally to visit their partner's institution. The remaining 7 partnerships indicated that they had communicated via the website only, with the intention of further contact in the future. When asked to explain potential barriers to in-person collaboration, 4 of 10 respondents (40%) indicated that finances and travel expenses were the chief obstacle. Another 3 respondents (30%) identified scheduling difficulties as a main barrier, and 2 respondents (20%) specified that being unsure how to develop a plan for col-

laboration was the primary obstacle. Three (30%) indicated that there were no barriers to collaboration.

In determining the main priorities of the collaboration, the development of sustainable in-country neurosurgical training was most frequently listed as being of the greatest importance, followed by surgical education via didactics and intraoperative teaching, and by clinical assistance with management of cases and operative support. Sharing of surgical equipment and development of research infrastructure were least frequently ranked as most important.

Discussion

Overview of Experience

Our data suggest that since its launch in March of 2018 the InterSurgeon website has shown consistent membership growth and has thus far facilitated a small number of international neurosurgical partnerships. Based on the current literature^{11,16} and historical trends, it is not surprising that collaborations were most commonly formed between HICs and LMICs. It is of interest, however, that there were several instances in which partnerships developed between 2 MICs or LICs. In decades prior, such collaborations would have been highly unlikely due to financial barriers to international travel and difficulty in making such connections. We propose that such communication among and between LMIC colleagues is perhaps one of the most important outcomes of the InterSurgeon platform. Indeed, technological advances such as video conference and free web-based messaging applications make the prospect of collaborating at a distance significantly more feasible for partners of all backgrounds. In addition to allowing collaboration between partners in economically similar contexts, nearly one-third of the part-

FIG. 3. Map visually depicting the global links formed by all partnerships described in the survey. The size of the dots overlying the locations is reflective of the duration of the partnership. The color of the dots and lines indicates the extent of contact involved in the partnership.

ner pairs detailed in our survey were based in the same or adjacent regions. Such geographic proximity allows for easier and financially efficient travel between partner locations. Such regional partnerships have also been advocated because they facilitate context-specific surgical education and exchange between partners with greater similarity in pathology treated, socioeconomic and cultural characteristics, and resources.⁶ These “near culture” interactions are an important step toward viable and sustainable surgical partnerships.^{20,21}

It is encouraging that 17% of the survey respondents had formed a partnership spontaneously by using the search function on the website to find and contact other neurosurgeons. This is the level of initiative and self-motivation that the InterSurgeon website was designed to assist and facilitate. Interestingly, many of the partnerships cre-

ated through InterSurgeon have thus far resulted in emails, calls, or video conference (7/18, 38.9%), as opposed to international visits. At first glance, this is not surprising because most of these collaborations have been created within the last 3 months and have not yet had time to develop into a visit. Additionally, it is possible that because many partnerships have involved LMIC-to-LMIC collaborations, there may be more emphasis on video conferencing and discussion of cases that does not require formal visits and associated travel and time away from work. These findings suggest that InterSurgeon has thus far facilitated both remote and interregional partnerships through formal visits and telecommunication.

InterSurgeon was designed with the intent of increasing global partnerships in neurosurgery, both traditional and virtual. These sorts of durable collaborations between

FIG. 4. Map visually depicting the global links formed by only partnerships based primarily in LMIC regions. The size of the *dots* overlying the locations is reflective of the duration of the partnership. The color of the *dots* and *lines* indicates the extent of contact involved in the partnership.

surgeons and institutions can potentially facilitate international education, clinical guidance, training, and research. Based on our data, we found that education and clinical guidance for cases and operative technique were thought to be the most important benefits of international collaboration (Table 2). This observation mirrors data in the global surgical literature indicating that surgical partnerships, particularly between LMICs and HICs, are most valuable when focused on training and education.^{8,13} Our data suggest that this includes not only formal and didactic teaching, but also reviewing cases, discussing operative strategies, and observing or working directly with outside neurosurgeons. With the advancement of communications technology applications like HelpLightning, WhatsApp, Viber, and others, it is becoming increasingly easy to expand neurosurgical education beyond traditional journal

publications to include email, video conversations, conference calls, shared didactics, and even virtual reality–based surgical mentorship.⁴

Interestingly, in our limited preliminary sample, developing a research infrastructure was believed to be a relatively less important feature of global neurosurgery. Despite this, we propose that it is likely that such international partnerships will still result in academic productivity as a byproduct of the clinical education over time. Additionally, given that the response to our survey was limited, it is not clear that the priorities identified by our respondents are generalizable to the entirety of the InterSurgeon membership. Based on this, we believe that there is still ample opportunity for InterSurgeon to facilitate interactions that improve our understanding of epidemiology and neurosurgical outcomes in limited-resource settings. Although this

TABLE 2. InterSurgeon survey results demonstrating demographic characteristics of respondents, number of partnerships made, duration of partnership, degree of interaction with partner, barriers to collaborating, and priorities of the interaction

Variable	No.	%				
Respondents by WHO region (n = 76)						
AMR	22	28.9				
EUR	19	25.0				
AFR	16	21.1				
SEAR	8	10.5				
WPR	11	14.5				
EMR	0	0				
Respondents by specialty (n = 76)						
Pediatric neurosurgeon	36	47.4				
Adult neurosurgeon	22	28.9				
Neurosurgical trainee	6	7.9				
Other	12	15.8				
Partnerships made (n = 76)						
No partnership	51	67.1				
Received match email	12	15.8				
Arranged via website	13	17.1				
Duration of partnership (n = 18)						
<3 months	11	61.1				
3 to <6 months	0	0				
6 to <9 months	4	22.2				
9 to 12 months	3	16.7				
Interaction with partner (n = 18)						
Website only	7	38.9				
Email or phone	6	33.3				
Video conference	1	5.6				
International visit	4	22.2				
Barriers to collaborating (n = 10)						
Finances	4	40				
Schedule conflicts	3	30				
Unsure how to proceed	2	20				
No barriers	3	30				
Priorities of collaborating (n = 19)*		1st	2nd	3rd	4th	5th
Education—didactics, bedside and intraoperative teaching		4 (21.1)	7 (36.8)	4 (21.1)	3 (15.8)	1 (5.3)
Clinical assistance—clinical care and operative support		4 (21.1)	3 (15.8)	6 (31.6)	3 (15.8)	3 (15.8)
Training—developing sustainable neurosurgical training in country		5 (26.3)	3 (15.8)	4 (21.1)	2 (10.5)	5 (26.3)
Equipment—sharing resources such as surgical instruments and supplies		3 (15.8)	3 (15.8)	2 (10.5)	7 (36.8)	4 (21.1)
Research—developing sustainable research infrastructure		3 (15.8)	3 (15.8)	3 (15.8)	4 (21.1)	6 (31.6)

* Users were asked to rank each item from 1st to 5th in terms of importance.

aspect was not emphasized by our limited cohort, global neurosurgery collaboration as a whole has the potential additional benefit of large-scale multiinstitutional research endeavors, connecting research expertise in HICs with high-volume medical centers in LMICs. Connecting these centers has the potential to increase research in global neurosurgery as well as the rigorous academic study of hydrocephalus, brain tumors, vascular disease, trauma, epilepsy, and other subjects.

Our data suggest that finances and travel expenses were the main barrier to meeting with a partner once the partnership was made, followed by scheduling difficulties and confusion with how to proceed with collaboration. Although InterSurgeon does not provide a specific format for collaboration, all members agree to comply with the organizational code of conduct prior to use. This set of guidelines outlines principles of effective collaborative partnerships, which include “preliminary discussion,” “ini-

tial visit,” “briefing of both parties on relevant social and cultural issues,” and “audit [and publication] of surgical outcomes . . . with the local team maintaining ownership of the data and intellectual property.” Such recommendations are meant to provide a framework within which a meaningful and productive collaboration can be built.

It is our hope that the increased interest in global neurosurgery will create further impetus for funding initiatives to support global collaboration. Organized neurosurgery, including but not limited to efforts by the Foundation for International Education in Neurological Surgery, the World Federation of Neurosurgical Societies, and the International Society for Pediatric Neurosurgery, has developed clinical and research fellowships for LMIC surgeons in HIC centers to help improve access to advanced neurosurgical education. It is our hope that in the future, these and other efforts will continue to facilitate and increase enthusiasm for global surgical collaboration by introducing neurosurgeons with similar interests from around the world.

Limitations of the Study

There are several obvious limitations to this study. Primarily, the study is based on data from a subjective survey with inherent biases dependent on a limited user response rate. Although the response rate is comparable to previously published surveys, there is a risk of sample error by generalizing these results to the InterSurgeon membership as a whole. Additionally, the number of partnerships generated was too small to perform continent- or region-specific analyses, so our discussion is limited to descriptive statistics only. It is noteworthy that the proportion of respondents having not formed a partnership is significantly greater than would be expected given the large number of match emails recorded by the website. Potential explanations for this include the following: 1) multiple matches going to single members in some cases; 2) it is possible that some members may have missed the match emails that were sent; and 3) some may have received a match email but elected not to respond or pursue a partnership. We currently do not have objective data on academic productivity, or the quality of partnerships created to assess program success, despite subjective testimonials from users emphasizing the success and usefulness of developed partnerships.

Future Directions

These preliminary results suggest that InterSurgeon answers an unmet need for connectivity between individuals and institutions in global neurosurgery and can be targeted to multiple surgical specialties across various geographic regions and levels of specialty training. Based on feedback from members and partnership with the G4 Alliance, an updated version of InterSurgeon was launched in late 2019 to allow registration of NGOs and their individual members involved in a wide variety of subspecialties in surgery, obstetrics, trauma, and anesthesia. Additional resources include information about creating durable and effective partnerships, education resources and information about virtual mentoring applications, and templates for conducting multinational research projects.

Conclusions

Within 1 year of launch, the InterSurgeon platform has grown significantly and expanded to include both pediatric and adult neurosurgery as well as urological surgery. It is poised to expand into other surgical disciplines and include membership by not only individuals, but also NGOs involved in advocacy and capacity building in global surgery, obstetrics, anesthesia, and trauma. Partnerships that have formed to date have involved international visits between surgeons from HICs and LMICs, as well as telecollaboration and inter-LMIC connections that allow for regional exchange of knowledge and expertise. It is our hope that InterSurgeon will continue to evolve from a website membership database to a valuable central hub of information and connectivity for international surgical, obstetric, anesthesia, and trauma care education and collaboration.

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Disclosures

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Author Contributions

Conception and design: Lepard, Haji, Davis, Harkness, Johnston. Acquisition of data: Lepard, Haji. Analysis and interpretation of data: Lepard, Akbari. Drafting the article: Lepard, Akbari. Critically revising the article: Akbari, Haji, Davis, Harkness, Johnston. Reviewed submitted version of manuscript: Davis, Harkness, Johnston. Study supervision: Harkness, Johnston.

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