

# The Orthopedic Trauma Symposium: improving care of orthopedic injuries in Haiti

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Accepted Dec. 5, 2016; Early-released  
June 1, 2017; subject to revision

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DOI: 10.1503/cjs.002316

**Background:** Although single-trip volunteer medical teams can provide much-needed acute trauma care following natural disasters, their ability to leave a legacy of improved care in the region is often limited. One way to improve treatment of traumatic injuries is through conference-based teaching, such as the Orthopedic Trauma Symposium (OTS), which took place in Haiti in 2014. However, there is little research evaluating the effectiveness of such teaching tools. We evaluated the OTS and the potential benefits of future iterations of the course.

**Methods:** A survey consisting of 5-point Likert scale questions as well as qualitative open feedback assessed respondents' opinions regarding the value, content and delivery of the OTS. Respondents were classified dichotomously in terms of their role in the OTS (instructor v. participant) to measure any meaningful difference in feedback.

**Results:** In total, 84% of all participants agreed that course content was clearly communicated, and 98% agreed that instructors were knowledgeable in the topics covered. Moreover, 87% of all participants responded that they would apply the training in their medical practices going forward.

**Conclusion:** Haitian physicians, residents and medical students responded favourably to the OTS. Open-ended questions offered concise, attainable improvements for future iterations of the course. Organizations committed to improving medical care in low- and middle-income countries should take note of these findings while continuing to develop the OTS and similar initiatives globally.

**Contexte :** Les équipes médicales bénévoles qui font des interventions ponctuelles sont en mesure de prodiguer des soins essentiels en traumatologie aigüe après des désastres naturels, mais elles laissent souvent un héritage limité pour ce qui est de l'amélioration des soins dans la région touchée. Or, il est possible d'améliorer le traitement des blessures post-traumatismes par le biais de conférences didactiques, telles que le Symposium de traumatologie-orthopédie (STO) tenu en Haïti en 2014. Peu de recherches ont toutefois mesuré l'efficacité de ce type d'outil didactique. Nous avons voulu faire un bilan du STO et des avantages potentiels qu'il y aurait à répéter l'expérience.

**Méthodes :** Un questionnaire prenant la forme d'une échelle de Likert en 5 points, ainsi que des questions qualitatives ouvertes, ont permis de recueillir l'opinion des répondeurs au sujet de l'utilité, du contenu et du déroulement du STO. Nous avons scindé les répondeurs en 2 groupes en fonction de leur rôle lors du STO (soit instructeurs, soit participants) pour mesurer les différences notables sur le plan des perceptions.

**Résultats :** En tout, 84 % de l'ensemble des participants ont affirmé que le contenu du cours avait été clairement communiqué et 98 % ont affirmé que les instructeurs connaissaient les thèmes abordés. En outre, 87 % de tous les participants ont répondu avoir l'intention d'appliquer dorénavant la formation à leur pratique médicale.

**Conclusion :** Les médecins, résidents et étudiants en médecine haïtiens ont répondu favorablement au STO. Les questions ouvertes ont suscité des suggestions concises et réalistes pour améliorer les futures éditions du cours. Les organisations vouées à l'amélioration des soins médicaux dans les pays à revenu faible et moyen devraient prendre note de ces observations tout en continuant d'exploiter la formule des STO et autres initiatives similaires ailleurs dans le monde.

The number of individuals impacted by natural disasters globally continues to rise, with as many as 200 million people being affected annually.<sup>1</sup> In 2012 the World Health Organization declared more than 700 emergencies as a result of natural disasters.<sup>2</sup> These staggering numbers have driven debate regarding the most efficient means of providing emergency medical relief to victims of such disasters. Specifically, the question of balancing emergency relief with the development of sustainable medical care for the affected population has come to the forefront.<sup>3</sup>

Following natural disasters, such as the 2010 earthquake that devastated Haiti, foreign emergency aid is often critical. This care, however, is generally unrealistic for the local populations to continue once foreign medical aid is withdrawn.<sup>4</sup> Although single-trip volunteer medical teams can provide much-needed acute trauma care, their ability to leave a legacy of improved care in the region is often limited.<sup>5</sup> To address this issue, medical relief teams, such as Team Broken Earth, have explored a more sustainable approach by continuing to provide medical support for years after the initial disaster.<sup>6</sup> These teams are mandated not only to provide care to patients, but also to provide education and training to local medical professionals. Using this approach, long-term improvements in patient care can be made.

Historically, global health organizations, such as the World Health Organization, have struggled with surgical care owing to its perceived high cost and limited public health benefits.<sup>7</sup> However, in recent years, this view has shifted. First, recent research suggests that surgical conditions are a major global health problem, with some authors estimating that 11% of the global burden of disease might be treatable with surgery.<sup>8,9</sup> Moreover, recent studies have demonstrated that surgical interventions compare quite favourably to other public health interventions in terms of their cost-effectiveness.<sup>10,11</sup>

Mock and colleagues<sup>12</sup> have argued that as many as 2 million deaths per year might be prevented by improving the care of traumatic injuries in low- and middle-income countries (LMICs). In a Ghana population, they found that long-term disability due to trauma was largely a result of orthopedic injuries.<sup>12</sup> These disabilities are often a result of absent or inadequate surgical care for the primary injury.<sup>13</sup> Although this poor level of care is multifactorial, one of the major barriers to the appropriate treatment of such injuries is the lack of appropriately trained orthopedic surgeons.<sup>14-16</sup> Some countries, such as Malawi and Mozambique, have attempted to address similar surgical shortages by training nonphysicians in surgery.<sup>17</sup>

A potentially more appropriate method to increase surgical capacity and skills would be to improve the training of medical students, residents, physicians and other health professionals who may encounter traumatic orthopedic injuries. Farmer and Kim<sup>18</sup> identified that sustain-

able surgical care in LMICs requires assistance not only in, but also beyond the operating room. A common method of training local professionals is one-on-one teaching from a volunteer surgeon in the operating room.<sup>19</sup> Although direct, this method lacks efficiency, as the number of volunteers available limits the number of opportunities for trainees. An alternative option includes providing local health professionals with course-based learning, such as that offered by the International Committee of the Red Cross in Eastern Africa.<sup>20</sup> Such courses allow for high-intensity teaching, while covering multiple clinically relevant topics over a short period of time.

A similar example of a course-based learning strategy for LMICs in need of surgical training is the Orthopedic Trauma Symposium (OTS). The symposium was held at the Bernard Mevs Hospital in Port-au-Prince, Haiti, May 15–16, 2014. The OTS was a 2-day event instructed by 8 physicians sponsored by Team Broken Earth. Instructors included 6 Canadian and 2 American orthopedic trauma surgeons. Seven of the 8 instructors had experience working in austere environments. Two senior Haitian orthopedic surgeons also participated as course instructors. The course was established to provide 2 days of orthopedic trauma care education to local Haitian physicians, residents and medical students. Ninety-three people attended the summit with representatives from all major hospitals in Haiti as well as multiple private practices. The majority of participants practised or planned to practise in a hospital-based setting, while the level of operating room capacity of the participants varied dramatically.

The ultimate goal of the OTS was to develop a standard of care on par with the World Health Organization's critical care standards in Haiti.<sup>21</sup> More specifically, the course objectives were to 1) upgrade knowledge and skills in orthopedic trauma care, 2) review the treatment of upper-extremity injuries, 3) review the treatment of lower-extremity injuries and 4) review the principles of immediate care of the injured patient with extremity injuries.

The course objectives were covered through a variety of methods, including lectures, case presentations and hands-on skill sessions (Table 1 and Table 2 outline the course syllabi for days 1 and 2, respectively). Participants were given didactic lectures on a particular topic that were translated into French in real time. Participants were then led in a related skill session where 1 or 2 instructors assisted a small group of participants. This course organization allowed for intimate discussion groups and meaningful hands-on experience.

Course-based surgical teaching in LMICs is in its nascent stage; the OTS was one of the first courses of its kind, with the first version given in Port-au-Prince in 2011. As such, there is a clear lack of research evaluating the implementation and effectiveness of such programs. The present paper offers survey data collected from both

the summit participants and instructors. We sought to compare response data from instructors with responses from participants to identify any meaningful differences. The potential implications of these data on future iterations of the OTS as well as the implementation of similar programs applied globally are explored.

## METHODS

Two separate surveys were developed to assess respondents' opinions regarding the value, content and delivery of the OTS. Both participant and instructor surveys were divided into 4 sections: course content and design (4 questions), evaluation of the instructors (3 questions), other (3 questions), and open feedback. The first 3 sections of the surveys were Likert-scale based, and the final section offered an opportunity for written feedback. The

participant qualitative section included 6 questions: 2 questions addressing topics the participants would have liked to have spent more/less time on, 3 questions prompting the participants to offer their opinions on various ways to improve the OTS and 1 question asking for any other feedback. The instructor qualitative section included 9 questions addressing the clinical application anticipated for participants moving forward as well as the instructors' opinions on the value of practical exercises and instructional aids and tools as they relate to participants as a whole and to the 3 subgroups of OTS participants individually.

Paper copies of the survey were provided to all 93 summit attendees after completion of the course. Summit participants were informed that the survey was voluntary, and both completed and uncompleted versions were collected anonymously. Summit instructors were contacted via email requesting completion of an online survey, which was also voluntary and anonymous.

### Statistical analysis

Quantitative data were analyzed using SPSS software version 19.0 (SPSS, Inc.), providing both descriptive statistics and 3 sets of *t* tests comparing the mean responses from the instructor to the responses of the 3 participant subgroups. Written comments were examined by an independent reviewer and categorized based on frequency of common themes.

## RESULTS

Of the 93 summit participants, 70 completed a course evaluation survey for an attendee response rate of 75%. Seven of the 8 instructors completed the survey for an instructor response rate of 88%. Twenty-nine of the participants self-identified as senior medical students, 21 as residents and 9 as practising physicians; 11 did not indicate their level of training.

Table 3 summarizes survey responses for the 4 respondent groups. Included are the mean values for each survey statement. In addition, Table 3 offers the percentage of each group who agreed or strongly agreed (score of 4 or 5 on the Likert scale) with each of the statements. In general, medical students disagreed more frequently with the survey statements than the other groups of respondents did. In total, 77% of all participants agreed that the OTS material was well organized and easy to understand, whereas only 58% of the students agreed or strongly agreed with that statement. Only 27% of students felt that the level of difficulty was appropriate for them, but it is important to note that only 57% of the instructors felt the material was at an appropriate level for medical students. Interestingly, a lower percentage of physicians (67%) and

**Table 1. Day 1 course syllabus (May 15, 2014)**

Time	Topic
08:30–09:00	Registration
09:00–09:10	Course introduction
09:10–09:30	Initial resuscitation of the trauma patient
09:30–10:00	Assessment of the traumatic extremity
10:00–10:30	Diagnosis and management of compartment syndrome
10:30–10:45	Coffee break
10:45–11:30	Managing the soft tissue injury in open and closed fractures
11:30–12:00	Q&A
12:00–13:00	Lunch
13:00–13:30	Damage control principles
13:30–14:00	Hand injuries
14:00–15:00	Case presentations
15:00–15:15	Coffee break
15:45–17:15	Laboratory: Introduction to basic instruments, lag screw concepts, compression plating
17:15–17:45	Q&A
17:30	Adjourn/optional casting session

**Table 2. Day 2 course syllabus (May 16, 2014)**

Time	Topic
08:00–08:30	Registration
08:30–09:00	Humeral shaft fractures
09:00–09:30	Forearm fractures
09:30–11:00	Small fragment intro/laboratory
11:00–11:15	Coffee break
11:15–11:35	Distal radius fractures
11:35–12:05	Femoral shaft fractures
12:05–13:05	Lunch
13:05–13:35	Tibial shaft fractures
13:35–13:55	Ankle fractures
13:55–15:15	Laboratory: Large external fixation tibia, spanning external fixation knee
15:15–16:00	Case presentations
16:00–16:30	Q&A
16:30	Adjourn

Table 3. Mean Likert scale scores and percentages of respondents agreeing with each survey question by participant subgrouping (4 or 5 on the Likert scale)

Questions*	Instructors			Physicians			Residents			Students			All participants†		
	n	Mean ± SD	Agree, %†	n	Mean ± SD	Agree, %†	n	Mean ± SD	Agree, %†	n	Mean ± SD	Agree, %†	n	Mean ± SD	Agree, %†
Course content and design															
Course objectives were clearly communicated	7	4.86 ± 0.38	100	9	4.11 ± 0.60	89	21	4.04 ± 0.67	81	29	4.10 ± 0.77	83	69	4.12 ± 0.7	84
Topics were well organized and easy to understand	7	4.57 ± 0.79	86	9	4.44 ± 0.73	89	21	4.28 ± 0.56	95	26	3.73 ± 0.83	58	67	4.09 ± 0.77	77
Pace was appropriate for the topics covered	7	4.57 ± 0.53	100	9	4.00 ± 0.87	67	21	3.95 ± 0.80	76	28	3.68 ± 0.67	64	68	3.79 ± 0.84	67
Level of difficulty was appropriate for															
All participants	7	4 ± 1.53	71												
Physicians	7	4.58 ± 0.79	86	9	4.00 ± 0.71	78									
Residents	7	4.43 ± 0.79	86	20	4.15 ± 0.75	80									
Students	7	3.71 ± 1.7	57	26	3.08 ± 0.74	27									
Evaluation of instructors															
Instructors were knowledgeable about the topics covered	7	5 ± 0	100	9	4.67 ± 0.5	100	20	4.60 ± 0.60	95	28	4.82 ± 0.39	100	68	4.74 ± 0.48	98
Instructors made most effective use of time together	7	5 ± 0	100	9	4.33 ± 0.5	100	20	4.25 ± 0.72	85	29	4.58 ± 0.63	93	69	4.43 ± 0.65	91
Instructors answered questions to students' satisfaction	7	5 ± 0	100	9	4.44 ± 0.53	100	20	4.25 ± 0.72	95	19	4.21 ± 0.79	79	59	4.29 ± 0.7	90
Other															
Participants will apply the training to their medical practice going forward	7	4.71 ± 0.49	100	9	4.88 ± 0.33	100	21	4.47 ± 0.81	90	29	4.17 ± 0.89	76	68	4.43 ± 0.8	87
Practical exercises were helpful and appropriate for															
All participants	7	4.57 ± 0.53	100												
Physicians	7	5 ± 0	100	9	4.56 ± 0.53	100									
Residents	7	5 ± 0	100	20	4.75 ± 0.44	100									
Students	7	4.57 ± 0.53	100	29	4.75 ± 0.44	100									
Instructional aids and tools used were helpful and appropriate for															
All participants	7	4.71 ± 0.49	100												
Physicians	7	4.86 ± 0.38	100	9	4.56 ± 0.53	100									
Residents	7	4.86 ± 0.38	100	19	4.78 ± 0.42	100									
Students	7	4.57 ± 0.79	86	28	4.46 ± 0.69	89									

SD = standard deviation.

\*Wording of statements is abbreviated from original survey.

†Combined percentages of responses of 4 or 5 on the Likert scale.

‡Including participants who did not self-identify level of training.

students (64%) than residents (76%) felt that the pace was appropriate.

Table 4, Table 5 and Table 6 display the *t* test results, comparing instructors' feedback against the 3 participant subgroups. Interestingly, the physician ( $t = 4.11, p = 0.013$ ), resident ( $t = 4.04, p = 0.006$ ) and student ( $t = 4.10, p = 0.018$ ) subgroups thought that the objectives were significantly less well communicated than did the OTS instructors. Student subgroup scores evaluating the organization ( $t = 3.73, p = 0.022$ ) and pace ( $t = 3.68, p = 0.003$ ) of the summit were both significantly lower than the instructors'

scores. In addition, both the physician ( $t = 4.56, p = 0.035$ ) and resident ( $t = 4.75, p = 0.021$ ) subgroups felt that the OTS practical exercises were not as helpful to their respective subgroups. The most striking results, however, were those concerning effective use of teaching time and answering students' questions. All participant subgroups felt that the summit teaching time was used less effectively than did the instructors (physicians:  $t = 4.33, p = 0.004$ ; residents:  $t = 4.25, p < 0.001$ ; students:  $t = 4.58, p = 0.001$ ). Further, the physician ( $t = 4.44, p = 0.013$ ), resident ( $t = 4.25, p < 0.001$ ) and student ( $t = 4.21, p < 0.001$ ) subgroups

**Table 4. Mean Likert scale scores and comparison of instructor and physician feedback**

Questions*	Instructors		Physicians		<i>p</i> value
	<i>n</i>	Mean ± SD	<i>n</i>	Mean ± SD	
Course content and design					
Course objectives were clearly communicated	7	4.86 ± 0.38	9	4.11 ± 0.60	0.013
Topics were well organized and easy to understand	7	4.57 ± 0.79	9	4.44 ± 0.73	0.74
Pace was appropriate for the topics covered	7	4.57 ± 0.53	9	4.00 ± 0.87	0.15
Level of difficulty was appropriate for physicians	7	4.58 ± 0.79	9	4.00 ± 0.71	0.15
Evaluation of instructors					
Instructors were knowledgeable about the topics covered	7	5 ± 0	9	4.67 ± 0.5	0.08
Instructors made most effective use of time together	7	5 ± 0	9	4.33 ± 0.5	0.004
Instructors answered questions to students' satisfaction	7	5 ± 0	9	4.44 ± 0.53	0.013
Other					
Participants will apply the training to their medical practice going forward	7	4.71 ± 0.49	9	4.88 ± 0.33	0.41
Practical exercises were helpful and appropriate for physicians	7	5 ± 0	9	4.56 ± 0.53	0.035
Instructional aids and tools used were helpful and appropriate for physicians	7	4.86 ± 0.38	9	4.56 ± 0.53	0.20
SD = standard deviation.					
*Wording of statements is abbreviated from the original survey.					

**Table 5. Mean Likert scale scores and comparison of instructor and resident feedback**

Questions*	Instructors		Residents		<i>p</i> value
	<i>n</i>	Mean ± SD	<i>n</i>	Mean ± SD	
Course content and design					
Course objectives were clearly communicated	7	4.86 ± 0.38	21	4.04 ± 0.67	0.006
Topics were well organized and easy to understand	7	4.57 ± 0.79	21	4.28 ± 0.56	0.30
Pace was appropriate for the topics covered	7	4.57 ± 0.53	21	3.95 ± 0.80	0.07
Level of difficulty was appropriate for residents	7	4.43 ± 0.79	20	4.15 ± 0.75	0.41
Evaluation of instructors					
Instructors were knowledgeable about the topics covered	7	5 ± 0	20	4.60 ± 0.60	0.008
Instructors made most effective use of time together	7	5 ± 0	20	4.25 ± 0.72	< 0.001
Instructors answered questions to students' satisfaction	7	5 ± 0	20	4.25 ± 0.72	< 0.001
Other					
Participants will apply the training to their medical practice going forward	7	4.71 ± 0.49	21	4.47 ± 0.81	0.47
Practical exercises were helpful and appropriate for residents	7	5 ± 0	20	4.75 ± 0.44	0.021
Instructional aids and tools used were helpful and appropriate for physicians	7	4.86 ± 0.38	19	4.78 ± 0.42	0.71
SD = standard deviation.					
*Wording of statements is abbreviated from the original survey.					

also reported significantly lower agreement than instructors with whether their questions were answered to their satisfaction.

*Participant written feedback*

Common themes that participants would have liked to spend more time on included the treatment of fractures (open fractures and fractures of various bones, as well as soft tissue management in fractures), the diagnosis and management of compartment syndrome, initial resuscitation of the trauma patient, treatment of polytrauma, discussion of flap coverage and interpretation of radiographs. The 6 major topics identified account for 87% of the feedback and are shown in Table 7. In addition, participants were asked what topics they would like to spend less time on; 38% stated they would like to spend less time on the various types of fractures.

Six main suggestions for improving the course were highlighted. Many of the responses overlapped and thus were analyzed together. The number of participants who identified each suggestion, as well as its associated frequency, is shown in Table 8. Notably, 33% of respondents would have liked handouts for the training material in order to follow along with presentations. In relation to this, some students also stated they would have liked the presentations in advance in order to prepare for the summit, and many would have liked to take the material for reference. Two respondents expressed a desire for an outline of the course in advance. Various suggestions were made about how to

distribute the material to students, including via the Internet, on compact disc and in printed form. Additional practice time was requested by 20% of participants, and some mentioned the need for materials and supplies to practise moving forward. Clinical cases were mentioned as a potentially useful tool.

*Instructor feedback*

Two important points emerged from the written instructor feedback. When asked whether in designing the course the variability of experience level of participants was taken into consideration, 6 of 7 instructors (86%) responded affirmatively. When asked who they thought was the intended audience of this course, 3 of 7 (43%) responded all of the above (physicians, residents and students), and 4 of 7 (57%) responded residents.

**DISCUSSION**

Traumatic injuries have become increasingly recognized as one of the major burdens of public health in LMICs during day-to-day life.<sup>22</sup> A subset of these traumatic injuries, those that are surgically treatable, are a significant global health problem that can be treated in a cost-effective manner compared with other global health interventions.<sup>8-11</sup> One of the major barriers to the effective treatment of traumatic injuries in these settings is the lack of appropriately trained orthopedic surgeons.<sup>18</sup> The OTS attempted to address this issue by providing trauma training to Haitian physicians, residents and medical students. Although the need for improved

**Table 6. Mean Likert scale scores and comparison of instructors and medical students**

Questions*	Instructors		Students		p value
	n	Mean ± SD	n	Mean ± SD	
Course content and design					
Course objectives were clearly communicated	7	4.86 ± 0.38	29	4.10 ± 0.77	0.018
Topics were well organized and easy to understand	7	4.57 ± 0.79	26	3.73 ± 0.83	0.022
Pace was appropriate for the topics covered	7	4.57 ± 0.53	28	3.68 ± 0.67	0.003
Level of difficulty was appropriate for students	7	3.71 ± 1.7	26	3.08 ± 0.74	0.37
Evaluation of instructors					
Instructors were knowledgeable about the topics covered	7	5 ± 0	28	4.82 ± 0.39	0.022
Instructors made most effective use of time together	7	5 ± 0	29	4.58 ± 0.63	0.001
Instructors answered questions to students' satisfaction	7	5 ± 0	19	4.21 ± 0.79	< 0.001
Other					
Participants will apply the training to their medical practice going forward	7	4.71 ± 0.49	29	4.17 ± 0.89	0.13
Practical exercises were helpful and appropriate for students	7	4.57 ± 0.53	29	4.75 ± 0.44	0.34
Instructional aids and tools used were helpful and appropriate for students	7	4.57 ± 0.79	28	4.46 ± 0.69	0.72

SD = standard deviation.  
\*Wording of statements is abbreviated from the original survey.

surgical care in LMICs has been clearly addressed,<sup>8,9,22,23</sup> there is a lack of research regarding the implementation of programs such as the OTS. The current survey data collected from OTS instructors and participants offers feedback regarding the implementation and efficacy of the OTS.

Survey results revealed that OTS participants held positive opinions of the course. In total, 98% of participants felt that the instructors were knowledgeable, 93% felt that the instructional aids used were helpful, and 87% felt they would apply their training going forward (Table 3). Despite the overwhelming positive feedback, several areas of improvement were identified in both planning and execution of the program. More specifically, areas for potential improvement included modifying the intended audience of the OTS and addressing the logistical challenges faced during implementation.

There was a clear division of responses regarding who the instructors thought was the intended audience of the OTS, with 43% indicating that the course was intended for physicians, residents and students, whereas 57% indicated that the teaching was predominantly intended for participants at the residency level of training. This lack of clarity and consensus may have led to some of the negative feedback from the course participants.

Overall, 53% of participants felt that the level of difficulty was appropriate. However, the percentage of students agreeing with the level of difficulty was much lower (27%) than the percentage of residents (80%) or physicians (78%; Table 3). This trend continued for other aspects of the course: 58% of students thought the course was well organized and easy to understand compared with 95% of residents and 89% of physicians. In addition,

79% of students felt that their questions were answered to their satisfaction compared with 95% of residents and 100% of physicians. It is worth noting the statistical comparisons of these questions between the instructor and participant surveys. Although the finding that a lower percentage of students felt the level of difficulty was appropriate is clearly valuable, it is also important to note that this was not significantly different from the instructors' opinions regarding the level of difficulty (Table 6). This may be taken to mean that although the majority of the students did not feel the level of difficulty was appropriate for them, this issue was also recognized by the OTS instructors. Alternatively, the lack of significant difference could be a result of the small instructor sample size. This is in contrast to the questions regarding organization of the summit and how well participants' questions were answered, both of which were found to have significantly different responses between the instructor and student groups.

With respect to the question of course organization, neither the physician nor the resident responses differed significantly from those of the instructors. Thus, the students were the only group who thought the course was less well organized than the instructors did. Given that the students likely have less experience with course organization than the physicians or residents, it seems likely that this poor evaluation regarding summit organization may be at least in part a reflection of students' difficulty with the material.

The present findings demonstrate the importance of determining in advance the audience of a course such as the OTS and tailoring the material to this audience. Although 86% of instructors felt that considerations were made regarding the intended audience, the lack of reliable information regarding the course attendees likely made such planning difficult. In practice, before early iterations of a course taking place in an LMIC, such information may not be available. However, subsequent iterations of the OTS should attempt to consider this information as a means of course improvement.

As discussed earlier, the implementation of a course such as the OTS will face unique challenges largely owing to the uncertainties of austere locations, such as Haiti. It is likely these uncertainties contributed to the logistical concerns indicated by the participants. Some of the common participant suggestions for improving future iterations of the OTS included handouts (33%), videos (22%) and improved facilities (43%). All of these suggestions are attainable in a high-income nation, but remain considerable challenges in an LMIC. Another issue raised by the participants was the performance of the translator. Although difficult, acquiring a translator who is bilingually proficient and has an understanding of the medical terminology might improve course communication.

**Table 7. Topics participants identified they would like to spend more time on**

Topic	No. (%)
Treatment of fractures	30 (43)
Diagnosis and management of compartment syndrome	14 (20)
Initial resuscitation of the trauma patient	13 (19)
Treatment of polytrauma	3 (4)
Discussion of flap coverage	3 (4)
Interpretation of radiographs	2 (3)

**Table 8. Participants' suggestions for course improvement**

Suggestion	No. (%)
Handouts to follow along with presentations	23 (33)
Videos to aid in lecture delivery	15 (22)
Additional practice time	14 (20)
Use of cadavers, mannequins and sawbones as teaching and practice aids	8 (12)
Additional demonstrations	6 (9)
Further courses and training	3 (4)

## Limitations

This study had 2 major limitations that should be considered. Although the response rate for both participants (75%) and instructors (88%) was high, the sample size for the instructor group ( $n = 7$ ) and physician subgroup ( $n = 9$ ) were quite small. This may have limited the statistical potential of the survey. Additionally, despite the surveys being voluntary and anonymous, it remains possible that a social desirability bias may have affected respondents' survey results.

## CONCLUSION

The survey of the OTS participants suggests that the course was well received and an excellent learning opportunity. Education and skills related to common orthopedic presentations and injuries were delivered in a practical way to be incorporated into clinical practice. The value of feedback when implementing this type of program was demonstrated, as student and instructor opinions differed regarding certain key points. Team Broken Earth and other organizations committed to improving trauma care globally should take note of these findings while continuing to improve the OTS and similar initiatives around the world.

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**Competing interests:** None declared.

**Contributors:** A. Furey designed the study. R. Normore, H. Greene and A. DeLong acquired and analyzed the data. R. Normore, H. Greene and A. DeLong wrote the article, which all authors reviewed and approved for publication.

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