January 2015

A Model For Short-Term Medical Service Trip Evaluation: Impact Of A Hand Surgery Trip To Honduras

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Impact of a Hand Surgery Trip to Honduras

A Thesis Submitted to the

Yale University School of Medicine

in Partial Fulfillment of the Requirements for the

Degree of Doctor of Medicine

by

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2015

A MODEL FOR SHORT-TERM MEDICAL SERVICE TRIP EVALUATION: IMPACT OF A HAND SURGERY TRIP TO HONDURAS. Kyle T Ragins and J Grant Thomson. Section of Plastic and Reconstructive Surgery, Department of Surgery, Yale University, School of Medicine, New Haven, CT.

This study evaluates the impact of a hand-surgery-focused short-term medical service trip (MST) to Honduras on the upper extremity morbidity and health-related quality of life of its patients. The aim of the study is to provide a quantitative measurement of patient impact, while providing a model for how other MSTs can evaluate their outcomes to eventually determine best practices for MSTs.

The 2010 Hand Help MST identified Honduran patients with indications for surgical operation on their upper extremities and conducted operations on 83 patients. Researchers administered research-validated Quick DASH and SF-12v2 surveys preoperatively and 6 months post-operatively to 70 patients to evaluate changes in patient upper extremity morbidity and overall health-related quality of life.

Patients showed statistically significant improvements in the physical component summary, physical functioning, and mental health sections of their SF-12v2 scores as well as their Quick DASH scores at 6 months post-operatively. Patients had decreased upper extremity morbidity and improved health-related quality of life 6 months post-operatively. This study demonstrates that follow-up studies of patients of MSTs in developing countries are becoming increasingly feasible with the spread of mobile phones. This study provides a model for other short-term medical missions to quantitatively measure their impact and eventually determine evidence-based best practices for MSTs.

Acknowledgements

This study would not have been possible without the incredibly generous guidance and support of Dr. Grant Thomson, my thesis advisor. Dr. Thomson opened his arms to include me in the work of his non-profit, Hand Help, Inc. even as a first-year medical student, allowing me incredible access to his work, his patients, his passion, and his intellect in designing and carrying out this study. I am also indebted to the medical students and trainees who came before me, pioneering medical student work and research with Hand Help and Dr. Thomson in Honduras including Dr. Laura Tom and Dr. Britt Colebunders. I am also thankful to Carolyn Chuang, a fellow Yale medical student, who has built on my work with Hand Help and continued the work to find new and innovative ways to increase the impact of Hand Help's work.

I would be remiss not to thank the many other health professionals that were involved in delivering care during the 2010 Hand Help trip to Honduras, including Dr. Kevin Tomany, Dr. Sohel Islam, Dr. Michael Terry, Dr. Kelly Babineaux, Dr. Richard Raker, Dr. Marcia Bergen, Dr. Gianni Checa, Dr. Alexei Birger, Dr. Nehal Gatha, Dr. Robert Golenbock, John Tangredi, Kim Rebucci, Brenda Hunt, Karyn Jozokos, Xiomara Castro, Linda Nugent, Karla Papenfuss, and Priscilla Riva. The work of this team would not have been possible without the support of the Ruth Paz Foundation, the Leonardo Martinez Hospital in San Pedro Sula, and Teleton and their many staff who helped handle logistics on the ground to make the trip a success. Furthermore, I'd like to thank Dr. Rosa Maria Tercero Rodezno and her mother, Leonor Rodezno Torres, for housing me in San Pedro Sula and being my local guides who kept me safe and sound when I returned to Honduras alone during the summer to follow up with our patients

Finally, I would like to thank Dr. John N. Forrest, Mae Geter, and the Office of Student Research at the Yale University School of Medicine for their tireless support of medical student research. Not only did the office provide me much needed guidance in designing and planning the research for this thesis, the Yale University School of Medicine Medical Student Research Fellowship, from the Office of Student Research, funded the completion of this study. The support of the Office of Student Research carried straight through to support my travel and registration to support the presentation of this research at numerous national conferences. I cannot thank Mae enough for her willingness to go above and beyond to make sure all Yale medical students, including myself, get the support we need to travel to present our research.

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Introduction

Background

Short-term medical service trips (MSTs)—short trips to foreign countries to provide medical services to those in need—have become increasingly popular among physicians from the United States and other developed countries. As of 2008, it was estimated that there are more than 6,000 such excursions from the United States alone to developing nations each year (1). The landscape of organizations and services behind these trips is complex, including groups that range from large, international organizations to small, subspecialty-focused private volunteer organizations (PVOs), providing services from primary care to specialized surgery (2). One of the most common focuses is surgical care, presumably due to the possibility that surgical operations can produce long-term health benefits with a short-term intervention (3).

The Need for Surgical MSTs

Without doubt, there is a need for the surgical services provided by MSTs. The shortage of surgical services in the developing world has been called "an existing public health emergency," with experts estimating that at least 11 percent of the world's burden of disease could be alleviated with appropriate surgical care (4, 5). In Latin America, it is estimated that 12 percent of the burden of disease could be surgically preventable (5). The deficit of trained surgical professionals in the developing world is severe. According to the most recent World Health Organization estimates, Honduras has 5.7 physicians per 10,000 persons, which is fewer than the

United States (26.7 physicians per 10,000 persons) (6, 7). Accurate data on the numbers of surgeons practicing in developing nations are not kept, but the deficit of surgical specialists is likely to be even greater (8).

Lack of Outcome Data

Despite acknowledging severe deficits in medical and surgical care in developing nations, some authors have questioned the value of MSTs to these underserved areas (9). It is true that substantial resources are provided annually toward a large volume of surgical care with little published research evaluating the impact of such MSTs on patients. The literature that does exist on MSTs tends to provide narrative accounts of their activities with "lessons learned", ideological critiques, or only very basic immediate results (10-12). One possible reason for the paucity of outcomes data is that the majority of the organizations that run MSTs are small, conducting fewer than 200 procedures annually (2). While small organizations spearheaded by a few physicians may feel that they do not have the resources to conduct comprehensive outcomes research, it is exactly this type of data that is most important in determining the future of MSTs. It is essential that we establish evidence-based best practices for small-capacity surgical groups, as these are the majority, and best practices for small-capacity groups may differ substantially from large, international organizations that conduct 50,000-100,000 surgical cases annually (2).

Review of Existing Literature

The first systematic review of the literature on MSTs was published in 2012 by Martiniuk et al., indicating growing interest in analyzing the literature to determine evidence-based recommendations for best practices in MSTs (13). While Martiniuk et al. identified 230 articles published on the topic of MSTs between between 1985 and 2009, the literature identified was mostly of low quality with 78 percent of articles providing purely descriptive accounts of MSTs, without any analysis of the effectiveness of the MST (13). The majority of the published articles did not disclose any information about the funding sources for the trips and were written by physicians who participated in the trips, introducing concerns about the possibility of large biases in what little published information does exist on MSTs (13).

The information Martiniuk et al. were able to extract from the published literature tells us about the landscape of MSTs currently being reported on and may give us some idea of the current landscape of MSTs being undertaken. Their analysis indicated that the MSTs reported on are typically short-term, with 74 percent lasting from 1 day to 4 weeks (13). The United States was the most commonly reported country of origin for MSTs in the literature, followed by Canada, Australia, and the UK (13). Honduras was the most commonly described destination country for MSTs in publication, accounting for 6.8 percent of publications overall, and 12.7 percent of those describing MSTs originating from the United States (13). While many publications did not specify a particular focus for the MST described, of those that did cleft lip and palate surgery was the most common, composing 23 percent of

reports (13). It is worth noting, however, that most MSTs never have any information published about them, descriptive or otherwise, so these statistics may not be reflective of MSTs overall, but simply those reported on.

MST Terminology

One of the difficulties encountered by Martiniuk et al. in their literature review on the topic of MSTs was that there is significant heterogeneity in the terminology used to describe MSTs. Some commonly used terms include "medical missions," "medical brigades," "volunteer trips," and "humanitarian assistance" (13). One article listed 45 different terms used in the literature to refer to the concept of MSTs (14). Meier notes that, while the term "mission" is most commonly used in the literature, it "has a religious (and sometimes negative) connotation" (15). In this paper, we have chosen to use the term "medical service trip (MST)" to avoid this religious connotation and maintain neutrality.

Recurring Themes in the Literature

Regardless of the terminology, various themes repeat themselves in the literature on the topic. In describing the benefits of MSTs, while few articles attempt to measure the impact on patients, many articles note that the impact of MSTs goes far beyond the immediate effects of the medical care delivered. In fact, many articles note that those traveling on MSTs delivering care receive significant benefits from the trip in the form of education about another place and culture or personal revitalization and reaffirmation of their passion for their work (13). The psychological benefits of

MSTs can carry over to the destination communities as well, fostering a feeling that the world is aware of their plight and building hope that more aid will come to improve community conditions (13).

Just as commonalities arise in the literature around the benefits of MSTs, common critiques also repeat themselves. Many articles note that MSTs have limited impact during the time they are present and often do not leave behind a sustainable infrastructure for improved care delivery when they are gone (13). Similarly, many question the cost-effectiveness of MSTs as a form of medical aid, noting that the significant sums spent flying a team of foreign health professionals to an underserved community to provide care might be better spent on direct aid to build the health infrastructure and capabilities of a destination community. For example, in one article a surgeon bluntly asks, "what business did our team of 10 members … have spending approximately $30,000 toward travel and hotel costs when the entire project cost for the building of a new 30-bed wing for the hospital in Ghana was $60,000?" (16).

A whole other host of criticism arises in the literature around the quality of care delivered and the ethics of MSTs. Trainees report having more autonomy to perform procedures on MSTs, whether it is a result of patient needs outstripping physician resources and ability to provide supervision or a diminished risk of malpractice legal suits in a resource-poor setting (13). Other reports describe a mentality of "fistula tourism" among physicians on MSTs, as they delight in encountering illnesses and advanced pathologies that are rare in their home countries, and which they may have little experience treating (17). Yet other concerns arise in the literature surrounding a

lack of support services or follow-up care to accompany physicians on MSTs that may leave patients with poor outcomes (13).

Review of Patient Outcomes of MSTs

Despite numerous anecdotal accounts of benefits and worries surrounding MSTs raised in the literature, there is very little actual data to describe the impact—good or bad—that MSTs have on either destination communities or physicians involved in MSTs. In 2014, Sykes conducted a follow-up systematic review of the literature on MSTs focused in particular on the issue of empirical data on MST impact. Sykes was only able to identify 67 studies presenting any kind of empirical data about a MST published between 1993 and 2013, with most of these published in recent years (the peak of 15 publications in single year occurred in 2012) (14). Of studies reporting empirical data, 81 percent described surgical MSTs, with 31 percent of those describing cleft-lip-and-palate-focused MSTs (14). Unfortunately, the vast majority of these studies empirical data is limited simply to "outputs" rather than "outcomes," simply listing the number of procedures completed and any perioperative morbidities or mortalities (14). Only 13 published studies were identified that described patient outcomes more than 8 days after the initial treatment (14). Even in these studies, the "outcomes" of patients tended to rely on individual physicians opinions of whether success was achieved and no quantitative measurements of long-term patient impact were described in any published study (14).

The Need for Research on MSTs

In sum, the published literature on MSTs is scant overall and what little exists provides little more than narrative accounts and physician opinion. There are numerous concerns surround MSTs from a patient outcome standpoint, but also from the standpoint of ethics and cost-effectiveness. While many physicians anecdotally report enjoying the experience of MSTs, the trend is rapidly growing with little data to support or guide it. There is a strong need to develop workable models for data collection to begin the slow but necessary process of obtaining the body of data necessary to develop evidence-based best practices to guide the growth of MSTs to channel the enthusiasm of physicians who want to help into activities that will have the greatest impact.

Statement of Purpose

This study quantitatively evaluates the impact of a hand-surgery-focused MST conducted by Hand Help, Inc. on patient quality of life and upper limb morbidity. Hand Help, Inc. is a small-capacity surgical volunteer organization. Hand Help was founded by Dr. J. Grant Thomson, in 2007, after a decade of experience leading hand-surgery-focused MSTs to Latin America. Hand Help, Inc. conducts 1 weeklong MST annually to the Leonardo Martinez Hospital in San Pedro Sula, Honduras, where a team including surgeons, anesthesiologists, nurses, hand therapists, pediatricians, and support staff from the United States typically operates on 60-80 patients in 5 operating days. This study evaluates the impact of the 2010 Hand Help MST to Honduras. It is the first published study of its kind, attempting to quantify the long-term impact on patient health-related quality of life and morbidity from a MST using research-validated survey tools (14). Our hypothesis in conducting the study was that we would be able to collect high quality data, despite the resource-poor setting, and data would demonstrate significant, measurable improvements in health-related quality of life in patients following operations by the Hand Help team. It is our hope that this study can provide an example to other small-capacity surgical volunteer organizations currently operating around the world, so that in the future, comparative studies of quantitative outcomes can determine evidence-based best practices for MSTs.

Methods

Mission Logistics

In January 2010, Hand Help, Inc. sponsored a surgical excursion for 1 week to the Leonardo Martinez Hospital in San Pedro Sula, Honduras. The team consisted of a total of 22 members: 3 hand surgeons, a hand surgery fellow, 2 plastic surgery residents, 3 anesthesiologists, an anesthesiology resident, a pediatrician, 6 nurses, a physical therapist, 2 medical students, and an administrator. Hand Help, Inc. has a long-standing organizational relationship with the Ruth Paz Foundation, a Honduran non-profit organization that is focused on providing healthcare to the underserved. The Ruth Paz Foundation organized local logistics to advertise to patients, arrange for local interpreters, reserve operating rooms, arrange for visas and handle foreign medical licenses, and work with the hospital to provide nursing/physician support staff for the Hand Help team during the week, and for patient follow-up appointments afterward.

On the first day of the trip, 229 patients were screened by the Hand Help team to identify those with indications for upper extremity surgical operations and to schedule these patients for operations over the subsequent week. Screening of patients included a multi-step process beginning with a history and physical examination by a surgeon, focused on the hand and arm, and assisted by an interpreter. If the surgeons determined the patient had an operable condition, the patients were additionally examined by an anesthesiologist (and a pediatrician when appropriate) to assess the patient's cardiovascular and general health suitability for operation. Following

examination by the physicians and determination that the patient was eligible to undergo an operation, the patients underwent an informed consent process for their operation. With the aid of an interpreter the surgeons explained to the patient the risks and benefits of the procedure and checked for understanding before consenting them for their and scheduling them for later in the week. Through this process, the team identified 94 patients eligible for surgical operations, scheduling them for operations over the next 5 days. By the end of the week, the team performed 84 surgical procedures on 83 patients; 11 of the originally scheduled patients did not come to their appointment or decided not to have an operation. The patients included an even breakdown of children and adults undergoing a wide variety of procedures (Table 1, Table 2).

Table 1. Demographics of patients treated during 2010 Hand Help MST

Characteristics	**Adults (36)**	**Children (36)**
Sex		
Female, % (N)	47% (17)	58% (21)
Male, % (N)	53% (19)	42% (15)
Age		
Average, years (SD)	43 (16)	8 (6)
Education		
Less than middle school, % (N)	60% (21)	85% (28)
Income		
Average household, annual $ (SD)	3970 (12200)	2490 (3900)

Note: This table only includes the patients who completed the 6-month follow-up visit and were enrolled in the outcomes study.

Table 2. Breakdown of procedures conducted during the 2010 Hand Help MST

Operation Type	Percent (N)
Syndactyly Repair	10% (7)
Polydactyly Repair	12% (9)
Tendon Transfer/Repair	14% (10)
Malunion/Nonunion Treatment	21% (15)
Scar Contracture Release/Skin Graft	20% (14)
Mass Excision	22% (16)
Carpal Tunnel Release	1% (1)

Note: This table only includes the patients who completed the 6-month follow-up visit and were enrolled in the outcomes study.

Hand Help uses standardized procedures to deal with any complications that arise in the course of treatment. Complications are categorized as either intraoperative or postoperative and managed accordingly. Since Hand Help was founded, only 2 intraoperative complications have occurred, both were patients who aspirated while under general anesthesia. Both were observed in the PACU for an hour, and, based on chest x-rays and clinical judgment, were subsequently transferred to the local university hospital to be admitted for further observation and antibiotics. Physicians on the Hand Help team rounded on these patients every day they were admitted to the

hospital until the end of the rip. Both patients improved and were discharged without sequelae. Immediate postoperative complications (up to 5 days postoperatively) are treated by the Hand Help team while they are present, while postoperative complications that occur after the Hand Help team departs are treated by local hospitalists and an orthopedic surgeon with whom the Hand Help team partners to provide follow-up care. Various minor postoperative complications have been observed both in the immediate postoperative period and subsequently, the most common being wound infections and poor skin graft take. No major complications have ever been identified. No complications of any kind occurred during the 2010 Hand Help MST to Honduras.

Patients were scheduled for follow-up visits with local physicians at the Leonardo Martinez Hospital to have stitches, casts, and/or pins removed as appropriate. Patients who lived far from the Leonardo Martinez Hospital and only needed simple stitch removal were given the option of reporting to their local health center for follow-up care. Patients in need of physical therapy following operation were given exercise instructions on discharge with examples performed by the Hand Help physical therapist, while more complex cases were referred to a local Honduran organization, Teletón, which provides free physical therapy services. Approximately 6 months after the initial operation, patients were scheduled for an additional follow-up appointment with study personnel that consisted of a history and physical examination (focused on the hand and arm).

Outcome Study Enrollment

At the time patients were scheduled for operations as part of the Hand Help MST, they were additionally offered the option of enrolling in an outcome study. Patients underwent an additional informed consent procedure for the study and were enrolled in the study once they consented. Their enrollment in the outcome study had no bearing on the care delivered through the Hand Help MST, and patients were offered the option of receiving standard care through the Hand Help MST without enrolling in the outcome study. Of the 83 patients who had operations through the 2010 Hand Help MST, 100% of them chose to enroll in the outcome study.

In addition to the standardized process for screening patients and scheduling them for operations, patients who enrolled in the outcome study also completed various surveys—described in detail below—both pre-operatively and at their follow-up appointment 6 months after the MST.

Impact Measurement

In order to quantify the impact of the Hand Help MST on patient health-related quality of life and upper limb morbidity, the team used research-validated Spanish translations of the SF-12v2 and Quick DASH (Disability of Arm, Shoulder, and Hand) survey tools. The SF-12v2 is a 12-item survey tool that has been validated as a general measure of health-related quality of life in a variety of cultural, linguistic and clinical scenarios (18). The Quick DASH is an 11-item survey tool designed to measure upper limb morbidity that has also been research-validated in a variety of

scenarios (19). These tools were chosen in order to have a general health-related quality of life outcome measure (the SF-12v2) that would allow for comparison with MSTs at large, and also a tool specifically related to the hand surgery focus of the Hand Help MST (the Quick DASH).

The Quick DASH and SF-12v2 surveys were administered to patients pre-operatively during the January 2010 MST, and again approximately 6 months post-operatively when a researcher (Kyle Ragins) returned to Honduras to conduct follow-up appointments. Two contact phone numbers and addresses were collected for each patient pre-operatively allowing for successful contact with patients 6-months post-operatively to schedule follow-up appointments.

Prior to administration of the research surveys, patients were asked whether they felt they would be able to complete the surveys on their own. In all cases where patients were capable of reading, writing and completing the research surveys on their own, the patients were allowed to do so. For patients who did not feel confident completing the surveys on their own, or who expressed difficulty in completing the surveys on their own, the survey questions were read to the patients by our staff researcher with answers filled in by the researcher. More than 90% of the patients were able to complete the surveys on their own without assistance.

Follow-up appointments were conducted with 71 of the 83 patients (86%); 12 of the patients were lost to follow-up. During the follow-up appointment, in addition to the history and physical examination, Quick DASH, and SF-12v2 surveys already mentioned, several other surveys were administered to obtain additional information

on the Hand Help patients and their experience. The additional survey tools administered at the follow-up visit included the Progress Out of Poverty Index (PPI), the Scale for Latin American and Caribbean Household Food Security Scale (ELCSA), and a Hand-Help-developed questionnaire related to post-operative course, satisfaction, and socioeconomic status. The Progress Out of Poverty Index (PPI) is a research-validated survey tool for measuring socioeconomic status in developing countries, which determines purchasing power parity income using an asset-based estimation (20). The ELCSA is a research-validate survey tool for measuring food security in Latin American countries (21). The PPI, ELCSA, and Hand-Help-developed questionnaire were administered in order to analyze whether the social situation of the patients and their reported behaviors post-operatively had any correlation with patient outcomes, as well as providing additional quality improvement data for future Hand Help MSTs.

Healthy Honduran Reference Group

In order to provide a healthy Honduran reference population for comparison to the Hand Help MST patient responses to the research-validated surveys, a convenience sample of 31 healthy Hondurans was drawn from family members of patients in the waiting room of the Ruth Paz Clinic in San Pedro Sula. These healthy Hondurans were administered the SF-12v2, Quick DASH, and PPI surveys. Hondurans of any age or sex that stated that they were “healthy” and did not have any problems with their hands, arms, and shoulders were invited to enroll as part of the

"healthy reference group." The persons in the healthy reference group were not patients and were not being seen in the clinic for any medical condition, they were simply family members of patients who happened to be present in the clinic waiting room during July of 2010. These healthy controls completed an informed consent procedure before being enrolled as the part of the healthy Honduran reference population. Once enrolled, these persons completed the SF-12v2, Quick DASH, and PPI surveys a single time. No identifiable information was collected for this healthy reference group and these people were never followed up or contacted again in any way.

Institutional Review Board Approval

The consent procedures and study methods employed in this study were approved by the Human Investigations Committee of Yale University under HIC Protocol #1001006175 prior to the start of the study.

Statistical Analysis

The pre-operative SF-12v2 scores and Quick DASH scores for patients were compared to the SF-12v2 scores and Quick DASH scores for patients 6 months after the Hand Help MST using a paired t-test. Only 70 of the 71 patients seen on follow-up were included in statistical analyses as one patient had incomplete pre-operative data, preventing analysis. A linear regression was used to examine the correlation between PPI and ELCSA scores and changes in SF-12v2 and Quick DASH scores pre- and post-operatively. For each regression, the PPI and ELCSA scores were

regressed on the change in SF-12v2 and Quick DASH scores between pre-operative measurement and measurement at 6 months after the Hand Help MST. The SF-12v2 and Quick DASH of the Hand Help MST patients were compared to the scores of the healthy Honduran reference using an independent t-test or a t-test without the assumption of equal variances in cases where Levene's test for equality of variances suggested significant differences in variances between the two groups. Statistical analyses were conducted using SPSS version 18 for Windows statistical software.

Delegation of Research Responsibilities

The thesis author, Kyle Ragins, initiated the creation of this study after approaching Dr. J. Grant Thomson after he presented to a student group on his work with his non-profit Hand Help, Inc. Mr. Ragins proposed the idea of conducting an outcome study of the 2010 Hand Help mission, where Mr. Ragins would go on the initial mission in January 2010 and perform pre-operative evaluations of patients and then return during the Summer of 2010 to follow-up with patients 6 months after the Hand Help MST. Dr. Thomson agreed to pursue the project with Mr. Ragins and together the two identified suitable research-validated survey tools to create a quantitative measure of the Hand Help MST's impact on patients and designed the study. Mr. Ragins wrote the HIC protocol for the study and drafted the original surveys that would be used for the study. Laura Tom, another Yale medical student, provided feedback on the HIC protocol, the original surveys, and the study design, aiding with these parts of the study while Mr. Ragins took the lead.

Mr. Ragins traveled with the Hand Help MST team to San Pedro Sula, Honduras in January 2010. During the January 2010 MST, Mr. Ragins enrolled the majority of the patients in the study and conducted the initial pre-operative surveys with the patients. Help was provided by another Yale medical student, Laura Tom, a research fellow, Britt Colebunders, and an undergraduate student, Priscilla Riva, in enrolling some of the patients and conducting their initial pre-operative surveys. Laura Tom and Britt Colebunders performed all of the data entry for the pre-operative surveys transferring the data from paper to electronic form after returning from the trip in February 2010. Mr. Ragins returned to San Pedro Sula, with the logistical help of local Honduran medical students and a partner non-profit organization, the Ruth Paz Foundation to conduct the follow-up visits with 2010 Hand Help MST patients. Over the course of two months, Mr. Ragins conducted all of the patient follow-up visits for the study.

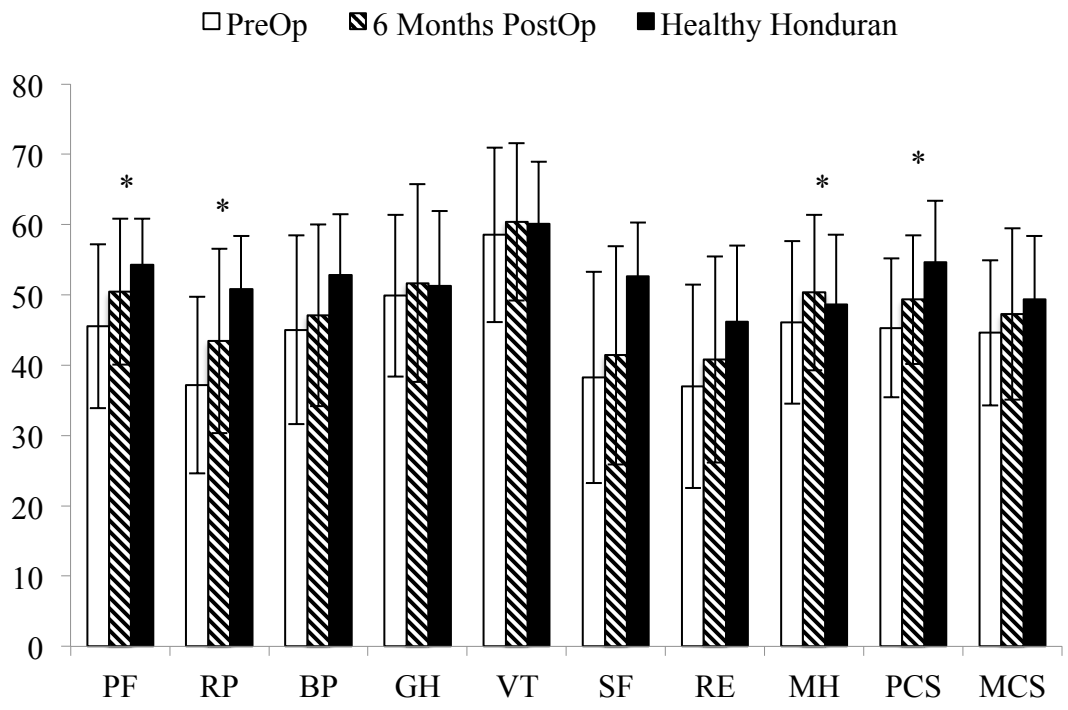
After returning from the Summer of 2010 in Honduras, Mr. Ragins conducted all of the data entry for the post-operative data, transferring it from paper to electronic form. Mr. Ragins conducted the initial statistical analysis on his own. He later got assistance from a Yale MPH student, Isabel Chen, to improve his statistical analysis. Mr. Ragins drafted all abstracts and posters for presentation of the research in the following months, with edits and improvements offered by Dr. Thomson, Laura Tom, Britt Colebunders, and Isabel Chen. Mr. Ragins additionally drafted a manuscript for publication of the research with edits and improvements offered by Dr. Thomson, Laura Tom, Britt Colebunders, Isabel Chen, and another Yale medical student,

Carolyn Chuang. Mr. Ragins finally drafted the research into a thesis with edits and improvements offered by Dr. Thomson.

Results

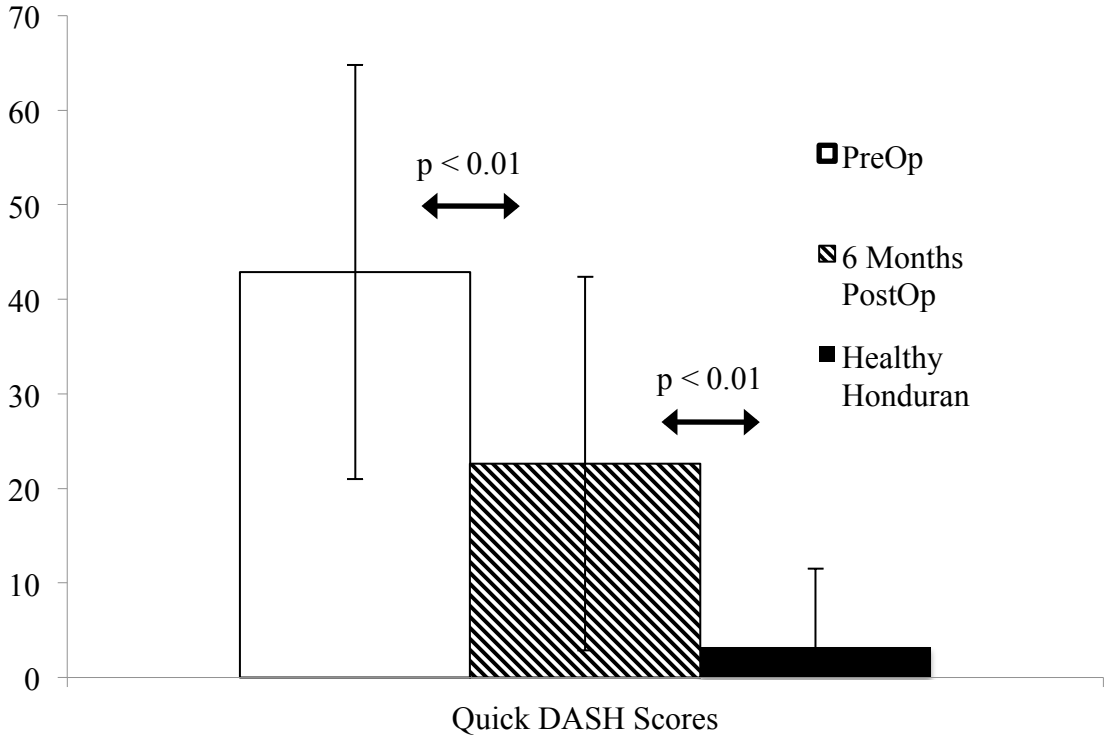
Hand Help patients trended towards improvement at 6 months following operation in health-related quality of life on all 10 SF-12v2 sub-scores, with four of these scores showing statistically significant improvements: physical functioning, role-physical functioning, physical component summary, and mental health (Figure 1, Table 3). Additionally, patients showed a statistically significant improvement in upper limb morbidity following operation indicated by an improvement in their Quick DASH scores (Figure 2, Table 3). On linear regression, a significant correlation was not found between PPI scores or ELCSA scores and post-operative changes in any SF-12v2 or Quick DASH scores.

Figure 1. SF-12v2 scores for 2010 Hand Help MST patients pre- and post-operation alongside a healthy Honduran reference group



* indicates significant ($p<0.05$) improvement in score between pre- and post-operation by paired t-test. Bars indicate standard deviation. PF: physical functioning; RP: role-physical functioning, BP:bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role-emotional functioning; MH: mental health; PCS: physical component summary; MCS: mental component summary.

Figure 2. Quick DASH scores for 2010 Hand Help MST patients pre- and post-operation alongside a healthy Honduran reference group



Bars indicate standard deviation.

Table 3. Significance of score differences between Hand Help MST patients pre- and post-operatively and compared to a healthy Honduran reference group

Outcome Score	Pre-Op vs. Post-Op	Pre-Op vs. Healthy Honduran	Post-Op vs. Health Honduran
Quick DASH	<0.001	<0.001	<0.001
Physical Functioning	0.009	<0.001	0.03
Role-Physical Functioning	0.01	<0.001	0.001
Bodily Pain	0.328	0.001	0.011
General Health	0.418	0.567	0.89
Vitality	0.372	0.478	0.89
Social Functioning	0.214	<0.001	<0.001
Role Emotional Functioning	0.18	0.001	0.046
Mental Health	0.04	0.292	0.456
Physical Composite Score	0.014	<0.001	0.008
Mental Composite Score	0.182	0.023	0.341

All values displayed are p-values. For pre-op vs. post-op comparisons a paired t-test was used. For comparisons with the healthy Honduran reference group an independent t-test was used or a t-test without the assumption of equal variances in cases where Levene's test for equality of variances suggested significantly different variances between the two groups.

Comparing Hand Help MST patients with the healthy Honduran reference group, the Hand Help MST patients scored significantly lower than the healthy reference both pre-operatively and post-operatively in 6 of 10 SF-12v2 scores as well as the Quick DASH (Figure 1, Figure 2, Table 3). On 3 of the 10 SF-12v2 domains, there was no significant difference between the healthy reference group and the Hand

Help MST patietns both pre-operatively and post-operatively (Figure 1, Table 3). In 1 of the 10 SF-12v2 scores, the mental composite score, the pre-operative score was significantly lower than the healthy group, but the post-operative score did not significantly differ from the control group (Figure 1, Table 3).

Discussion

The results of this study indicate that the 2010 Hand Help MST to Honduras had a positive impact on patient health-related quality of life and upper limb morbidity. Most of the benefit to patients appeared to be directly related to improvement in their physical abilities and functioning, since the distribution of significant improvements was primarily among the outcome measures directly related to physical ability and function: the Quick DASH score, the physical functioning score, the role-physical functioning score, and the physical composite score. These scores directly related to physical ability and function encompassed 4 out of the 5 outcomes measures that saw significant improvement post-operatively. While most of the benefit of the intervention to patients seemed to be physical, even 6 months post-operatively patients were still at a level of physical ability and function significantly below that of healthy Hondurans, as indicated by the significant differences in Quick DASH, physical functioning, role-physical, and composite physical scores between the healthy group and the Hand Help MST patients both pre- and post-operatively (Figure 1, Table 2).

The bodily pain domain of the SF-12v2 did not show significant improvement post-operatively, and the healthy Honduran reference group scored significantly better than the treatment group both pre-operatively and post-operatively (Table 1). The most likely reasoning behind this is that the improvements some patients saw in pain following operation were offset by other patients who experienced new pains following operation associated with healing, recovery, and scarring from the

operation itself. In follow-up interviews, it was common for patients to present with increased function, strength, and range of motion, but also complaints of residual pain or even new pain that they believed to be associated with the operation. This anecdotal experience appeared to be consistent with the SF-12v2 score analysis.

On the psychological spectrum of health-related quality of life, it appeared that patients saw significant benefit in their internal mood and feelings, but no significant benefit in their interaction with others from the intervention. The mental health domain of the SF-12v2 that relates to patients' internal feelings saw a significant improvement post-operatively. Of note, the mental health domain scores of patients were not significantly different from the healthy group pre-operatively or post-operatively (Table 1). It seems that, while the mental health of the MSTs patients was similar to healthy Hondurans at the start, they experienced a boost in their mental health associated with the improvements they saw in themselves after the operation. Interestingly, it does not seem that this boost in internal feelings significantly influenced the way patients interacted with others. Neither the social functioning nor role emotional functioning domain scores of the SF-12v2 saw significant improvements following operation, and both were significantly lower than the healthy group both pre- and post-operatively. These low scores surrounding social interaction also account for the lack of a significant improvement in the mental component summary score, as these components are used as part of the calculation of that score.

Of note, the vitality and general health domains of the SF-12v2 that are related to energy level and overall perception of health did not show scores that significantly

differed between the Hand Help MST patients and the healthy Honduran reference group (Table 1, Table 2). The Hand Help MST patients did not see significant gains in these scores post-operatively, but they did not differ significantly from healthy Hondurans pre-operatively either (Table 1, Table 2). This suggests that energy levels and perception of overall health are not greatly affected by upper limb morbidities in a Honduran population.

One might logically suspect that patient outcomes might be correlated with socioeconomic status in some way. As patients of lower socioeconomic status lack access to clean water or proper sanitation, one might expect to see higher post-operation infection rates. Poorer patients may have less access to transportation, limiting their access to important postoperative follow-up activities, such as hand therapy. Similarly, patients of with higher food insecurity be more prone to nutritional deficiencies. These and other factors could theoretically combine to worsen outcomes. However, our measurements of socioeconomic status, the PPI (a microfinance tool that attempts to predict purchasing power parity income based on household characteristics) and the ELCSA (which measures food insecurity) did not show significant correlations with outcomes measurements on regression (Table 3). This is encouraging, as it indicates that even the poorest patients can still experience significant benefits from the services of a MST.

It is worth noting that the Quick DASH and SF-12v2 survey tools used in this study were originally designed to be used in adults (19, 22). While the SF-12v2 has been shown to maintain validity for use with patients at least as young as 14, the

Quick DASH has not been validated in populations under 18 (18, 19). The patients analyzed in this study included both pediatric and adult patients; 54% of the patients were 18 years old and over and 46% were under 18. While this might undermine the robustness of the conclusions drawn from this study, when statistical analyses were repeated including only patients of the age groups for which the surveys were validated, the same variables saw significant ($p<0.05$) improvements post-operatively as when all the patients were included in the analysis.

The outcomes measured in this study provide some insight into how future MSTs conducted by Hand Help, Inc. might be improved in the future. The MST had a robust impact on patient's physical wellbeing, but no significant impact on their emotional/mental wellbeing. This indicates an opportunity for improvement in the MST, as programming might be developed to better address the emotional and mental state of patients in regards to their upper extremity disorders. In the context of the MST team, this might be addressed by inclusion of occupational therapists or licensed clinical social workers, who could provide support in helping patients deal with the emotional and social impact on their lives. Effectively addressing these issues in the course of the short trip, and recruiting individuals for the MST team who are capable of making an impact in the cultural and linguistic environment of Honduras would be a challenge. An alternative, that might be more likely to have a lasting impact, would be to partner with occupational therapists or social workers practicing in Honduras to provide ongoing care to Hand Help patients after the MST departs, similar to the partnership Hand Help has developed to provide physical therapy to patients after

departure. Ideally, in the same model as physical therapy is integrated into the MST for Hand Help, health professionals could accompany the MST to get patients started with care directed towards their social, mental, and emotional wellbeing during the MST, and then partner with local providers in Honduras to provide ongoing care with this goal.

Prior to this study, the only published patient outcome studies on MSTs took three forms: 1) very basic counts of complications/deaths, 2) a retrospective classification of cases as successes or failures, or 3) a qualitative description of the benefits accrued to patients (14). Prior to the last several years, only basic counts of complications and deaths existed in the literature, usually as a side note on papers more focused on giving a narrative account (14). In the last several years, a number of studies have been published on basic success rates of operations during MSTs based on retrospective analysis of patient charts and photographs, with physician classifications of cases as "successes" (12, 23, 24). The largest of these studies published is the Operation Smile International study, analyzing 4,100 patients across 40 MSTs using a standardized photographic protocol and comparing pre-op and post-op photos (25). While these studies certainly offer more information about patient outcomes than a simple list of procedures performed and perioperative complication rates, these studies do little to quantify outcomes in a way that could provide comparative best practices. Only one published study that we are aware of tries to describe MST patient outcomes in any way more complex than "success" or "failure." In this study, a researcher conducted qualitative interviews with the families of

recipients of cleft lip and palate operations, and attempted to categorize the number of patients experiencing various benefits from the operation (improved speech, etc) (26). Follow-up rates are low in all of these outcome studies (30-60%), and no quantitative measurement of patient impact has been published to this point.

Our study of the 2010 Hand Help MST is the first to quantitatively describe the impact of a MST on health-related quality of life and morbidity using research-validated tools. While there are no similar published studies quantifying the patient impact of an MST to compare our results to, our results are consistent with other more simplistic outcome studies of MSTs that found many of their cases to be "successes" (12, 23-25).

Our study is also the first published study on the outcomes of a hand-surgery-focused MST. As there are no other published studies of any kind the outcomes of a hand-surgery-focused MST, there is no way to determine whether there are differing practices with respect to hand surgery conducted in the context of an MST that might lead to improved outcomes.

While most outcomes studies of MSTs currently published describe their cases merely as successes or failures, quantitative measurements of the impact of MSTs, can provide the more granular level of detail needed to detect subtle benefits to patient outcomes from logistical changes in the way MSTs are run. Quantitative outcome data similar to that collected for the 2010 Hand Help MST could be used by even small capacity PVOs to analyze how changes in policies affect patient outcomes. Increased collection of this type of data might also contribute to determination of

which types of patients experience the greatest benefit from MST treatment. In the future, this information might provide evidence-based strategies to triage patients for MSTs to treat those most likely to benefit, when there is not time or capacity to perform procedures on all patients with all indications. If a body of literature were developed utilizing this type of outcome measure, comparative analyses between organizations and policies could also be developed to begin to determine evidence-based best practices in MSTs.

Outside of improvement in care delivery of MSTs, increased rigor in outcomes research in MSTs can also address many ethical issues raised in the literature. Ethical criticisms of MSTs and other forms of short-term medical aid are a rapidly growing component of the MST literature. However, nearly all of these criticisms base their discussion on personal experience and thought experiments rather than outcomes data from the patients and communities served in low- and middle-income countries (13). Therefore, future studies exploring outcomes of MSTs may help assess the magnitude of and resolve ethical arguments in MSTs. For example, we noted earlier that significant concerns have been raised about the quality of the care delivered and the supervision of trainees in the setting of MSTs (13). If outcome data existed to show that outcomes from MSTs are similar to those in the home countries where MSTs originate from, these critiques of MSTs would be quieted.

It is our hope that this study can serve as a model for other PVOs to conduct detailed impact analyses of their MSTs. Using short, easily-administered, research-validated surveys, high-quality, detailed patient outcomes data can be obtained on

MSTs. In the past, such research may have been harder to conduct, as locating patients for follow-up in remote, resource-poor settings was challenging. In recent years, however, cell phones have become more widespread, even among low-income families in developing countries, making patient communication for follow-up easier, even in resource-poor, remote settings. We would recommend our protocol for collecting patient contact information to any PVO interested in conducting a follow-up outcome study with patients of a short-term medical mission. We collected 2 phone numbers for every patient—usually that of the patient and another person in their family—as well as their address. With this information, we were able to achieve a high follow-up rate (86%). While in our study a researcher spent almost two months conducting these follow-ups, with a larger team and forward planning to schedule follow-up visits with patients before arrival, similar results may be possible in a much shorter time.

Conclusion

The patients of the 2010 Hand Help MST to Honduras experienced significant improvements in upper limb morbidity and health-related quality of life in physical and mental health domains 6 months following the MST. The positive patient outcomes measured, as well as the lack of correlation of these outcomes with socioeconomic status, are encouraging towards those who organize MSTs to serve the poor. Additionally, this study provides a model for others that organize MSTs to develop detailed, quantified patient outcome measurements that can be used in the future to determine evidence-based best practices for MSTs.

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