A Conceptual Model for the Evaluation of Surgical Missions

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Abstract

Background:
Medical missions to low and middle-income countries are increasingly frequent, with an estimated 6,000 trips accounting for ~ 200,000 surgical cases and over $250 million in costs annually. However, these missions have received little critical evaluation, which has prompted questions about their sustainability, cost-effectiveness, and quality of care. In response to these critiques, a few proposed frameworks for the evaluation of missions have been published. While these publications offer theoretical frameworks that detail topics for evaluation, they do not agree on which aspects should be assessed and they have not been shown to quantify or change the practices of an established mission. This paper presents proposes an evaluation model for surgical missions based on the research program of Operation Walk (Op-Walk) Boston, a mission trip to the Dominican Republic that provides total joint arthroplasty.

Methods:
We began the construction of the evaluation model by using the Center for Disease Control and Prevention’s (CDC) “Framework for Program Evaluation in Public Health” to analyze Op-Walk Boston’s prior research efforts. This led to the creation of a logic model to better visualize Op-Walk Boston’s work stream for providing care. Additionally, the logic model delineated the different aspects of the mission that should be evaluated. In order to compare how our evaluation categories compared to other evaluation models, we conducted a literature search for review papers on medical missions as well as prior evaluation models.

Using the information gathered from the CDC framework and the literature, we propose an evaluation model that calls for an assessment of the salient contextual factors (e.g. culture & beliefs), system management (structure, process and outcomes), and the sustainability of the program interventions. We then used these domains to present findings from the quantitative and qualitative research work of Op-Walk Boston.
Results:
Op-Walk Boston’s qualitative research findings demonstrated that cultural factors are important determinants of patients’ perceptions of arthritis etiology, physical activity patterns and treatment preferences. Quantitative assessments documented that the Dominican patients had worse lower extremity functional status (mean WOMAC function score of 33.6 compared to 43.3-54) and pain preoperatively than patients undergoing total hip or knee replacement in the US, yet they achieved excellent outcomes (fifty-point improvement), comparable to those of their US counterparts. Assessments of the quality and of sustainability of the program showed that the quality of care provided by Op-Walk Boston meets Blue Cross/Blue Shield Center of Excellence criteria and that sustainable changes were transferred to the host hospital. Finally, we assessed the effectiveness of Op-Walk Boston’s prior research work using the CDC’s recommended standards for effective evaluation implementation and determined that it met appropriate levels of utility, feasibility, propriety, and accuracy.

Conclusion:
Our proposed model offers a method for the formal assessment of medical missions that addresses the call for evidence of their merit. The prior research efforts of Op-Walk Boston within each of our suggested evaluation domains have improved the work of the mission by detecting both the strengths and inadequacies of the program. We suggest that surgical missions adopt quantitative and qualitative strategies to document their impact, identify areas of improvement and justify program continuation, growth and support.
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Listing of Abbreviations

CDC – Center for Disease Control and Prevention
FAIRNeSS criteria - The Framework for the Assessment of InteRNational Surgical Success
HGPS- Hospital General de la Plaza de la Salud
IRB- Institutional Review Board
LMIC - Low and middle-income countries
OA - Osteoarthritis
Op-Walk- Operation Walk
TJA - Total joint arthroplasty
WHO- World Health Organization
WOMAC- Western Ontario and McMaster Universities Arthritis
Introduction

Arthritis affects the lives of hundreds of millions of people worldwide, with osteoarthritis (OA) causing the loss of over 17 million disability-adjusted life years worldwide in 2010(1-3). The prevalence of OA is growing rapidly in low and middle-income countries (LMIC), whose populations are surviving longer and reporting higher rates of obesity, a key OA risk factor(4, 5). Additionally, patients in LMIC with inflammatory arthritis frequently develop end stage structural damage as biologic therapies are seldom available due to high cost(6).

Total joint arthroplasty (TJA) provides pain relief and functional improvement in persons with end stage arthritis(7, 8). In response to the growing burden of joint disease in LMICs, international medical missions offer TJA programs in these countries. Delivery of care through medical missions has increased, with US organizations sponsoring 6,000 trips per year(9, 10), resulting in estimated annual expenditures of $250 million(11). The cost of these missions has prompted questions about their sustainability, cost-effectiveness, and quality of care(9, 11-14). Butler et al. highlighted that short-term trips may not always benefit host institutions, as their volunteer work may cause financial losses to local surgeons and disturb daily work(15). Additionally, Butler noted that missions can produce poor outcomes if a follow-up care plan has not been identified, and may have limited impact if there is not a focus on long-term capacity building. Other authors, such as Shrime et al. have run simulated models which show that that short-term medical missions are not the most cost-effective method of health care delivery when compared to investing in and changing the practices of local public hospitals(16, 17). Although these cost-effectiveness models are not generalizable to all missions and countries, they underscore the general need to formally evaluate the impact of mission trips.

While the need for research has been recently emphasized, in a literature review on mission trips Martiniuk et al. found that only 5.7% of articles had any theoretical or conceptual analysis, with the majority being descriptive and implementation-focused (18). Additionally, Sykes found that even though over 200,000 surgeries were performed annually on mission trips, as of 2013 there were only thirteen published
studies on the long-term (≥ 8 days post treatment) outcomes of these interventions (19). Although current literature on mission trips mostly consists of descriptions of mission implementation (20-22), reflections on their experiences (23, 24), and commentary on their short falls (15, 16, 25), these articles can offer insights into which aspects of mission trips may be important to formally evaluate. Boston et al. provide an outline for surgical mission planning and discuss, for example, the importance of understanding the local health care infrastructure, as well as the possible benefits of investigating opportunities for capacity building and patient outcomes (21). Although they do not specify the manner in which these aspects can be assessed, the authors enumerate the many topics that can be used to evaluate the value of missions.

In response to the paucity of research on mission trips, a few proposed frameworks for the evaluation of missions have been published. Ibrahim et al. surveyed surgeons from developed countries and LMICs who had been involved in international missions (26). The authors used the themes from the participant’s responses to create a tool intended to measure the sustainable impact of surgical missions on LMICs. They created the FAIRNeSS criteria (The Framework for the Assessment of InteRNational Surgical Success) which identifies short-term, intermediate-term and long-term indicators of success. The authors enumerated several indicators including: number of operative cases during the mission, development of a prospective database, involvement of host staff in published manuscripts, surgical volume of local surgeons, and formal evaluations of host staff. Similarly, Maki et. al also created their own evaluation tool based on interviews with mission trip personnel (9). They developed a detailed survey that mission trips could use which was based on the following principles: cost, efficiency, impact, preparedness, education and sustainability. While both Ibrahim and Maki et. al used similar methods, the major themes in their frameworks differ. Additionally, both papers propose theoretical frameworks which have not been used to change the practices of an established mission.

Operation-Walk (Op-Walk) Boston has conducted yearly one-week trips to the Dominican Republic since 2008 to provide free total hip and knee replacements to economically disadvantaged patients. Op-Walk Boston is one of fourteen Operation Walk programs, which provide TJAs internationally, and is one of the few missions that
focus on elective procedures as opposed to trauma care(27). Op-Walk Boston is affiliated with an academic health center and numerous team members have roles in research and quality improvement. Reflecting these roots, Op-Walk Boston has instituted a robust research program evaluating multiple aspects of the mission (28-40). Given the rising popularity of global mission trips and the lack of a cohesive, evaluative framework for these endeavors, the aim of this investigation is to introduce a conceptual evaluation model for short-term surgical missions. The second aim is to describe the research approach of Op-Walk Boston using this proposed evaluation model.
Methods

Setting and mission details:

The Dominican Republic occupies the eastern two-thirds of the Caribbean island of Hispaniola. Roughly 41% of the 10.5 million Dominicans live below the international poverty line. The economy is largely agricultural and service-based, yielding a per capita gross national income of $13,570, roughly 24% of that in the US(41). Although the basic health needs of most citizens are covered by a public health care system, advanced treatments such as TJA are generally not accessible to the poor.

In 2008 Op-Walk Boston partnered with Hospital General de la Plaza de la Salud (HGPS) in Santo Domingo and has been providing pro-bono TJAs yearly. HGPS is a private hospital with over 2,200 employees, 12 operating rooms and three orthopedic surgeons who perform TJA. Prior to 2008 they collectively performed fewer than 20 TJAs annually. Op-Walk Boston sought a partnership with HGPS due to multiple key factors, such as its affiliation with a Dominican medical school, the presence of the infrastructure need for surgery, as well as dedicated orthopaedic surgeons who could provide postoperative care.

The Op-Walk Boston team consists of an average of fifty staff members from various health care fields including orthopaedic surgery, anesthesiology, internal medicine, pharmacy, physical therapy, nursing, as well as operating room personnel, medical students, and other staff. The staff members mostly work in Boston, and the majority returns every year. This American cohort works with over 200 Dominican colleagues at HGPS, including orthopaedic surgeons, nurses, medical students, and administrative staff. During the year, the administrative staff in each country work together to address logistics such as patient recruitment, which is done via public media announcements. Additionally, administrative and surgical staff across countries screen interested patients for surgical indications, medical contraindications and financial need prior to the mission week.

During each annual one-week trip Op-Walk Boston operates on approximately forty to fifty patients. Since 2008 they have performed TJAs on 380 patients with advanced, hip or knee arthritis and limited financial resources. The patients operated
upon come from almost all provinces in the country (Fig 1). The operational program costs are about $150,000 with donated implants and surgical supplies totaling about $600,000.

**Evaluation model development:**

To aid in the construction of the evaluation model we used the steps outlined in the Center for Disease Control and Prevention’s (CDC) “Framework for Program Evaluation in Public Health”(42). We chose to use the CDC’s framework because it is a detailed guide on how to properly construct, launch, and improve program evaluation. We then systematically went through their six steps in evaluation practice, which include: 1) Engage stakeholders, 2) Describe the program 3) Focus the evaluation design, 4) Gather credible evidence, 5) Justify conclusions, and 6) Ensure use and share lessons learned. Given that Op-Walk Boston has already conducted eight years of research prior to this evaluation model proposal, we retroactively applied the CDC’s suggestions to assess whether all the steps had been incorporated. Any gaps in our prior approach were considered as additions to the model proposal.

The CDC advises involving stakeholders in the program, such as international collaborators and staff, when initially developing the evaluation tool(42). Getting more parties involved allows for a variety of opinions on what topics are important to evaluate. This is especially important in international settings as engaging with host staff and patients can increase the cultural competence of the traveling cohort. Op-Walk Boston was able to engage stakeholders through its initial work exploring patients’ perspectives on OA(33), as well as later work assessing patient and physician attitudes towards pain management(37, 38).

The second step in the CDC guide consists of carefully describing the goals and activities of the program in order to better assess which aspects of the program to evaluate(42). This is often visually represented through a logic model, which illustrates the relationships between the different elements of the program(43). We created a logic model to help delineate targets for evaluation (Fig 2). This exercise emphasizes the importance of initially understanding the cultural and practical context in which the
mission is taking place prior to goal setting. Additionally, visualizing the mechanisms needed to affect change increases the organization’s ability to improve these practices.

The third and fourth steps in the CDC evaluation guide are centered on clarifying and implementing the methodological approach to program assessment(42). Specific tips include: having buy-in from stakeholders, creating detailed protocols, and working with researchers who are experienced with the intended methods. The purpose of this rigorous process is to acquire high quality data that can be used to reliably assess the impact of the mission. Op-walk Boston has been able to follow this model from the onset by working with experts in patient reported outcomes research, as well as qualitative methods. Additionally, the use of these various research methodologies has allowed for a multi-prong approach to impact assessment.

The final recommended CDC steps detail what should occur after quality data has been collected, namely using the appropriate analysis, accurately stating the conclusions, and disseminating the findings(42). The CDC emphasizes the need for proper interpretation of the data based on agreed upon standards. Op-Walk Boston has worked with statisticians and experts in quantitative and qualitative methods to ensure proper data analysis. The data has then been shared amongst the leadership team in order to evaluate the efforts of the mission and opportunities for improvement. Additionally, in order to share the lessons learned from the various research projects, Op-Walk Boston has published thirteen articles in various journals.

The exercise of going through the CDC’s “Framework for Program Evaluation in Public Health” allowed us to delineate the aspects of Op-Walk Boston that should be assessed, as well as the general structure of an evaluation tool. In order to see how other mission organizations approached this topic, we conducted a literature search for review papers on medical missions as well as prior evaluation models for missions. We searched the Cochrane Database, EMBASE, and MEDLINE. The search strategy used MeSH terms and words from the title or abstract, including “international mission,” “surgical mission,” “humanitarian,” and “volunteer.” Reviewers manually traced the bibliographies of all included studies for any citations missed by the initial search algorithm. We identified review papers by Sykes and Martiniuk et al., as well as assessment tools by Maki and Ibrahim et al.(9, 18, 19, 26). These authors identified the
following domains used to assess mission trips: patient outcomes, quality and effectiveness of care, perspectives of health care professionals and patients, sustainability, cost effectiveness, and education. We grouped these domains into three themes: quality of care, sustainability, and personal perspectives. We used these themes as a starting point for shaping our evaluation model because they aligned with previous research conducted by Op-Walk Boston.

However, given that quality of care is the most common theme in mission trip research, we felt that we needed to further clarify how to evaluate quality. Therefore, we searched for a conceptual framework for health care quality assessment to incorporate into our model and chose Donabedian’s structure, process and outcome framework due to its long-standing prominence in quality improvement literature(44).

While quality of care and sustainability are often used to assess mission trip impact, a multilevel approach is needed to capture the perspective of clinicians and patients participating in these missions. Maki et al. include patient perspectives in their model using surveys, which limit patients' ability to discuss cultural beliefs. We felt that a thorough assessment of patient perspectives should be included in the evaluation model, as this can delineate the social determinants of health in the host country. As discussed by Braveman and Gottlieb(45), social determinants can have synergistic or antagonistic relationships with medical care. Given the influence of social determinants on health we propose that missions evaluate contextual factors, such as culture and beliefs, in order to better understand the people they are serving.

Evaluation model proposal:

Using the information gathered from the literature, the CDC’s program evaluation guide, and Op-Walk Boston’s ten years of experience we propose an evaluation model based on three major domains: contextual factors, system management (structure, process and outcomes), and sustainability (Fig 3).

Contextual Factors:

As seen in our logic model (Fig 2), the ability of the mission to occur depends upon the context of the situation, i.e. the characteristics of the host setting. For example, the health literacy, and health-related beliefs of the population can shape the patterns of
utilization and outcome. Specifically, patients’ views on the etiology of their disease, need for treatment, and medication practices can alter management recommendations. Furthermore, the host institution’s treatment guidelines, such as preferred medication regimens, and health care delivery system should be understood in order to develop appropriate management strategies. Finally, identification of all stakeholders in the mission, such as the patients, host institution staff, and mission volunteers, is needed to ensure that all parties are involved in the design of the impact assessment.

**System Management:**

The system management domain is influenced by the input and output sections of the logic model (Fig 2). This domain is further stratified into three assessment categories: structure, process, and outcome. Structure includes the physical structures where care is delivered, clinical and nonclinical staff, as well as financial and administrative support. Process focuses on care processes such as screening, peri-operative evaluation, intra-operative management, and post-operative care. Both the structure and process of the mission trip organization and host institution should be assessed using standard guidelines. The results of these analyses are essential to improving the care provided by the mission as many of the factors, such as patient screening protocols, can be adjusted quickly.

The outcome category refers to the clinical outcomes of the treatments. In order to evaluate the success of the treatments supplied by the mission it is important to quantify the initial disease severity in patients, as well as outcomes using standardized, validated measures. This allows for the assessment of long-term outcomes and comparison with cohorts in other locations, which helps to quantify the impact of the mission.

**Sustainability:**

For multiyear partnerships, the sustainability and cost effectiveness of the missions should be assessed. Evaluation of host organization practices and work culture prior to and after forming a relationship with the mission organization can reveal if any changes have occurred and whether they were due to knowledge transfer. Furthermore, cost-effectiveness analyses can determine if the ratio of incremental costs and health benefits of the programs compares favorably with other programs that
compete for resources in these developing countries. The contents of this domain are drawn from the outcomes and impact section of the logic model (Fig 2).

**Brief overview of prior Op-Walk Boston research methods:**

Op-Walk Boston has used different aspects of the evaluation model in the past, which has led to thirteen publications. In order to describe the results of these investigations, here we briefly detail the technical methods used in these studies. The Op-Walk Boston research program has used quantitative and qualitative methods, as appropriate to the research question. All study procedures were approved by the institutional review boards (IRB) at both the Brigham and Women’s Hospital in Boston and HGPS in Santo Domingo.

**Quantitative methods:**

The Op-Walk Boston research program obtains patients’ preoperative and postoperative data creating a longitudinal database. All patients, with the help of a research assistant, complete a baseline survey that consists of several reliable and validated measures of health-related quality of life, as well as demographic questions and patient expectations of surgery(46, 47). We documented the reliability of these measures in this Dominican cohort(32, 48). From 2009 to 2016, 91.4% of patients completed the baseline survey. Additionally, patient reported outcomes are collected up to two years from the date of surgery. 77.5% of patients operated on between 2009 and 2015 completed at least one one-year or two-year follow-up survey.

**Qualitative methods:**

Investigators utilized structured one-on-one interviews to elicit patient and staff member beliefs and practices. Moderator’s guides were created by multidisciplinary teams including experienced qualitative researchers. Interviews were conducted in Spanish, digitally recorded and later translated into English. Transcripts were analyzed using content analysis to identify themes(49), which were then converted into a set of content area codes(50). An investigator then used this coding scheme to go back through and code each transcript. The inter-rater reliability of coding for themes and content were assessed by having an additional investigator code a subset of transcripts.
Results:
Brief overview of prior Op-Walk Boston research results:

Op-Walk Boston has conducted several research studies in the Dominican Republic during its partnership with HGPS, and these were used to inform our proposed model. Below we provide a brief overview of the results of these investigations stratified by the three evaluation domains.

Contextual Factors:

Several qualitative studies were conducted to understand how culture influences patients’ experience with disease as well as physician’s practice patterns. Niu et al. investigated patients’ understanding of arthritis and found that patients used religious and environmental theories to explain their disease. For example, they stated that their arthritis had been caused by God or through contact with water(33). Patients were also interviewed about their arthritis treatment prior to TJA. They reported a reliance on non-pharmacologic therapies, as well as family and religious support. They had limited knowledge of opioids and trusted God and their doctors to cure their pain(38).

In order to better understand the analgesic prescription culture at HGPS and compare that to the practices of Op-Walk staff, Devine et al. interviewed American and Dominican providers about their prescription patterns and decision making frameworks. Dominican surgeons rarely prescribed opioids due to limited availability, and adhered to a standardized pain protocol. This contrasted with American surgeons who subscribed to a shared decision-making model for analgesic prescribing, and prescribed various medications including opioids(37).

System Management:

Blue Cross/Blue Shield developed criteria for designating Centers of Excellence for total hip and knee replacement surgery in the US(51) that involve a combination of structural elements, processes of care and outcomes. Using the Center of Excellence criteria a study found that Op-Walk Boston scored 71 points out of a possible 100, with a score of 60 qualifying as a Center or Excellence(31). Op-Walk Boston was especially successful in satisfying process-based criteria, reflecting the capacity of the organization to collaborate with HGPS to implement high quality processes of care even in a resource constrained environment.
Research on surgical outcomes has yielded several important findings (Table 1). First, the functional status of patients undergoing TJA in the Op-Walk Boston sample is considerably worse, on average, than that of patients undergoing these procedures in high income countries (baseline WOMAC function score of 33.6 compared to 43.3-54, using a 0-100 scale where 100 is better), reflecting more advanced disease at the time of presentation(32). Nevertheless, Dominican patients improved considerably following TJA and reached average pain and function scores at one year (fifty-point improvement) that are comparable to patients who present with higher preoperative function(30). Additionally, to assess physical activity among TJA recipients, the research team developed and validated a Spanish translation of the Yale Physical Activity Scale(35). Only 43% of patients assessed 1-4 years after TJA did enough physical activity to satisfy CDC and World Health Organization (WHO) recommendations. Patients who were older, those who lived alone and those who were more pessimistic about the outcomes of surgery were less likely to be physically active(39). A related study of patients' post-operative experiences showed that patients generally resumed obligatory (those required to fulfill their social roles) activities but did not resume or try new discretionary activities(28).

Sustainability:

We studied how the Op-Walk partnership had influenced the structure and process of care at HGPS or at the home institutions of the OP-Walk Boston staff(36). This study utilized interviews with various American and Dominican personnel such as surgeons, nurses, administrative staff etc. Study participants noted sustainable changes that occurred in the way care is delivered at HGPH, due to the technical knowledge transfer and managerial examples provided by Op-Walk Boston staff. Examples included improved infection control and documentation of care. Additionally, HGPS staff attributed an evolution in nursing care to interactions with Op-Walk Boston nurses, who introduced a culture of greater independence in decision making for nurses and desire for continued education. US staff noted gaining a better appreciation for different providers' roles and greater cost-consciousness. This study also helped identify barriers to knowledge transfer in this setting, such as language and organizational hierarchy.
Evaluation model effectiveness:

Once an evaluation model has been created its effectiveness is determined by whether it is properly implemented. In order to assess the effectiveness of Op-Walk Boston’s evaluation model we referred back to the CDC’s “Framework for Program Evaluation in Public Health,” specifically the section on standards for effective evaluation implementation(42). The CDC recommends using the standards agreed upon by American Evaluation Association, which are grouped into the following assessment groups: utility, feasibility, propriety, and accuracy.

According to the utility standards used by the CDC, Op-walk Boston’s evaluation model, as exemplified by the mission’s prior publications, fulfills the following standards: stakeholder identification, evaluator credibility, proper selection of assessment topic, clarity of findings, and use of findings to change practices. In terms of the feasibility of the evaluation model, the various components of the model can lead to many achievable research endeavors. Specifically, it stresses the use of practical and cost-effective methods, as recommended by the CDC. Another consideration besides whether the research is achievable and worthwhile is whether it is being conducted ethically and legally. Op-Walk Boston has followed these guidelines in the past by obtaining IRBs at both the volunteer and host hospitals, disclosing conflicts of interest, and fully revealing project results. These acts satisfy the propriety standards. Finally, as detailed in the methods, Op-Walk Boston has fulfilled the CDC’s accuracy standards given its emphasis on obtaining quality data and using the appropriate analysis.
Discussion

The number of medical mission trips and financial investment in these endeavors has steadily increased over the years (10), prompting demands for proof of their value (13, 14). As Sykes stated in a recent systematic review: “there is a need for comprehensive data collection and outcome assessment to justify, quantify, and verify the impact of mission trips” (19). In this paper, we propose a comprehensive evaluation model for mission trips and use the work of Operation Walk Boston as an example of its implementation.

We present a new evaluation model that assesses mission quality across three domains: contextual factors, system management, and sustainability. These domains were chosen after using a logic model to lay out Op-Walk Boston’s work stream and then consolidating the different topics into general themes. An assessment of the contextual factors, such as patients’ understanding of their illness and host hospital prescription patterns, is needed in order to adapt mission practices in a culturally sensitive manner. Additionally, as all facets of the mission will be influenced by the context in which it takes place, it is important to understand these background aspects in order to improve the program (Fig 3). Our next domain, system management, focuses on quality of care by using the structure, process, outcome paradigm popularized by Donabedian (44). For this evaluation domain, we recommend the use of standardized outcome measures as they will allow for comparisons to other health care providers. Finally, our last domain, sustainability, consists of evaluating whether changes have occurred at the host institution over time due to its relationship with the mission organization. We propose that the use of this domain can help verify and justify the impact the mission has had on the host institution.

Op-Walk Boston’s implementation of this comprehensive tool illustrates the value it can provide to a mission trip. Under the contextual factors domain, Op-Walk Boston’s use of qualitative studies allowed for an increased understanding of the differences in medical practices and catalyzed adaptation to cultural norms, as well as identification of needed interventions. For example, studies on patient opioid use and physician opinions on prescription medications showed that HGPS physicians rarely prescribed opioids and patients had limited experience with them (37, 38). These observations
prompted the Op-Walk clinical leaders to reduce the role of opioids in the postoperative pain management protocols for the program, as well as evaluate the reasoning for their prescription practices at their home institutions. Additionally, studies showing patients’ limited understanding of arthritis etiology and recommended activity levels post TJA have prompted increased patient education efforts (28, 33).

To formally document the merits of the mission trip and impact on HGPS using the system management domain, the research program used the Blue Cross/Blue Shield criteria for centers of excellence and found that the mission met Center of Excellence requirements. Additionally, various studies on postoperative outcome have demonstrated that despite worse preoperative pain and function, Op-Walk patients achieved comparable levels of functional status at 1-2 years post-surgery to those observed in US cohorts (30, 32, 40). In fact, patients in the worst tertile of preoperative pain and function improved so drastically after TJA that at one year follow-up there were no differences between those patients and those who had started with the least preoperative limitations (30). These data suggest that even though TJA recipients in developing countries such as the Dominican Republic are likely to be substantially limited preoperatively, they still can achieve excellent outcomes and should not be denied surgery due to advanced functional limitations.

Given the multi-year partnership between Op-Walk Boston and HGPS, a sustainability analysis was conducted to look at the technical and managerial skills that had been conveyed while asking what inhibited further knowledge transfer (36). This study highlighted the procedural and cultural evolution that occurred at HGPS, as well as the continual obstacles created by language barriers. This investigation also provided insight into areas for improvement. Specifically, future research could collect annual educational metrics and cost data to evaluate how changes in systems management have made the mission more cost-effective and sustainable.

Conducting program evaluation in the developing world has several challenges. The infrastructure needed to conduct follow-up assessment of postoperative outcomes may be lacking. For example, the lack of reliable postal service in the Dominican Republic requires that follow up evaluations be done in person or by phone but not by mail. Additionally, it may be difficult for patients to return to the original site of treatment
if they traveled far for the operation. Despite these difficulties, Op-Walk has collected follow-up assessments of 77.5% of patients, which is largely attributed to the patients' gratitude and loyalty to the program. Further challenges include limited education and literacy in the patient population, as well as the generalizability of individual study findings.

Our study has several limitations. As our evaluation model was developed by retrospectively looking at Op-Walk Boston’s past research projects, it’s utility as a prospective tool has not been established. Additionally, while the comprehensive nature of the evaluation model will provide better documentation of a program’s merit, it may be too cumbersome for a new mission to take on. Furthermore, not all programs may have the many resources, such as statisticians and qualitative methods experts, that are needed to implement the model. Finally, the lessons learned from Op-Walk Boston’s research experience may not be generalizable to every surgical mission. However, we believe that our evaluation model provides indicators that are important for all missions to evaluate.

Conclusion

In conclusion, our proposed evaluation model offers a new method for the formal assessment of surgical mission trips. Specifically, assessing contextual factors aids in the identification of local cultural factors that can influence outcomes, and points out opportunities for better adaptation to host country customs. Additionally, qualitative and quantitative studies focused on the evaluation of system management help verify and quantify the impact of the mission on patients and the host institution. Furthermore, an analysis of the sustainability of the mission’s work at the host institution can chronicle the long-term effect of the mission. Ultimately, this evaluation model can help global mission trips implement a comprehensive research approach to document their impact and justify their endeavors.

Suggestions for Future Work

Given that our model has not been implemented prospectively, future work should demonstrate its feasibility and utility at the onset of a mission. Specifically, the
value of the evaluation model would be demonstrated if a new mission adopted this model when crafting the research component of their program. Additionally, as our model was developed from the experience of an orthopedic mission trip to the Dominican Republic, the use of the model in another setting would attest to its generalizability.

Future work could aim to distill the most salient aspects of our comprehensive tool into a more convenient, shorter form. While we believe that the breadth of our evaluation tool allows for a critical evaluation of the impact of surgical missions, a shorter form could possibly let more missions conduct their own assessments. Further research could focus on both the design of the shorter form and its implementation.
Summary

This work proposes a comprehensive evaluation model for surgical mission trips based on nearly ten years of research experience by Operation Walk Boston. The development of this evaluation model was based on the CDC’s “Framework for Program Evaluation in Public Health” and utilized a logic model to visualize and sort the program’s facets into separate evaluation domains. The work generated three distinct domains and highlighted how prior research projects within each domain changed the mission’s practice and documented its impact. Our evaluation model utilizes the following domains:

1) Contextual factors: An assessment of the background context in which the mission is taking place, e.g. patient health literacy, and host hospital policies, can improve the effectiveness of the mission work.

2) System management: Quality of care should be documented using the structure, process, outcome paradigm to establish the mission’s value.

3) Sustainability: The impact of a mission on the host institutions practices can be assessed using qualitative research methods that target the sustainability of the mission.
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Figure 1: Distribution of patients among Dominican cities.
Figure 2: Logic Model of Operation Walk Boston’s mission work

Operation Walk Boston Logic Model

**Context**
- Mission occurs in Spanish speaking nation, with low health literacy
- There is a need for musculoskeletal care
- Surgery is not covered by insurance and can be cost-prohibitive
- Host hospital has adequate resources necessary for surgery
- Host staff supports mission efforts

**Priorities**
- Patient care
- Knowledge transfer

**Inputs**
- Visiting staff
- Surgical supplies
- Mission funding
- Administrative planning
- Patient screening
- Post-operative physical therapy
- Established follow-up
- Patient surveys at baseline and follow-up

**Outputs**
- Number of cases
- Post-operative patient pain and functional outcomes
- Patient satisfaction
- Database creation
- Research publications
- Education

**Outcomes/Impact**
- Improved host health care practices
- Increased host surgical volume
- Long-term patient outcomes
- Improved mission efficiency
- Stronger partnership between host and mission organization
Figure 3: In the evaluation model, contextual factors create the background in which system management and sustainability factors interact to produce mission outcomes and impact.
| Authors, Year | Article Title | Study Type | Research Focus | Summary/Conclusions |
|--------------|--------------|------------|---------------|---------------------|
| Niu et al., 2011<sup>23</sup> | Patient Disease Perceptions and Coping Strategies for Arthritis in a Developing Nation: A Qualitative Study | Qualitative | Patient perceptions | Semi-structured interviews with patients with advanced arthritis in the Dominican Republic revealed that patients invoke religious and environmental theories of disease etiology. Social effects of arthritis are sex-specific |
| Niu et al., 2011<sup>22</sup> | Pre-operative Status and Quality of Life Following Total Joint Replacement in a Developing Country: A Prospective Pilot Study | Quantitative | Pain and functional status | Patient-reported WOMAC pain and function scores were poor preoperatively, but improved significantly after total joint TJR, indicating that TJR was effective in relieving pain and restoring function |
| Niu et al., 2011<sup>24</sup> | Singing Intervention for Preoperative Hypertension Prior to Total Joint Replacement: A Case Report | Qualitative | Preoperative therapy | A 76-year-old woman with chronic stable hypertension experienced severely elevated blood pressure prior to total knee replacement. The blood pressure dropped dramatically when she sang several religious songs. This case highlights the possible therapeutic effects of singing and the value of culturally sensitive care |
| Nwachukwu et al., 2013<sup>19</sup> | Obesity & Hypertension Are Determinants of Poor Hemodynamic Control During Total Joint Arthroplasty: A Retrospective Review | Quantitative | Intraoperative management | Retrospective cohort analysis identified hypertension and obesity as substantial risk factors for poor hemodynamic control during TJR surgery. Hypertensive and/or obese patients warrant further attention and optimization prior to TJR |
| Dempsey et al., 2013<sup>20</sup> | Associations Between Preoperative Functional Status and Functional Outcomes of Total Joint Replacement in the Dominican Republic | Quantitative | Functional status | Dominican patients with poor preoperative WOMAC and SF-36 functional scores had greater improvement but similar 12-month functional outcomes compared with patients who had a higher level of function before surgery |
| Authors, Year | Study Title                                                                                                                                         | Methodology | Research Focus         | Findings                                                                                                                                                                                                 |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dempsey et al., 2013<sup>21</sup> | Enhancing the Quality of International Orthopedic Medical Mission Trips Using the Blue Distinction Criteria for Knee and Hip Replacement Centers | Qualitative | Quality of care        | The Op-Walk Boston 2012 medical mission was evaluated using BlueCross Blue Shield’s Centers of Excellence criteria and received 71 of 100 possible points, qualifying it as a Blue Distinction center, validating the high quality of care being delivered through the program in the Dominican Republic. |
| Katz et al., 2014<sup>25</sup> | Development and Validation of a Spanish Translation of the Yale Activity Questionnaire                                                              | Translation validation | Physical activity      | We developed a new Spanish translation of the Yale Physical Activity Questionnaire and administered it to 107 Dominican subjects with advanced knee or hip arthritis just prior to or 1-4 years after TJR. The translation demonstrated convergent validity and appears well accepted and valid. |
| Stenquist et al., 2015<sup>28</sup> | Physical Activity and Experience of Total Joint Replacement in Patients One to Four Years Postsurgery in the Dominican Republic: A Qualitative Study | Qualitative | Physical activity      | Semi-structured interviews with patients with advanced arthritis revealed that TJR allowed most patients to regain previous levels of physical activity, while a few were limited by continued pain or other comorbidities. Even with remaining limitations to physical activity, many patients felt that the improved mobility that TJR afforded was life-changing. |
| Elman et al., 2014<sup>29</sup> | Participation in Physical Activity in Patients 1-4 Years Post Total Joint Replacement in the Dominican Republic                                         | Quantitative | Physical activity      | Compared with an age-matched, nonpostoperative population in the U.S., postoperative Dominican patients participate in less physical activity, as measured by the Yale Physical Activity Questionnaire. |
| Bido et al., 2015<sup>26</sup> | Sustainability Assessment of a Short-Term International Medical Mission                                                                           | Qualitative | Sustainability         | Interviews with Dominican and American staff revealed multiple sustainable changes, such as technical skills and nursing culture evolution. Cultural norms and organizational structure are important. |
| Study | Title | Method | Outcomes | Findings |
|-------|-------|--------|----------|----------|
| Devine et al., 2016<sup>27</sup> | Postoperative Pain Management Among Dominican and American Health-Care Providers: A Qualitative Analysis | Qualitative | Pain management | There were differences in Dominican vs. American provider practices in regards to patient-provider relationship, pain medication prescribing variability, and access to medications. Dominican providers described less opioid availability and thus fewer prescriptions than American providers. |
| Yu et al., 2016<sup>28</sup> | Pain Management Among Dominican Patients with Advanced Osteoarthritis: A Qualitative Study | Qualitative | Pain management | Patients reported relying on nonpharmacologic therapies as well as family and religion to cope with their pain. They reported modest use of pain medications, with limited use or knowledge of opioids. |
| Bido et al., 2017<sup>30</sup> | Predictors of Patient-Reported Outcomes of Total Joint Arthroplasty in a Developing Country | Quantitative | Pain and functional status | The predictors of follow-up pain and function outcomes in the Dominican Republic were not the same as those seen in the U.S. Worse preoperative pain and function in the Dominican patients, as well as bilateral surgery, were associated with greater improvement in function. |

*WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, TJR = total joint replacement, and SF-36 = 36-Item Short-Form Health Survey.*