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ORIGINAL SCIENTIFIC REPORT

What is the Cost of Free Cleft Surgery in the Middle East?

Samar Sheriff[1] · Hassan J. Zawahrah[3] · Lenisa V. Chang[2] · Sonay Beyatli[4] · Haithem M. Elhadi Babiker[1] · Ashton L. Roach[1] · Natalyia Biskup[1] · John A. van Aalst[1]

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Abstract

Background This project explores the costs of cleft lip and/or palate surgeries in Palestine and Sudan, two low- and middle-income countries (LMIC), in the Middle East. Our purpose is to examine the veracity of advertisements from international cleft organizations claiming that "250 US dollars (USD) covers the cost of a single cleft surgery." We hypothesize that the actual cost of surgery is greater than 250 USD.

Methods Costs for each cleft surgery were organized broadly into 5 categories: hospital charges, personnel (time and money spent for health professionals to travel to LMIC, including lost wages), tests, consumables, and reusables. Each item was priced at market value during the time of data collection. Following itemization of actual costs, we compared the costs per cleft surgery among four surgical practice models: (1) visiting international surgical teams, (2) visiting international surgeon working with local teams, (3) local teams working at government hospitals, and (4) local teams working at private hospitals.

Results Our results suggest that 250 USD is an underestimate of actual costs per cleft surgery in all models. The most expensive model in both Palestine and Sudan was the first model, visiting international teams performing all team functions; the cheapest surgical model in both countries was a local team working at government hospitals. The largest cost for any of these models is travel and lost wages for international team members. Eliminating this single cost (travel) decreases overall cost tremendously, but still does not approach the advertised cost of 250 USD.

Conclusions We conclude that 250 USD underestimates the actual costs to perform a single cleft surgery in Palestine and Sudan. If international cleft organizations are genuinely committed to creating sustainable international cleft programs, they should focus exclusively on training local professionals to perform surgery in hospitals of their own choosing.

✉ John A. van Aalst
john.vanaalst@cchmc.org

1 Division of Plastic Surgery, Cincinnati Children's Hospital Medical Center, 3333 Burnet Avenue, MCL # 2020, Cincinnati, OH 45229, USA

2 Department of Economics, University of Cincinnati, 2925 Campus Green Dr, Cincinnati, OH 45221, USA

3 Jordan University of Science and Technology, Al-Rumtha, Irbid 22110, Jordan

4 Acibadem University School of Medicine, Kerem Aydinlar Kampusu, Kayisdagi Caddesi No:32, 34752 Atasehir, Istanbul, Turkey

Introduction

Numerous philanthropic cleft organizations suggest that 250 USD covers the cost of a single cleft surgery [1, 2]. However, certain costs are likely not incorporated into this estimate. Among the five general categories of costs (hospital charges, personnel, tests, consumables, and reusables), hospital charges are generally disregarded because hospitals in many international venues allow visiting teams to use the facilities without charge. Visiting personnel costs may also be disregarded because team members are volunteers and pay for international travel. However, payment

is still required for visas, airline tickets, food, lodging, and local transportation. Additionally, lost wages for visiting volunteers are never calculated into the cost equation. Pre- and post-operative tests may be required, including chest X-rays and blood work, and are often not included as part of the cost estimate. Finally, because many cleft organizations receive discounts and donations for surgical supplies (both reusables and consumables), these costs are also not included in the estimate of 250 USD.

There have been attempts to explore the costs of cleft surgeries in the USA, but few attempts have been made to itemize surgical costs in international venues [3]. A report from a US children's hospital found the cost of bone grafting for cleft lip and palate (CL/CP) to be between $18,000 and 21,000 [4]. In another study that examined 6000 CP surgeries at pediatric hospitals throughout the USA, the mean cost per hospitalization was $19,000 [5]. Additional studies estimate the cost of care over the first 12 months-of-life for a patient with a cleft to be $13,405; lifetime expenses may be as high as $101,000 [6–9]. An alternative study found the median cost of 12 isolated CL surgeries to be $13,013 in 2008 USD [10]. Interestingly, this group found that the main drivers of cost were the surgery itself and inpatient costs. When operating room costs were further examined, the authors found that the vast majority of cost was attributable to patient time in the room, translating to facility overhead, staff, equipment, and medication charges. Surgeon compensation was another major cost driver because surgical payment is determined based on Relative value unit (RVU) and only partially dependent on time. Anesthesiologist compensation is more directly dependent on length of the procedure: the longer the surgery and time in the operating room, the more anesthesiologists are compensated. Costs also increased dramatically the moment a patient was admitted to the hospital for an overnight stay [10].

In the international philanthropic arena, Magee et al. [3] explored costs of cleft mission trips to Vietnam, Nicaragua, Kenya, and Russia with costs split into general categories: (1) mission cargo and supplies, (2) team transportation, lodging, and meals, (3) and planning and logistics. Cost per surgery ranged from 85 to 630 USD. However, the authors purposely excluded expenses incurred by partner hospitals, patients, and families, as well as the indirect expenses to Operation Smile. Cost estimates did not include significant detail about the items used during surgery.

There are multiple models for international cleft care, varying from fully functioning international cleft teams that visit a site in the developing world, with the opposite extreme being local professional-only teams, and then a myriad of hybrids, that include varying combinations of visiting professionals working with local cleft practitioners. In trip descriptions by Operation Smile International (OSI), international trips are defined as missions where over 50% of volunteers are international and/or missions that are planned and executed by OSI. Local missions are defined as surgical trips where over 50% of the volunteers are local and include trips planned and executed by local foundations [3].

The purpose of our paper is to determine cost breakdown for a single cleft surgery in both Palestine and Sudan and to compare these costs in the context of four different team models with varying involvement by visiting cleft practitioners (Fig. 1). We predict that all models for surgery will cost more than the 250 USD.

Methods

Costs for each surgery were divided into five general categories (Tables 1, 2, 3): hospital charges, personnel cost (including, when appropriate, travel and lodging expenses for visiting team members, lost wages for these professionals, and salaries for local team members), tests, reusables (multiple-use items), and consumables (single-use items). In initial work, we calculated costs for CL and CP surgery separately; however, there were minimal differences between the two types of surgery. Subsequently, all cost estimates are reported as CL/CP surgery.

In order to identify costs for each surgery, we made general assumptions about procedures performed in Palestine from 2006 to present and in Sudan from 2013 to the present. All costs were determined at current market value. Local provider salaries were determined using the purchasing power parity (PPP) method (Tables 4, 5) because non-tradable goods, such as provider salaries, are more accurate using this method. Prevailing market exchange rates were 3.87 shekels and 6.43 Sudanese pounds per 1 USD; at the time, the study was performed in June 2016 [11, 12]. The PPP method rates were 4.215785 for Palestine (an average of rates from 2000 to 2015 using the Israeli Shekel) and 3.739869 for Sudan (an average of the two Sudanese PPP factors from 2014 to 2015) [6, 7, 13]. All results were based on online price listings as well as interviews with employees of hospitals, pharmacies, and medical supply vendors both in the USA and in the respective countries.

Additionally, we compared costs per surgery in the context of four team models: (1) visiting international surgical teams, (2) visiting international surgeon working with local teams, (3) local teams working at government hospitals, and (4) local teams working at private hospitals. In the first model, all team members are assumed to be visiting international professionals. Within the second model, we recognize that multiple hybrids may exist (combinations of visiting and local professionals);

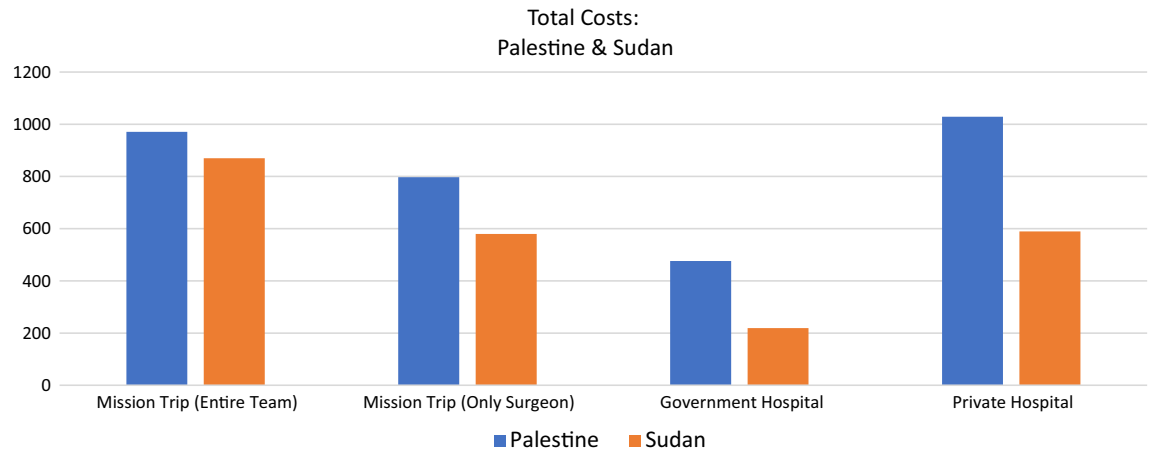

Fig. 1 Total costs by model and country

however, we chose the single visiting surgeon with all other professionals from the local community, because this has been a model utilized in Palestine as part of the local team training process. The last two models assume that all practitioners involved in the surgical care of patients are from the local community.

Palestine

For cost estimates of surgery in Palestine, we assumed that four surgeries were performed in a single operating room each day over a 7-day period for a total of 28 cases. Our assumptions and analysis are based on a combined total of 4100 cases performed in the Palestinian territories and Sudan. Six surgical team members were present for all cases, including a Surgeon, Palestinian Surgical Trainee, Anesthesiologist, Anesthesia Technician, Scrub Nurse, and Circulating Nurse. A Palestinian surgeon is part of all surgical teams for training purposes. On average, surgical time in the operating room was 2 hours. Each patient enters the hospital the night before surgery, receives a chest X-ray and a complete blood count (CBC), and spends at least one night in the hospital immediately after surgery. The two-night stay and the pre-operative tests are mandated by the Ministry of Health in government hospitals.

Costs related to government hospital employees were estimated based on a 40-hour workweek and reported monthly salaries for each profession: surgeons $450/week, anesthesiologists $643/week, anesthesia technicians $257/week, and nurses $321/week. Private hospital employee costs were based on flat rates per surgery: Surgeons are compensated $463 per surgery, anesthesiologists $195 per surgery, anesthesia technicians $42/surgery and nurses $44/surgery. For visiting team members (generally from the USA), we assumed the flight and visa cost to be $1500 per person, food expenditures of $245 for the entire week ($5 for breakfast, $10 for lunch, and $20 for dinner), and $85 for nightly lodging. These costs were based on averages of previous surgical trips.

Sudan

In order to determine costs per surgery in Sudan, we assumed that three surgeries would be performed in each operating room over 3 days for a total of nine cases. These assumptions are based on a combined total of 4100 cases that were performed in both the Palestinian territories and in Sudan. Six people were present on each surgical team including a Surgeon, a Sudanese surgical trainee, Anesthesiologist, Anesthesia Technician, Scrub Nurse, and Circulating Nurse. A Sudanese surgeon always participates in team activities for training purposes. Each surgery lasts an average of 2 h. In Sudan, patients are admitted to the hospital on the day of surgery, and on average, spend one night only stay in the hospital post-operatively. Each patient receives a CBC; only selective patients with symptoms related to chest infection undergo a chest X-ray (1 in 50 patients).

Government hospital employee costs were based on each profession's monthly salary and a 40-hour workweek: Surgeons earn $311 per 40-hour workweek, anesthesiologists $311 per week, anesthesia technicians $93/week, and nurses $93/week. Private hospital employee costs were based on flat rates per surgery: Surgeons are compensated $93 per surgery, anesthesiologists $78/surgery, anesthesia technicians $23/surgery, and nurses $31/surgery. For visiting team members from the USA, we assumed the flight and visa cost to be $1300; food, lodging, and transportation were approximately $500 per week ($5 for breakfast, $15 for lunch, and $10 for dinner). These costs were based on averages of previous surgical team expenditures.

Table 1 Palestine surgery costs by model

Palestine: average cost per cleft lip/palate surgery					
Conversion rate: 1 USD = 3.87 NIS (June 15, 2016)					
Category	Source	Mission trip (entire team)	Mission trip (only surgeon)	Government hospital	Private hospital
Hospital charges	Hospital stay (2 nights)	$257.28	$257.28	$257.28	$129.82
	Follow-up appointments	0	0	0	$12.86
Sum		$257.28	$257.28	$257.28	$142.68
Personnel	Surgeon	$83.57	$83.57	$22.50	$463.05
	Local surgeon training	$22.50	$22.50	$22.50	0
	Scrub nurse	$83.57	$16.08	$16.08	$44.20
	Circulating nurse	$83.57	$16.08	$16.08	$44.20
	Anesthesiologist	$83.57	$32.15	$32.15	$195.00
	Anesthesia technician	$83.57	$12.86	$12.86	$42.90
Sum		$356.78	$183.24	$122.17	$789.35
Tests	Chest X-ray	$5.00	$5.00	$5.00	$5.00
	Complete blood count (CBC)	$3.86	$3.86	$3.86	$3.86
Sum		$8.86	$8.86	$8.86	$8.86
Reusable	Oxygen	$2.57	$2.57	$2.57	$2.57
	Nitrous oxide	$10.71	$10.71	$10.71	$10.71
	Electronic cautery	$8.80	$8.80	$2.00	$2.00
Sum		$22.08	$22.08	$15.28	$15.28
Consumables	Propofol	$3.22	$3.22	$3.22	$3.22
	Isoflurane	$0.23	$0.23	$0.23	$0.23
	Pentathol	$11.32	$11.32	$11.32	$11.32
	Local anesthetic	$10.44	$10.44	$11.32	$11.32
	Antibiotic	$33.89	$33.89	$10.28	$10.28
	Ventonil	$48.10	$48.10	$6.69	$6.69
	Dexamethasone	$18.91	$18.91	$0.77	$0.77
	Racemic epinephrine (1 in every 20 cases)	$18.51	$18.51	0	0
	Nebulizer solution	$0.40	$0.40	$1.00	$1.00
	Oral rae tube	$9.10	$9.10	$0.70	$0.70
	Nasal Airway 18 Fr (1 in every 10 cases)	$2.50	$2.50	$0.30	$0.39
	Tubing suction 1 (remnants after surgery)	$1.30	$1.30	$0.13	$0.13
	Tubing suction 2 (regular, used in suction machine)	$1.30	$1.30	$0.74	$0.74
	Peds size circuits	$9.53	$9.53	$7.80	$7.80
	Drapes	$2.81	$2.81	$0.64	$0.64
	Gauze sponges (10 pieces)	$0.92	$0.92	$0.30	$0.30
	Gauze pad (1 piece)	$0.77	$0.77	$0.10	$0.10
	Arm restraints	$28.00	$28.00	$1.88	$1.88
	Sterile latex gloves (×6 individuals)	$2.48	$2.48	$1.56	$1.56
	Dermabond	$18.75	$18.75	0	0
	5-0 Chromic sutures (×1)	$11.75	$11.75	0	0
	5-0 Plain suture (×1)	$26.90	$26.90	0	0
	6-0 Plain sutures (×1)	$22.16	$22.16	0	0
	5-0 Vicryl sutures (×2)	0	0	$3.50	$3.50
	4-0 Vicryl sutures (×2)	0	0	$3.50	$3.50
	4-0 PDS sutures (×1)	$19.75	$19.75	$3.75	$3.75
	6-0 Monocryl sutures (×1)	$22.75	$22.75	$2.91	$2.91
Sum		$325.79	$325.79	$72.73	$72.73
Total cost		$970.79	$797.25	$476.32	$1028.90

Table 2 Sudan surgery costs by model

Sudan: average cost per cleft lip/palate surgery					
Conversion rate: 1 USD = 6.43 Sudanese pound (June 15, 2016)					
Category	Source	Mission trip (entire team)	Mission trip (only surgeon)	Government hospital	Private hospital
Hospital charges	Hospital stay (1 nights)	$12.44	$12.44	$12.44	$155.52
	Follow-up appointments	0	0	0	0
Sum		$12.44	$12.44	$12.44	$155.52
Personnel	Surgeon	$106.50	$106.50	$15.55	$93.31
	Local surgeon in training	$15.55	$15.55	$4.67	$20.22
	Scrub nurse	$106.50	$4.67	$4.67	$31.10
	Circulating nurse	$106.50	$4.67	$4.67	$31.10
	Anesthesiologist	$106.50	$15.55	$15.55	$77.76
	Anesthesia technician	0	$4.67	$4.67	$23.33
Sum		$441.55	$151.61	$49.78	$276.82
Tests	Chest X-ray (1 in every 50 cases)	$10.89	$10.89	$10.89	$10.89
	Complete blood count (CBC)	$7.78	$7.78	$7.77	$7.77
Sum		$18.67	$18.67	$18.66	$18.66
Reusable	Oxygen	$2,57	$22.57	$7.77	$7.77
	Nitrous oxide	$10.71	$10.71	$4.67	$4.67
	Electric cautery	$8.80	$8.80	$7.77	$7.77
Sum		$22.08	$22.08	$20.21	$20.21
Consumables	Propofol	$3.22	$3.22	$3.11	$3.11
	Fentanyl	$23.29	$23.29	$1.55	$1.55
	Isoflurane	$0.23	$0.23	$7.78	$7.78
	Dexamethasone	$18.91	$18.91	$0.77	$0.77
	Atracurium	$1.81	$1.81	$3.11	$3.11
	Diclofenac	$1.26	$1.26	$3.11	$3.11
	Lidocaine	$10.44	$10.44	$6.22	$6.22
	IV Antibiotic (3rd-generation Cephalosporin)	$5.80	$5.80	$7.78	$7.78
	Oral antibiotic 5-day course (3rd-generation Cephalosporin)	$33.89	$33.89	$3.11	$3.11
	Racemic Epinephrine (1 in every 100 cases)	$18.51	$18.51	$0.77	$0.77
	Ventolin (1 in every 50 cases)	$48.10	$48.10	$0.16	$0.16
	IV fluids	$8.00	$8.00	$3.11	$3.11
	Syringes	$1.00	$1.00	$0.77	$0.77
	Oral rae tubes	$9.10	$9.10	$2.33	$2.33
	Cannula	$2.32	$2.32	$0.77	$0.77
	Adhesive plaster	$0.40	$0.40	$2.33	$2.33
	Anesthesiology suction catheter	$7.62	$7.62	$0.77	$0.77
	Anesthesiology suction tubing	$1.30	$1.30	$15.55	$15.55
	Breathing circuits	$9.51	$9.51	$15.55	$15.55
	Anesthesiology examination gloves (×6 individual)	$2.00	$2.00	$0.31	$0.31
	Anesthesiology Gauze	$0.92	$0.92	$0.77	$0.77
	Arm restraints	$28.00	$28.00	$12.44	$12.44
	Disinfectant solution	$8.47	$8.47	$1.56	$1.56
	Drapes	$2.81	$2.82	$2.33	$2.33
	Surgical gauze	$0.92	$0.92	$5.60	$5.60
	Surgical suction tubing 1 (remnants after surgery)	$1.30	$1.30	$3.11	$3.11
	Surgical suction tubing (suction machine)	$1.30	$1.30	$3.11	$3.11
	Surgical sterile latex gloves (×6 individual)	$2.48	$2.48	$1.87	$1.87
	Dermabond	$18.75	$18.75	0	0
	5-0 Plain sutures (×1)	$26.90	$26.90	$1.56	$1.56
	6-0 Plain sutures (×1)	$22.16	$22.16	$1.56	$1.56
	5-0 Vicryl sutures (×1)	0	0	$5.44	$5.44
	4-0 PDS sutures (×1)	$19.75	$19.75	0	0
	6-0 Monocryl sutures (×1)	$22.75	$22.75	0	0
	5-0 Chromic sutures (×1)	$11.75	$11.75	0	0
Sum		$374.97	$374.97	$118.31	$118.31
Total cost		$869.71	$579.77	$219.40	$589.52

Table 3 Summary of costs by model and country

	Mission trip (entire team)	Mission trip (only surgeon)	Government hospital	Private hospital
Palestine				
Hospital charges	$257.28	$257.28	$257.28	$142.68
Personnel	$356.78	$183.24	$122.17	$789.35
Tests	$8.86	$8.86	$8.86	$8.86
Reusables	$74.38	$74.38	$39.73	$39.73
Consumables	$273.49	$273.49	$48.28	$48.28
Total cost	$970.79	$797.25	$476.32	$1028.90
Sudan				
Hospital charges	$12.44	$12.44	$12.44	$155.52
Personnel	$441.55	$151.61	$49.78	$276.82
Tests	$18.67	$18.67	$18.67	$18.67
Reusables	$22.08	$22.08	$20.21	$20.21
Consumables	$374.97	$374.97	$118.31	$118.31
Total cost	$869.71	$579.77	$219.40	$589.52

Table 4 Costs utilizing purchasing power parity methods for local provider salaries: Palestine

	Mission trip (entire team)	Mission trip (only surgeon)	Government hospital	Private hospital
Palestine				
Surgeon	$83.57	$83.57	$20.65	$425.07
Local surgeon training	$20.65	$20.65	$20.65	0
Scrub nurse	$83.57	$14.76	$14.76	$40.57
Circulating nurse	$83.57	$14.76	$14.76	$40.57
Anesthesiologist	$83.57	$29.51	$29.51	$179.01
Anesthesia technician	0	$11.80	$11.80	$39.38
Sum	$354.93	$175.06	$112.14	$724.60

Table 5 Costs utilizing purchasing power parity methods for local provider salaries: Sudan

	Mission trip (entire team)	Mission trip (only surgeon)	Government hospital	Private hospital
Sudan				
Surgeon	$106.50	$106.50	$26.74	$160.47
Local surgeon training	$26.74	$26.74	$8.03	$34.77
Scrub nurse	$106.50	$8.03	$8.03	$53.48
Circulating nurse	$106.50	$8.03	$8.03	$53.48
Anesthesiologist	$106.50	$26.74	$26.74	$133.73
Anesthesia technician	0	$8.03	$8.03	$40.12
Sum	$452.74	$184.08	$85.61	$476.05

In a checklist published by Shrime et al., there is a cautionary note to utilize societal perspective when estimating surgical costs. These costs include patient and family non-medical direct and indirect costs, including transportation, food, and lodging during the surgery. Though these are legitimate costs, they are likely to be similar for each of the study models, and hence, are not likely to change final model cost comparisons [14].

Results

The cost of a single CL/CP surgery in Palestine ranged from $476 to $1189; the local-only team working at a government hospital was the cheapest model, while the international visiting team was the most expensive model (Fig. 1; Tables 1, 2, 3). The cost of a single surgery in Sudan ranged from $219 to $976. The local-only team

Table 6 Mission trip model costs incorporating providers' lost salaries: Palestine

	Mission trip (entire team)	Mission trip (only surgeon)
Palestine		
Surgeon	$4890.57	$4890.57
Local surgeon training	$22.50	$22.50
Scrub nurse	$852.57	$16.08
Circulating nurse	$852.57	$16.08
Anesthesiologist	$4890.57	$32.15
Anesthesia technician	0	$12.86
Sum	$11,508.78	$4990.24

Table 7 Mission trip model costs incorporating providers' lost salaries: Sudan

	Mission trip (entire team)	Mission trip (only surgeon)
Sudan		
Surgeon	$4913.50	$4913.50
Local surgeon training	$15.55	$15.55
Scrub nurse	$875.50	$4.67
Circulating nurse	$875.50	$4.67
Anesthesiologist	$4913.50	$15.55
Anesthesia technician	0	$4.67
Sum	$11,593.55	$4958.61

working at a government hospital was the cheapest model, while the international visiting team was the most expensive. The only model in which cost approximated the commonly advertised 250 USD per cleft surgery was the local-only team working at a government hospital in Sudan ($219; Table 3).

In Palestine, the local-only team working at a government hospital is 40% the cost of the international visiting team. To establish cost equivalence with the local team, the international visiting team would need to complete 2.5 cases for each case performed at a government hospital by a local team. The visiting team would need to perform 70 cases during the surgical week (this schedule would be impossible, based on the assumed 28 cases in a single operating room during the week of surgery). When comparing the visiting surgeon model (model 2) with Palestinian local team, the visiting surgeon team (58% higher cost) would have to perform 1.7 cases for every case performed by the local-only team. This would necessitate the completion of 48 cases for the surgical trip (Tables 1, 3).

In Sudan, the local-only team working at a government hospital is 22% the cost of the international visiting team. For each case performed at a government hospital by a local team, the visiting team would have to perform 4.4 cases to establish cost equivalency. The visiting international team would therefore need to perform 40 cases during the 3 days of surgery assumed in the model. When comparing the visiting surgeon team with the local Sudanese-only team, the visiting surgeon team is 38% more expensive and would have to perform 2.6 cases for each local-only cleft surgery to be cost equivalent to the local-only team. This would necessitate the completion of 24 cases for the 3-day surgical trip (Tables 2, 3).

Discussion

International philanthropic cleft organizations have enabled the surgical reconstruction of congenital deformities for hundreds of thousands of children at no cost to patients and families. In order to raise funds and awareness, these organizations advertise that cleft surgeries can be performed for 250 USD and that surgeries take as little as 45 min to complete. Because our group has participated in surgical trips to Palestine and Sudan (>50 trips total), we wanted to determine the actual costs per surgery for two countries in the Middle East. We hypothesized that cleft surgeries in these two low- to middle-income countries (LMIC) would cost more than 250 USD per surgery.

Our analysis of actual costs per surgery took into account every aspect of cost, including hospital charges, personnel, tests, reusables, and consumables; supply costs were calculated at market value at the site of purchase. This strategy for cost analysis is similar to calculations used to

determine costs for cleft surgery in the USA. [4–10] In contrast, cost calculations for international cleft trips often ignore several types of charges, including hospital charges. [3] These charges are a major contribution to overall cost per surgery and include time in the operating room (usually in 15-min blocks), charges for a hospital room prior to or after surgery. These charges can be "ignored" because hospitals often "donate" their facilities for use by visiting international teams. [3] Ignoring these costs, however, does not mean that they do not exist. These same hospitals would not donate their facilities for use by local practitioners to care for local patients, and to arbitrarily exclude them from a visiting team cost calculation is problematic. International cleft organizations also tend to ignore the costs of personnel during surgery, assuming that all people involved are volunteers. [3] However, as in the instance of hospital charges, ignoring these costs does not mean they do not exist. Someone pays for air travel and visas.

The third cost category—pre-and post-operative tests—for otherwise healthy children is generally minimal and does not contribute significantly to overall costs (Fig. 1, Tables 1, 2, 3). Reusable and consumable supplies, however, add significant cost per surgery. Local teams may or may not have access to donated supplies, and hence, including these costs for comparison among the models is appropriate. Locally available sutures and surgical equipment, though usable, may not be of the same quality as the supplies that international visiting teams bring with them and should be considered in terms of patient outcomes (which is outside the scope of this article and hence a limitation of this study—see study limitations).

Team member composition is clearly the greatest contribution to cost per surgery, with the general truism that the greater the distance traveled to participate in the surgical trip, the greater the cost; this makes regional and local personnel much more attractive from a cost standpoint. In our analysis, we assumed four team models; the first model was made up entirely of visiting professionals, the second was a hybrid of a single visiting lead surgeon working with local professionals. We recognize that there are multiple such hybrids (e.g., a visiting surgeon, anesthesiologist and scrub nurse working with a local anesthesia technician, and circulating nurse) and are dependent on the adequacy of trained and available local professionals. The cheapest models in both Palestine and Sudan, as would be expected, are local-only professionals working at government hospitals, and not at private hospitals, where employee pay is more generous, leading to cost increase per case. In the final analysis, the last two of these local-only models are the most cost-effective; some combination of work in government and private hospitals by local professionals, dictated by their own choices of where to work, is the only sustainable mechanism by which to perform cleft work.

For the visiting team model to become cost equivalent to the local team performing cleft cases, the visiting team to Palestine must perform 70 cases in a single operating room during the 7-day surgical trip and 40 cases in one room during the 3-day surgical trip in Sudan. Doing this number of cases is unrealistic. However, it highlights the point that the only way for a visiting team to improve cost-efficiency is to complete more cases. These visiting teams can never do enough cases to become as cost-effective as the local teams. From a cost standpoint, if expense and sustainability are linked, the most expensive model is also the least sustainable; the least expensive is the most sustainable.

Well-trained individuals are required to perform cleft surgery. Inexperienced and improperly trained surgeons may perform surgeries that lead to high complication rates, which in turn, lead to increased cost burden. When local surgeons operate in government hospitals with high complication rates, any cost-benefit advantages may disappear because of the poor quality of surgery. Though we recognize this as a cost disadvantage, we have no current mechanism for measuring rates of complications; hence, for the present study, we made the assumption that surgeons performing these cases are well-trained cleft surgeons, with similar quality of care. We do recognize that properly trained cleft surgeons may not be present in many parts of the world. In these circumstances, visiting teams may be a temporary, though, more costly necessity; but only until there are qualified local professionals to continue this work.

We recognize that visiting teams have a role in international cleft care, but their role should be time-restrained, with clearly defined exit strategies. These teams and organizations should transition, through training programs, within pre-arranged time intervals, to hybrid models, where local professionals become integrated into the team, and eventually lead to all local cleft efforts. Local-only teams need to be defined as truly local, not an amalgam of visiting and local professionals. [3] An intermediate step to local-only teams would be for successful trainees from countries within the Middle East, such as Turkey or Egypt, to become more involved in regional cleft care. These regional visitors would provide a more cost-effective intermediate model for cleft care than visiting Western teams.

The only means of ensuring a transition from visiting to local-only team cleft care is a high level of commitment to training local professionals. The less efficient a visiting team is in the training process, the longer this transition will take. One way to determine whether visiting teams are committed to training is to assess how long they have worked in a particular location: The longer their stay, with repeat visits, the more likely it is that they have not been successful in training local practitioners, or, in fact, may have completely abandoned the training process.

Limitations to study

In this specific study, visiting surgeons traveling to Palestine and Sudan utilize vacation time to operate. However, when visiting professionals volunteer their time to international cleft work, lost productivity and salary at their home institutions should be considered in the cost estimations of model 1 and 2. We contemplated scenarios accounting for lost salaries among these volunteers (Tables 6, 7). In order to make these calculations, we used a modest starting salary of a craniofacial surgeon ($250,000), anesthesiologist ($250,000), and nurse ($40,000). We added a week of lost salary for these individuals to the personnel costs for models 1 and 2, making these models even more cost-prohibitive compared to models 3 and 4.

Conclusions

In conclusion, costs for individual cleft surgeries in two Middle Eastern countries are generally greater than the popularly advertised rate of 250 USD. Given that the most significant contributor to cost per surgery is the distance traveled by care providers, a cornerstone for sustainability must be to enable local teams to perform cleft surgery at local hospitals of their choice. In order to make this a reality, international cleft organizations should fund raise, not simply to perform individual cleft surgeries, but to train local and regional providers to provide effective and safe care for children with clefts in their own countries.

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