

The Plastic Surgery Workforce and Its Role in Low-income Countries

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Background: Plastic surgery varies in scope, especially in different settings. This study aimed to quantify the plastic surgery workforce in low-income countries (LICs), understand commonly treated conditions by plastic surgeons working in these settings, and assess the impact on reducing global disease burden.

Methods: We queried national and international surgery societies, plastic surgery societies, and non-governmental organizations to identify surgeons living and working in LICs who provide plastic surgical care using a cross-sectional survey. Respondents reported practice setting, training experience, income sources, and perceived barriers to care. Surgeons ranked commonly treated conditions and reported which of the Disease Control Priorities-3 essential surgery procedures they perform.

Results: An estimated 63 surgeons who consider themselves plastic surgeons were identified from 15 LICs, with no surgeons identified in the remaining 16 LICs. Responses were obtained from 43 surgeons (70.5%). The 3 most commonly reported conditions treated were burns, trauma, and cleft deformities. Of the 44 "Essential Surgical Package" procedures, 37 were performed by respondents, with the most common being skin graft (73% of surgeons performing), cleft lip/palate repair (66%), and amputations/escharotomy (61%). The most commonly cited barrier to care was insufficient equipment. Only 9% and 5% of surgeons believed that there are enough plastic surgeons to handle the burden in their local region and country, respectively.

Conclusions: Plastic surgery plays a significant role in the coverage of essential surgical conditions in LICs. Continued expansion of the plastic surgical workforce and accompanying infrastructure is critical to meet unmet surgical burden in low- and middle-income countries. (*Plast Reconstr Surg Glob Open* 2021;9:e3428; doi: 10.1097/GOX.0000000000003428; Published online 23 April 2021.)

INTRODUCTION

Safe and affordable surgery plays a critical role in the prevention and treatment of medical conditions globally. It is estimated that 28%–32% of the global burden of disease (GBD) requires surgical care as a component of effective treatment. However, 5 billion people worldwide lack access

to such care, with a disproportionate number of these living in low- and middle-income countries (LMICs).¹

The skill set encompassed by plastic and reconstructive surgery includes management of diseases and conditions that disproportionately affect people in the developing world.^{2–5} These conditions, including burns, trauma, and congenital anomalies, can cause severe morbidity and contribute significantly to the GBD. Additionally, plastic and reconstructive surgery is needed to treat the increasing burden of noncommunicable diseases, including conditions due to cancer and diabetes, as well as injuries sustained from humanitarian conflict or natural disasters.^{6,7}

To address the burden of surgical care in LMICs, plastic surgeons from high-income countries have long been involved in both short-term surgical trips (often called "missions") and longitudinal partnerships for local surgical capacity building. These efforts, largely spearheaded by non-governmental organizations (NGOs), have played a significant role in providing care in LMICs.^{7,8} However, despite this work, little is known about local plastic surgery

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workforces in low-income countries (LICs) and their impact on the GBD. To support national health plans in expanding the ability to address the burden of surgical conditions requiring plastic surgical expertise, it is imperative to understand the current plastic surgery capacity in LICs. In this study, we sought to quantify the plastic and reconstructive surgery workforce in LICs, understand the most commonly treated conditions in LICs, and assess the barriers faced by plastic surgeons. With this framework, we provide approaches to address the identified needs, specifically calling upon actions from governing and financing entities in the context of national surgical planning.

MATERIALS AND METHODS

This study was conducted by the Program in Global Surgery and Social Change at Harvard Medical School, in collaboration with the International Confederation of Plastic Surgery Societies.

Assessment of Plastic Surgery Workforce

To estimate the number of surgeons providing plastic surgical care in LICs, we queried national and international surgery societies, plastic surgery societies, and NGOs. For international societies, we assigned surgeons to the country they list in their registration. We also utilized personal contacts, who were plastic surgeons known to any of us, to assist with delivery of the survey and to encourage responding regardless of society membership, and used snowball methodology to further elucidate recipients. Due to the anonymity of our survey, we are unable to estimate how many additional respondents this generated. Additionally, we conducted internet searches for plastic surgeons in each LIC and investigated the existing national plastic surgery societies in each LIC. (See **appendix 1, Supplemental Digital Content 1**, which shows a full list of societies queried. <http://links.lww.com/PRSGO/B636>.)

Survey Design

A survey was designed to capture information about surgeons practicing in LICs who consider themselves plastic surgeons. LICs were selected based on World Bank classification for the year 2018. Respondents reported information, including demographics, practice setting, specialty training, income sources, perceived barriers to care, GBD conditions treated, and essential surgical procedures as defined in the Disease Control Priorities-3 (DCP-3) performed.⁹ (See **appendix 2, Supplemental Digital Content 2**, which displays the plastic surgeon respondents by country. <http://links.lww.com/PRSGO/B637>.)

Eight condition categories were selected from the GBD study that were considered likely to be treated by plastic surgical expertise either primarily or at some point in the care of the disease. These included breast conditions, facial/head/neck conditions, melanoma, non-melanoma skin cancer, leprosy, neoplasms (excluding skin cancer), non-cancerous skin and subcutaneous diseases, congenital anomalies, neural tube defects, cleft lip/cleft palate,

trauma or wounds, and burns (acute or reconstruction). The proportion of purely cosmetic conditions comprising the practice as well as an estimate of proportional income from cosmetic surgery were also included.

Each of the 44 “essential surgery procedures” from the *Disease Control Priorities, 3rd edition, Essential Surgery Manual* were listed to determine which of these procedures surgeons were performing in their home country.

Additional survey questions included country of origin, demographics, time spent in surgical and plastic surgical training, the type of hospital setting in which the respondent worked, and the primary payment method of patients. Hospital setting refers to primary (district), secondary (regional hospitals), or tertiary hospital (national referral centers).

Population and Survey Distribution

Potential survey participants were identified based on the previously described workforce assessment. All such participants whose email addresses were available through international and national plastic surgery societies were sent an email with a short cover letter and a link to the survey instrument. Additionally, the president of each surgery society as well as College of Surgeons of East and Central Africa and the West Africa College of Surgeons were contacted separately and asked to distribute the survey among their members. All personal contacts of any of the authors were also utilized both as respondents and for further contacts. The NGO Smile Train facilitated the sending of the survey to plastic surgeons with whom it has relationships. Due to the variability in the training requirements and the breadth of procedures performed by plastic surgeons, we did not specifically define plastic surgery and included any participant who self-reported themselves a plastic surgeon. For the purposes of our survey, we allowed plastic surgeons to self-identify themselves as plastic surgeons regardless of their formal training or certifications. Thus, the inclusion criteria were reporting to be a plastic surgeon and living and working in an LIC. Volunteer or foreign plastic surgeons participating in short-term surgical trips or other situations that are not permanent parts of the health care system in these countries were excluded.

The survey was distributed from May 2019 to September 2019. The initial email including cover letter was sent in May 2019, with an additional follow-up letter to all plastic surgery society presidents sent in July 2019. Ethical approval was granted by Boston Children’s Hospital IRB (IRB-P00030606). Study data were collected and managed using Research Electronic Data Capture.

Statistical Analysis

Descriptive statistics were calculated to summarize the frequency that each condition was ranked among the top 3 treated within a respondent’s plastic surgical practice. Additionally, the proportion of providers performing each essential surgery procedure in their practice was calculated and reported among each hospital type and payment method. All analyses were performed using SAS, version 9.4 (Cary, N.C.).

RESULTS

Practice Patterns

A total of 63 surgeons working in the 31 LICs were identified by the World Bank designation.¹⁰ In 16 of these, no surgeons were identified and no specific plastic surgery societies were identified; 5 countries had 1 surgeon and 4 countries had 2 surgeons (Fig. 1). Responses to the survey were obtained from 43 surgeons practicing in 12 LICs (Table 1).

Among respondents, the median number of years in practice was 7.5 years (IQR = 2.25–14.75; Table 2). The median number of years in surgical training was 5 years (IQR = 5–6 years), and the median number of years of plastic surgery training was 3 years (IQR = 3–3.25). Regarding practice environment, 10 respondents reported working in a primary district hospital, 9 in a secondary hospital, 20 in a tertiary hospital, and 13 in a private hospital (Table 2). In reporting all hospital settings in which he or she works, the majority of respondents worked in urban settings (n = 36), while 11 reported working in the suburban setting and 5 in the rural setting. Thirty practice only in urban settings, and no respondents practiced only in a rural setting. The majority of respondents characterized their work distribution as entirely or primarily clinical (n = 39), with the

minority doing entirely or primarily administrative work (n = 3).

The median number of operations per year was 300 (IQR = 250–500). Two surgeons (5%) reported more than 40% of their cases to be non-plastic surgery procedures and 3 surgeons (8.8%) reported more than 40% of their cases to be cosmetic. Of those responding to the survey item regarding income from cosmetic procedures (n = 33), 85% (n = 28) reported <20% of their total income to be from cosmetic procedures. An estimated 41% reported treating children and adults with equal frequency (n = 18), while 7 surgeons reported treating predominantly pediatric patients.

Most surgeons reported the primary payment model to be self-pay (n = 17), with 14 surgeons reporting private insurance and 8 reporting both models equally. Seven of the 12 who practice in private settings reported that third party was the predominant form of payment. Four of those 12 reported self-pay to be predominant, and the other reported a roughly equal mix of those two schemes. Eight of the 20 surgeons practicing primarily in tertiary hospitals reported predominant third party payment as opposed to 4 of 17 practicing in district and secondary hospitals combined.

Barriers to Care

The most commonly cited barriers were lack of surgical equipment (60.5%), lack of more specialized training (53.5%), and patient factors (53.5%). Nearly 47% of respondents reported lack of medications and infrastructure. Forty-four percent of respondents indicated lack of surgical equipment, and 41.9% reported lack of anesthesia provider as barriers. Only 2.3% of respondents reported no barriers to providing plastic surgical care.

Regarding respondents' perceptions of adequacy of the plastic surgery workforce, 9.3% of respondents believe there are enough plastic surgeons to handle the burden of plastic surgery disease in their practice area, and 4.7% stated there are enough plastic surgeons to handle the burden of plastic surgery in their country.

Global Burden of Disease Conditions Treated

Respondents were asked to rank the 3 most frequent conditions they treat from a list of conditions selected from the GBD study as well as cosmetic procedures. The most commonly treated conditions are burns (n = 29, 67.4%), cleft lip and palate (n = 25, 58.1%), and trauma (n = 24, 55.8%). About one-fifth of respondents regularly treat head and neck diseases (n = 9, 20.9%), and about one-tenth of respondents frequently treat breast disease (n = 5, 11.6%) and congenital anomalies other than facial clefts (n = 5, 11.6%). Only 9.3% reported cosmetic procedures to be among their 3 most common procedures (Fig. 2).

Essential Surgery Addressed by Plastic Surgeons

Respondents were asked to select the DCP3 essential surgical procedures that they perform (Fig. 4). The majority of respondents perform skin grafting (n = 32, 74.4%), cleft lip and palate repair (n = 29, 67.4%), escharotomy and fasciotomy (n = 28, 65.1%), trauma-related amputations

Table 1. Plastic Surgeon Responses by WHO Region

Region	Plastic Surgeons Identified	Survey Respondents (% of Total)
African region	38	29 (67)
Region of the Americas	2	2 (4.6)
Southeast Asia region	9	9 (21)
European region	7	0 (0)
Eastern Mediterranean region	7	3 (7)
Western Pacific region	0	0 (0)

Table 2. Description of Plastic Surgery Respondents

Respondent Characteristics	Median (IQR)
Years in practice	7.5 (12.5)
Years in residency	5 (1)
Years in plastic surgery training	3 (0.3)
Time distribution	
Entirely or primarily clinical	39 (92.9)
Entirely or primarily administrative	3 (7.1)
Hospital setting	N (%)
Urban	36 (83.7)
Suburban	11 (25.6)
Rural	5 (11.6)
Hospital type	N (%)
Level 3	20 (46.5)
Level 2	9 (20.9)
Level 1	10 (23.3)
Private	13 (30.2)
Other	2 (4.6)
Most common age group treated	N (%)
Pediatric (<14 years old)	7 (17.5)
Adult	15 (37.5)
Both equally	18 (45.0)
Payment model of the majority of patients	N (%)
Self-pay	17 (43.6)
Third party	14 (35.9)
Both equally	8 (20.5)

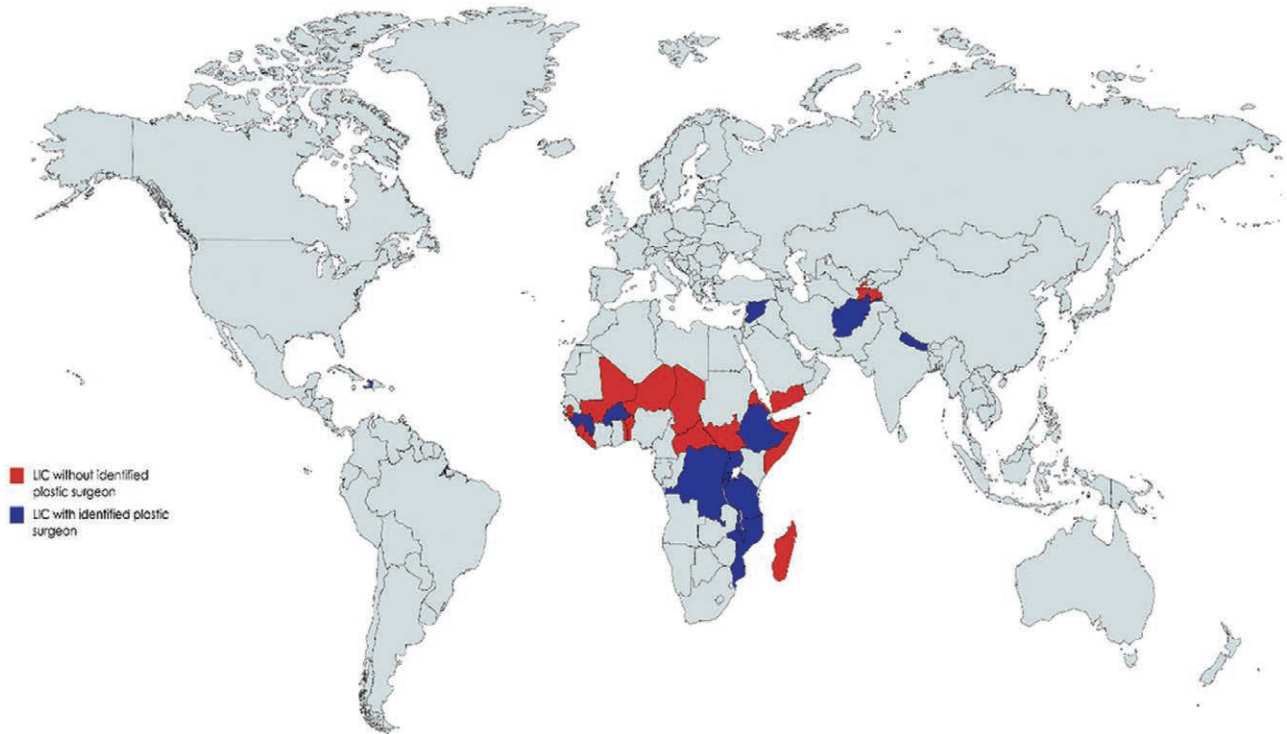


Fig. 1. LICs with at least 1 identified plastic surgeon.

($n = 27$, 62.8%), and lacerations ($n = 25$, 58.1%). Other essential surgical care provided by at least one-third of respondents include superficial abscess drainage ($n = 15$, 34.9%), male circumcision ($n = 20$, 46.5%), and basic life support ($n = 15$, 34.9%). All essential surgical procedures were reported being performed by at least 1 respondent, with the exception of treatment of caries, cesarean birth, vasectomy, obstetric fistula repair, cataract extraction, and eyelid surgery for trachoma (Fig. 3).

DISCUSSION

We found that surgeons providing plastic surgery in LICs manage a broad range of conditions, albeit predominantly trauma and congenital defects, but are very poorly represented in these countries. Ethiopia and Nepal were identified as having the largest number of plastic surgeons in our study, but still have poor representation in relation to population size. The finding that 16 LICs had no identifiable plastic surgeons indicates that 229 million people, 82.6 million of whom are children, may have no access to a plastic surgeon.¹¹

The practice patterns of surgeons in our study reflect this broad spectrum of surgical care, which may address a broad spectrum of the global burden of surgically amenable conditions.⁵ Previous studies have estimated that conditions amenable to plastic surgery care comprise 16% of the overall surgical need.¹² Burn injuries, trauma, and facial clefts were the most commonly treated problems by surgeons in our study and align with conditions of significant burden. Burns are generally noted to be associated with poverty, and trauma is a leading cause of death and

disability in LICs.^{3,13} Facial clefts, although not a proportionally large component of the GBD, are nevertheless a relatively common problem amenable to plastic surgical care that otherwise is devastating to the affected individuals.¹⁴ From the GBD study, we know that these 3 entities represent a high proportion of the burden in LICs, and none are expected to diminish over the next several years. Additionally, while our study focuses on essential surgical conditions, there are also a host of cancer diagnoses that require surgery and potential intervention by a plastic surgeon for reconstruction for both functional and cosmetic purposes.

Plastic surgical needs in low-income settings have often appeared in the literature to suggest a preponderance of issues related to facial clefts and, to a lesser extent, burn injury. These conditions likely reflected the interest of high-income country (HIC) authors rather than the needs of the populace, often with overwhelming HIC emphasis on the short-term surgical trip model for aiding plastic surgical care in LICs. Although such trips may appear to be helpful for addressing current needs, the skewed nature of the clinical issues addressed by these programs are not a reflection of the actual needs of these regions. Our findings indicate that facial clefts were indeed 1 of the 3 most commonly managed problems for these surgeons; however, this is likely a reflection of the influence of foreign teams and of foreign medical aid which may incentivize surgeons to perform operations that align with funding from NGOs. Clefts, particularly cleft lips, can also be managed in a quality manner with less infrastructure than many other problems that would require plastic surgical expertise. We therefore cannot draw conclusions on

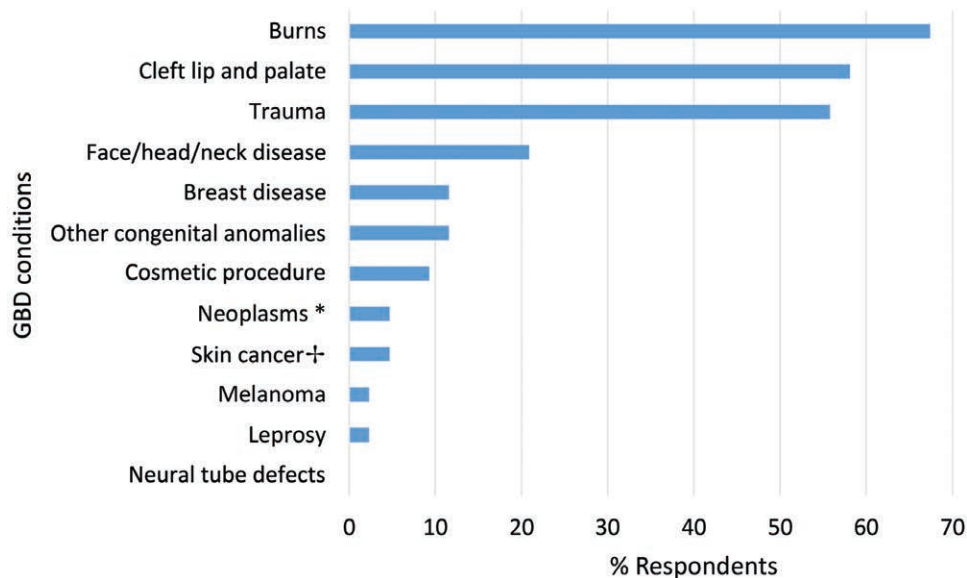


Fig. 2. Most frequently treated GBD conditions by respondents. *Non-skin cancer; †Non-melanoma.

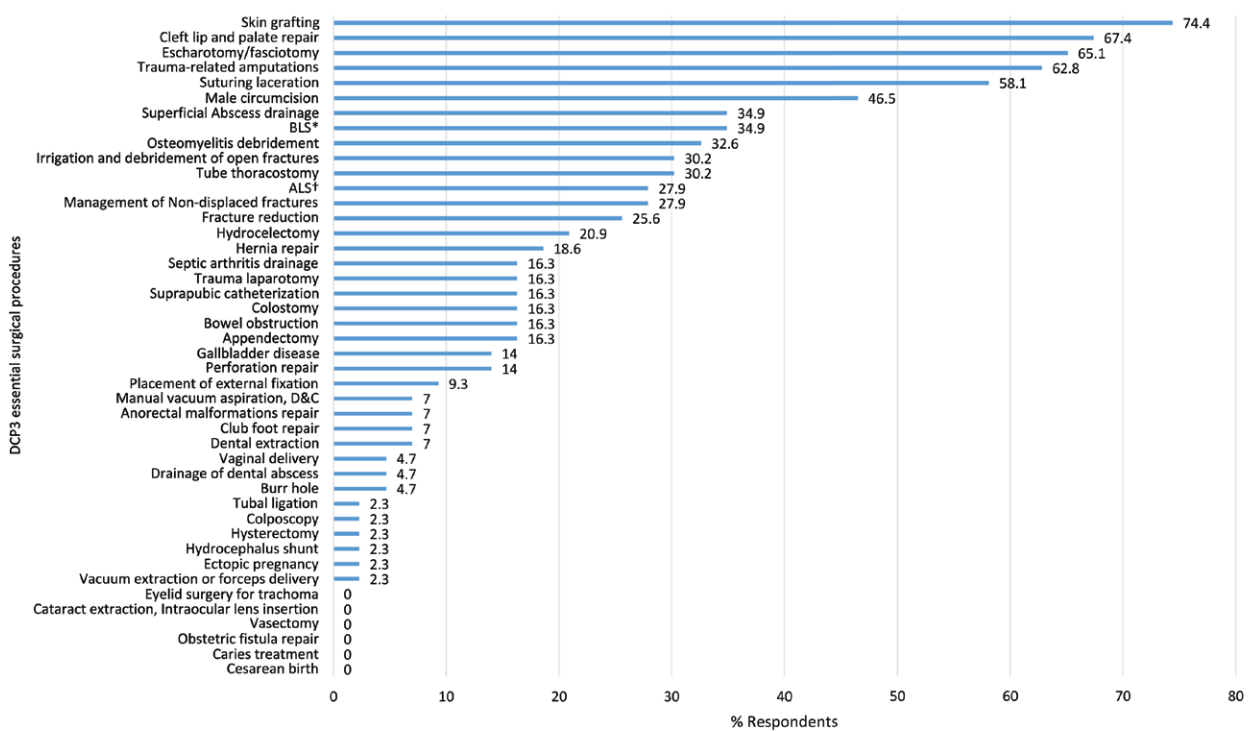


Fig. 3. DCP3 44 essential surgical procedures treated by plastic surgeon respondents. *Resuscitation with basic life support measures. †Resuscitation with advanced life support measures, including surgical airway.

the unmet burden of disease from the practice patterns of these surgeons. Beyond clefts, the predominance of trauma and burn care by plastic surgeons working in LICs suggests that surgeons working in these settings serve not only as subspecialists, but as generalists who respond to the highest burden conditions.

We found that the barriers to adequate surgical care perceived by these LIC surgeons encompassed essentially every

aspect of care. These included basic infrastructure, lack of anesthetic care, lack of support staff and medications, inadequate reimbursement, and the need for more specialized training. These are consistent with other LIC assessments, including Dewan et al's assessment of the neurosurgical workforce.¹⁵ Furthermore, almost all respondents reported an insufficient number of plastic surgeons in their country. It was found in this study that the supply of plastic surgeons

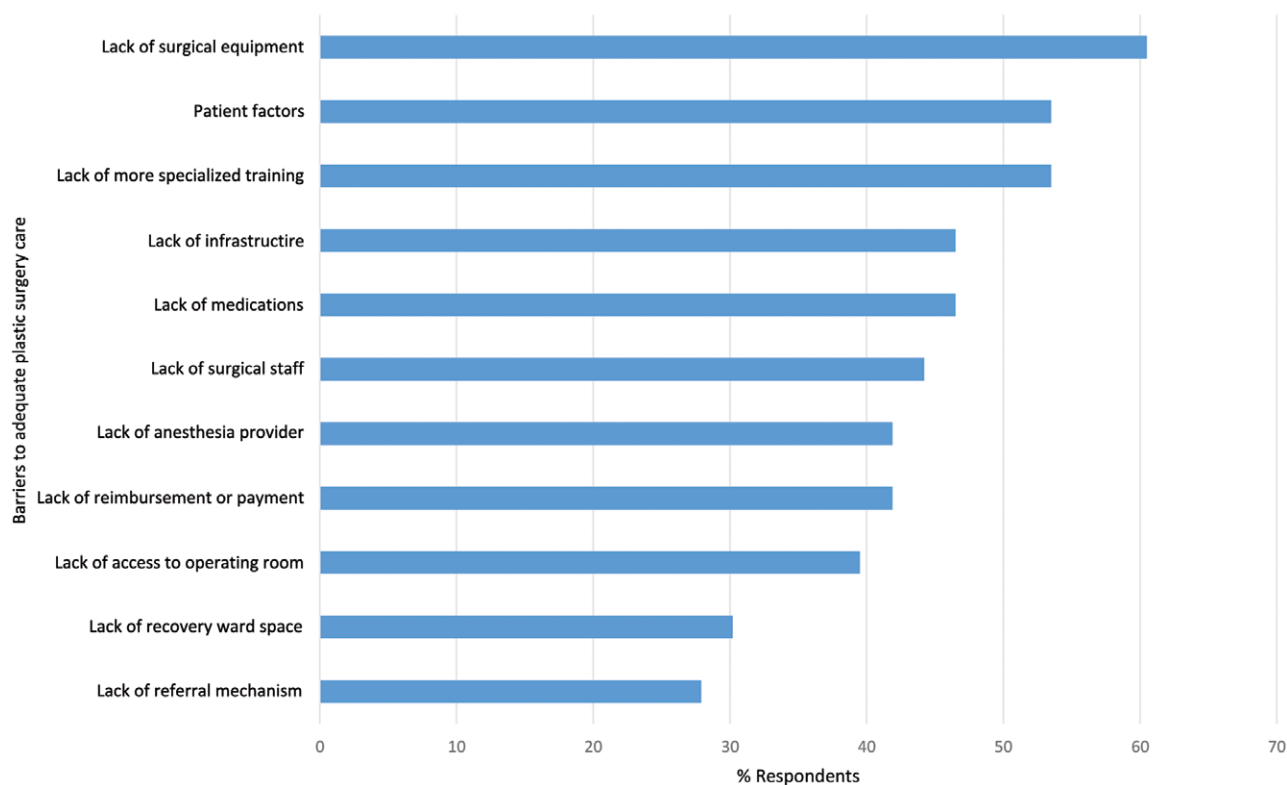


Fig. 4. Barriers to adequate plastic surgery care.

is in the range of 0.0073/100,000 population in LICs, or 0.0093/100,000 when excluding the 16 countries in which no plastic surgeons were identified. This is in contrast to the 2.18/100,000 plastic surgeons in practice in the United States (a 300-fold difference), using 2020 population estimates and data from the American Society of Plastic Surgeons.^{11,16} Although HIC surgical workforces should not be used to benchmark optimal workforce requirements, the marked difference highlights the immense need in expanding plastic surgical care in LICs.

It is apparent that many more plastic surgeons will need to be included in the push for greater development of health care practitioners in the coming years. This will require a concerted effort by the plastic surgery community and health systems to provide such training opportunities and for foreign NGOs to integrate into existing LIC training programs for the purpose of developing LIC plastic surgeons. Although the short-term surgical mission trip model has been the dominant strategy in the past, a shift toward health systems investment and training is necessary to ensure an adequate number of plastics surgeons in LICs. Although reducing the burden of cleft surgery required by local surgeons may allow them to focus their time on other conditions with high burden, we found that many plastic surgeons rely on congenital operations as a significant source of income, which further undermines the surgical mission approach. The literature demonstrates that many physicians in LICs must go abroad to receive specialized training, and support of in-country training programs would alleviate some of this migration.

As economies improve, an important consideration in developing adequate plastic surgery care in LICs is the need for adequate reimbursement. We found that <10% of respondents in this study regularly perform cosmetic surgery, performed at market-driven prices that can easily outweigh the reimbursement for most surgical care that addresses the GBD. Given even a relatively small portion of the populace with the wealth to support cosmetic surgical practice, market-driven reimbursement for cosmetic surgery enables the practitioner to recoup some of the value of the years of training and experience and to have a lifestyle that is generally commensurate with their attained professional status. To overcome the possibility that cosmetic surgery can usurp general plastic surgery practice, it is necessary for the reimbursement for the trauma and burn care performed by plastic surgeons to be appropriately and competitively reimbursed. National Surgical Anesthesia and Obstetric Plans have evolved as a way to systematically address gaps in access to surgical care in LMICs through informed national policy and rely on scale-up of local surgical workforce to improve access to quality surgical care globally.¹⁷⁻¹⁹ Inclusion of plastic surgeons in these processes combined with policies to support the plastic surgery workforce may help to improve access to plastic and reconstructive services.

Based on our findings, if HIC plastic surgeons and plastic surgery institutions are to help in the expansion of access to plastic surgical care in LICs, those effort must move far

beyond the surgical mission approach and focus on working directly with existing LIC institutions. This approach combines 3 pillars: (1) identify and empower the local workforce, including institutions as well as individuals, (2) align plastic surgical support with local disease burden, and (3) embed plastic surgery priorities within National Health Plans. Identifying and empowering the local workforce involves quantifying the number of surgeons working and living in LMICs and providing support with respect to training if needed, infrastructure, and financial reimbursement. Initial success has been had with reimbursement strategies for cleft repair by local surgeons, but these efforts should continue to be aligned with local burden and incentivize plastic surgeons to provide other needed services such as effective burn management, trauma care, cancer care, and basic reconstructive surgery. Organizations focused on providing plastic surgical care should embed financial incentives to perform these procedures as well as recognize the role of non-plastic surgeon providers who may benefit from additional training. The large number of barriers to care of plastic surgery by local workforce represents core needs that can begin to be addressed by National surgical planning strategies, including those of the National Surgical, Anesthesia, and Obstetric Plans or similar initiatives. Future research should focus on further identifying the degree of task sharing by non-plastic surgeons, and measuring the effectiveness of alternate models of plastic surgery care in low resource settings.

This study is not without limitations. We believe that our method is the most comprehensive to date, but still represents an underestimation of the global plastic surgery workforce. We are unaware of the proportion of plastic surgeons who join membership societies and as such are unable to account for those surgeons who do not join any national or international societies. Due to the significant cost of societal memberships, this may bias our estimates by excluding those surgeons working in the most rural settings who face the largest barriers to joining societies. We pursued all available avenues for identifying these surgeons, but undoubtedly failed to identify all, and were unable to contact some of those we did identify. Of note, 18 of our responses were from Ethiopia, which may represent a sampling bias; however, these numbers reflect the number of surgeons identified through national and international plastic surgery societies for which we found a large number present in Ethiopia. There also are other surgeons who likely manage a number of plastic surgery conditions but are not plastic surgeons and do not consider themselves to be. To address differences in specialty certification and memberships in professional societies across countries, we did not explicitly define a plastic surgeon in an attempt to include those surgeons who consider themselves a plastic surgeon but lack formal specialty training or certification. Our survey response rate is unclear as we distributed it both to individual surgeons and through societies; however, given that we were able to find a total of 63 surgeons with 43 responses, we believe our data are highly representative of the plastic surgeon workforce in LICs. Non-response bias,

particularly by rural plastic surgeons in these settings, is likely.

CONCLUSIONS

This study quantifies the marked dearth of plastic surgeons practicing in LICs and the broad range of conditions treated by plastic surgeons working in these settings. Plastic surgeons who work in LICs contribute substantially to the delivery of emergent and essential surgical care. There is a strong need for continued development of the local plastic surgery workforce and the accompanying infrastructure to meet unmet needs and to expand surgical care.

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