Impact of short-term reconstructive surgical missions: a systematic review

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ABSTRACT

Introduction Short-term missions providing patients in low-income countries with reconstructive surgery are often criticised because evidence of their value is lacking. This study aims to assess the effectiveness of short-term reconstructive surgical missions in low-income and middle-income countries.

Methods A systematic review was conducted according to PRISMA guidelines. We searched five medical databases from inception up to 2 July 2018. Original studies of short-term reconstructive surgical missions were included, which reported data on patient safety measurements, health gains of individual patients and sustainability. Data were combined to generate overall outcomes, including overall complication rates.

Results Of 1662 identified studies, 41 met full inclusion criteria, which included 48 546 patients. The overall study quality according to Oxford CEBM and GRADE was low. Ten studies reported a minimum of 6 months' follow-up, showing a follow-up rate of 56.0% and a complication rate of 22.3%. Twelve studies that did not report on duration or follow-up rate reported a complication rate of 1.2%. Fifteen out of 20 studies (75%) that reported on follow-up also reported on sustainable characteristics.

Conclusions Evidence on the patient outcomes of reconstructive surgical missions is scarce and of limited quality. Higher complication rates were reported in studies which explicitly mentioned the duration and rate of follow-up. Studies with a low follow-up quality might underestimate the positive impact of missions. This review indicates that missions should develop towards sustainable partnerships. These partnerships should provide quality aftercare, perform outcome research and build the surgical capacity of local healthcare systems.

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INTRODUCTION

Conditions that are treatable by reconstructive surgery make up a large part of the global burden of surgical disease. Examples are burns (8.1 million disability-adjusted life years [DALYs]),¹ oro-facial clefts (0.23 million DALYs),¹ complex wounds including trauma-related wounds (unknown DALYs, but estimated to be significant), pressure sores (0.67 million DALYs)¹ or noma (a neglected tropical disease, a roughly estimated 1–10 million DALYs).² Short-term reconstructive surgical missions are a well-established routine method of addressing these conditions and reducing their impact on global health by providing specialised care in underserved populations.³ Such missions are commonly short term, disease specific, focus on service delivery and have a tendency to work outside the local healthcare system. This is also referred to as a ‘vertical approach to healthcare development’.⁴

Despite being a common model, the impact of reconstructive surgical missions is hardly known.¹ ⁶ Medical missions in general are
commonly debated in the literature.\textsuperscript{7-15} There is rising concern about the limited accountability of missions, with little data reported back to healthcare authorities due to a lack of outcome measurements.\textsuperscript{8 9} Quality of care is debated, as missions often have limited capacity to provide ancillary services or follow-up.\textsuperscript{10} Furthermore, sustainability is questioned in terms of lasting positive impact on the local healthcare system or its cost-effectiveness. The question is whether short-term surgical missions are the most rational allocation of resources to address local healthcare needs.\textsuperscript{4 7 8 12 15} Ultimately, the ethical implications of surgical volunteerism often ignite debate.\textsuperscript{17 18}

These concerns are discussed in several reviews of medical missions in low-income and middle-income countries (LMICs).\textsuperscript{7 9 10 12-15 19} For instance, Martiniuk \textit{et al} and Roche \textit{et al} argued that global standards are needed for short-term medical missions,\textsuperscript{7 14} and Sykes shows that only 6\% of all published studies on medical missions report on empirical data.\textsuperscript{16} Only a few studies reviewed surgical missions specifically.\textsuperscript{9 12-15 19} Shrim \textit{et al} systematically compare three types of charitable platforms for global surgery (short-term missions, self-contained surgical platforms and specialty surgical hospitals run by non-governmental organisations [NGOs]). Although they conclude that evidence in the literature is scarce, they state that self-contained temporary platforms and specialised surgical centres appear to provide more effective and cost-effective care than short-term surgical missions, except when no other delivery platform exists.\textsuperscript{12}

These reviews provide valuable insights into medical missions in general. However, the diversity of medical and surgical missions is large, which hampers the interpretation of empirical data. This review aims to systematically review evidence on the impact of short-term reconstructive surgical missions specifically, and critically analyses the quality of the available empirical data. In this review, four key aspects are addressed: basic characteristics of missions, patient safety, health gains of individuals and sustainability.

\textbf{METHODS}

We conducted a systematic review of the literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines.\textsuperscript{20}

\textbf{Inclusion criteria}

All original studies that analysed empirical data of short-term missions pertaining to reconstructive surgical care in LMICs were eligible. Studies lacking analyses of empirical data, reviews, studies of specialty surgical hospitals that provide continuous year-round care, mobile surgical platforms sent from in-country hospitals, studies in conflicts zones, studies not related to LMICs or studies of patients that were transported to high-income countries (HICs) were excluded. The studies were restricted to English and Dutch language. No restrictions were applied regarding publication dates. Duplicates were excluded.

\textbf{Search strategy and data sources}

PubMed, Embase.com, Clarivate Analytics/Web of Science and Open Grey were searched up to 1 July 2018; Proquest up to 1 July 2017 (by CR, TH and JK). The last database was no longer available to us after 2017. The following terms—including synonyms—were used as index terms or free-text words: ‘plastic surgery’, ‘reconstructive surgical procedures’, ‘cleft lip’, ‘post-burn contractures’ or ‘noma’ combined with ‘medical missions’, ‘humanitarian’ or ‘charity’. More studies were identified by reviewing the bibliographies of retrieved studies. The full search strategies for all databases can be found in the online supplementary file 1.

\textbf{Study selection}

Studies were screened for eligibility by two independent investigators (TH and CR): in case of disparity, a third author was involved (MB). Two investigators independently extracted the data to create tables and figures (TH and CR).

Data on mission characteristics and individual patient-level data were extracted and analysed across four key features:

1. Basic characteristics of the missions, including mission length, number of patients who received surgery, and age and gender distribution.

2. Patient safety by means of complication registration. Data were collected on three indicators: follow-up length, follow-up rate and complication rate. The follow-up rate was calculated by the number of patients who completed follow-up divided by the total number of patients who were included for follow-up. The complication rate was calculated as follows: the number of patients with complications divided by the total number of patients who completed follow-up.

3. Health gains: data on surgical outcomes were collected, for example, improvement of range of motion, patient-reported outcome measures (PROMs) or DALYs averted per patient. All reported PROMs were recorded, for example on surgical outcomes, complications or the quality of care provided. All types of formats, questionnaires or any other tool describing these outcomes were included. DALYs are used to define the overall disease burden over a population and are calculated by ‘adding the number of years of life lost due to premature mortality to the number of years of healthy life lost related to disability’.\textsuperscript{21} This means that 1 DALY can be defined as one lost year of healthy life.\textsuperscript{21} Many limitations of this approach are described in the literature. The biggest challenge is that it is not based on health data from countries, but on complex estimation techniques. DALYs are therefore estimations and many concerns exist about their reliability and uncertainty.\textsuperscript{22 23}
these challenges, DALY metrics are commonly applied in global surgery studies.1 21 24
4. Sustainable characteristics of missions: studies were reviewed for data on long-term partnerships, training objectives and involvement of local staff. Also, data on the cost-effectiveness of missions were collected. Missions were categorised either as stand-alone or consecutive missions to the same hospital, region or country.

Data analysis and synthesis
After a pilot, data were extracted independently and in duplicate using a data extraction sheet (TH and CR). Authors were contacted when data on complication registration were missing. Quantitative data synthesis consisted of compiling total number of patients (eg, total number of patients who were included, total number of patients with complications) to generate overall outcomes. Table 1 and the online supplementary appendix file 1 provide details of the data extracted from each reference. Due to the heterogeneity of studies in types of surgery, local healthcare settings or available resources, statistical analyses were not feasible. Study quality assessment was performed independently by authors TH and CR according to the Oxford CEBM Level of Evidence classification25 and the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) system.26

RESULTS
The search identified 1662 unique citations. After screening titles and abstracts 1570 studies were excluded because they did not concern short-term reconstructive surgical missions. Ninety-two studies concerned reconstructive surgical missions and were reviewed full-text. Of the full-text studies, 51 were excluded. Please see figure 1 for the screening and selection process. Studies reviewing specialty hospitals missions were excluded, as this was outside the scope of this review. After full-text analyses, 41 met full inclusion criteria (figure 1 and table 1).27–67

The studies included predominantly consisted of case series, with 37 studies graded at Oxford CEBM Level IV. The remaining four economic analyses were graded at level IIB. This resulted in a C grade of recommendations for our review, according to CEBM. The overall GRADE score was 2.7 (low to moderate quality), meaning that our confidence in the effect estimate is limited (table 2).26 68

Twenty-eight of 41 studies included pertained to cleft care (78% of the total study population). The number of patients in all studies totalled 48 546, with a mean age of 13.4 years (SD 8.5) (table 3). The average mission length was 10 days (SD 3.8; range, 6–21 days). Organisations were active in Africa, South-East Asia, Eastern Europe, and South and Central America. A typical mission team consisted of two or three plastic and/or maxillofacial surgeons, one or two anaesthetists, a mission coordinator, theatre nurse and one or two resident doctors, totalling 8 to 10 individuals for one single mission.32 33 37 46 47 50 51 54 58 Some teams were considerably larger, up to 40 individuals.36

Regarding patient safety, nine studies (22%) did not report on complications. Twelve studies (29%) only reported a complication rate without reporting on follow-up length or rate. The overall complication rate in these 12 studies was 1.2%. Ten studies (21%) reported a follow-up length shorter than 180 days, with a mean follow-up rate of 81.3% and a complication rate of 7.1%. Ten studies (24%) provided a follow-up length longer than 180 days, reporting a mean follow-up rate of 56.0% and a 22.3% complication rate (table 3). Mortality after cleft surgery was reported in three studies, totalling 3 out of 14 551 patients included in these studies.16 28 64 For general reconstructive surgical missions—not specified for a single disease—one single study reported one death54 and no mortality was reported in contracture and noma missions.

Twelve studies (29%) reported on health gains of the mission, reporting heterogeneous methods and outcomes (table 1). Methods used in cleft studies included photographic assessment of aesthetic outcomes,30 56 speech evaluation,16 47 or DALYs averted.41 43 48 55 Three cleft studies evaluated speech functionality postoperatively, either by questionnaires61 or speech tests.16 47 Study methods were clear and showed overall improvements of speech. Four cleft studies reported on DALYs averted by cleft lip and palate repair surgery. DALYs averted per patient were 3.9,43 6.041 and 10.1 per patient.48 In three noma missions, a surgeon-reported outcome scale was used to score aesthetic and functional outcome.32 50 52 Overall findings showed that high-complex surgery is associated with greater risks of unsatisfactory results. Three studies used PROMs. One contracture study reported improvements in quality of life and disability by using validated questionnaires, and reported overall positive outcomes.60 Two cleft studies used self-developed questionnaires to assess PROMs, reporting positive results.61 66 None of the studies reported on patient-reported outcomes on the quality of the care provided.

With regard to the sustainable characteristics of missions, 29 studies reported qualitative data (71%) on sustainability, while none of the studies reported quantitative data. Fifteen out of twenty studies that reported on follow-up and complications also reported on sustainable characteristics such as long-term partnerships or training activities (table 4). Ten organisations (24%) were engaged in longer-term partnerships, and thirteen missions (32%) returned to the same regions or hospitals. Few data were available on the frequency of missions, although several studies reported conducting yearly missions.32 35 45 59 Fifteen studies (35%) described teaching objectives as a goal during their missions. Activities mentioned were lectures,29 37 55 training of local surgeons,16 33 38 54 health-care workers57 55 60 or fellowships in donor countries.16 53 55
| Authors (year) | Affiliated organisations | Country of mission | Year of mission | Number of patients treated | Length of follow-up | Follow-up rate | Complication rate | Health gains |
|---------------|--------------------------|-------------------|----------------|---------------------------|-------------------|---------------|------------------|-------------|
| Aziz et al (2009)²⁷ | NA | Bangladesh | 2006–2008 | 146 | ≤10 days | NA | 8/146 (5.5%) | NA |
| Bello et al (2018)²⁸ | CFDF | Nigeria | 2011–2017 | 448 | 2 months | 155/448 (34.6%) | NA | 35/155 (34.6%) | NA |
| Bermudez and Lizarra (2009)²⁹ | Operation Smile | 40 countries | 2007 | 4086 | 1 year | 812/4086 (19.9%) | NA | NA | NA |
| Calis et al (2016)³¹ | Interplast Turkey | Uzbekistan | 2009–2014 | 529 | NA | NA | 1/529 (0.2%) | NA |
| Daniels et al (2016)³² | ReSurge Int. | China | 2005–2009 | 201 | 1–5 years | 116/201 (57.7%) | 34/96 (35.4%) | NA |
| Fayyaz et al (2015)³³ | Cleft Lip and Palate Association | Pakistan | 2014 | 312 | 3 months | NA | 18/312 (5.8%) | NA |
| Guneren et al (2015)³⁴ | Turkish international development agency | Asia, Middle East, Africa | 2007–2014 | 25 | NA | NA | NA | NA |
| Hackenberg et al (2015)³⁵ | Operation Smile | India | 2006–2012 | 3503 | NA | NA | NA | Total 21 008 DALYs averted 6.0 DALYs averted per patient |
| Hughes et al (2016)³⁶ | Hands Across the World | Ecuador | 2015 | 27 | NA | NA | NA | NA |
| Hughes et al (2012)³⁷ | Hands Across the World | Ecuador | 1996–2011 | 1142 | 7 days | 1089/1142 (97.1%) | 40/1122 (3.6%) | Total 396–1042 DALY averted 3.9–10.2 DALY averted per patient |
| Maine et al (2012)³⁸ | ReSurge Int and Rostros Felices | Ecuador | 2000–2005 | 315 | >14 days | 128/315 (40%) | 72/128 (56.3%) | NA |
| McQueen et al (2007)³⁹ | Operation Smile | Jordan, Iraq | 2005 | 71 | NA | NA | 4/71 (5.6%) | NA |

Continued
| Authors (year) | Affiliated organisations | Country of mission | Year of mission | Number of patients treated | Length of follow-up | Follow-up rate | Complication rate | Health gains |
|---------------|--------------------------|--------------------|----------------|---------------------------|-------------------|--------------|------------------|--------------|
| McQueen et al (2009) | Operation Smile | 18 Countries | NA | 8151 | NA | NA | 67/8151 (0.8%) | NA |
| Moon et al (2012) | Smile for Children | Vietnam | 2007–2010 | 303 | NA | NA | NA | Total 377 to 458 DALYs averted on average mission |
| Navarro (2015) | CIRPLAST | Peru | 1994–2014 | 6108 | 12 days (range 12 days to 9 years) | 5162/6108 (84.5%) | 377/5162 (7.3%) | NA |
| Park et al (2018) | Operation Smile | India | 2010–2011 | 890 | 7 days | 662/890 (74.4%) | 101/662 (15.3%) | NA |
| Rauso et al (2015) | Emergenza Sorrissi Onlus | Uganda, Gabon | 2012–2014 | 56 | NA | NA | 2/56 (3.6%) | NA |
| Rivera et al (2013) | Operation Smile | Honduras | 2007 | 45 | 6 months | 22/45 (48.9%) | 3/22 (13.6%) | NA |
| de Buys Roessingh et al (2012) | SedoGoho hospital, TdH, CHUV Laus. | Benin and Togo | 1993–2008 | 131* | 5.6–7.6 years | 36/71 (50.7%)* | 14/71 (19.7%)* | Speech follow-up: 36 patients. Acceptable 17/36=47.2%. Unacceptable 19/36=52.8% |
| Rossell-Perry et al (2015) | ReSurge International and Smile Train | Peru | 2002–2012 | 257 | 1–5 years | 97/353 (27.5%)* | 34/257 (13.2%)* | NA |
| Sharp et al (2008) | Operation Smile | Philippines | 2003 | 120 | 6 months | 52/99 (52.5%)* | 10/50 (20.0%)* | Improved speech 52% ▶ Improved eating 25% ▶ Improved social benefit 14% ▶ Improved appearance 6% |
| Sieg et al (2004) | NA | Africa, Asia, Central America | NA | 14 | ≥1 year | 10/14 (71.0%)* | 1/10 (10%)* | NA |
| Uemura et al (2015) | Duang-Kaew Foundation | Thailand, Vietnam, Myanmar, Laos, Cambodia, China, Sri Lanka, Bhutan and India | 1988–2008 | 6832 | 1 month | 5412/6832 (79.2%) | 186/5412 (3.4%) | NA |
| Uetani et al (2006) | Japanese Cleft Palate Foundation | Vietnam | 1993–2003 | 790 | NA | NA | NA | NA |
| Wes et al (2017) | Changing Children’s Lives Int. | Thailand | 2013 | 56 | <1.5 years | 30/56 (53.6%) | 0/30 (0%) | Self-reported improvement: social interactions 83.3%; confidence 83.3%; school performance 75% |

Table 1 Continued
### Table 1  Continued

| Authors (year) | Affiliated organisations | Country of mission | Year of mission | Number of patients treated | Length of follow-up | Follow-up rate | Complication rate | Health gains |
|----------------|--------------------------|--------------------|-----------------|---------------------------|---------------------|----------------|------------------|--------------|
| **Post-burn contracture** | | | | | | | | |
| Borghese et al (2005) | NA | Cambodia, Bangladesh | 2002, 2003 | 200 | NA | NA | 14/200 (7.0%) | NA |
| El Ezzi et al (2017) | Terre des hommes | Benin and Togo | 2002–2011 | 50 | 3.6 years | 50/50 (100%) | 28/50 (56.0%) | NA |
| Fuzaylov et al (2015) | Doctors Collaborating to Help Children | Ukraine | 2011–2013 | 39 | NA | NA | 1/39 (2.6%) | NA |
| Kim et al (2012) | Operation ReStore, Operation Smile and Cents of Relief | India | 2010 | 38 | NA | NA | 9/60 (15.0%) | NA |
| Sinha et al (2016) | Operation ReStore | India | 2012 | 31 | 84 days | 31/39 (79.5%) | 9/31 (29.0%) | SF-36 QoL : improvement of 5.8 points WPI: 13.7% mean improvement |
| **Noma** | | | | | | | | |
| Bouman et al (2010) | Facing Africa and Dutch Noma Foundation | Ethiopia, Nigeria | 2007, 2008 | 63 | 35 days | 74/74 (100%) | 47/74 (63.5%) | Excellent results 36% Satisfactory 23% Mediocre 16% Poor 11% Very poor 14% |
| Marck et al (2010) | Facing Africa | Ethiopia | 2007, 2008 | 77 | 35 days | 77/77 (100%) | 54/77 (70.1%) | Good results 30.7% Acceptable 34.6% Mediocre 17.9% Poor 7.7% Very poor 9.0% |
| Rodgers et al (2015) | Facing Africa and Dutch Noma Foundation | Ethiopia | 2008–2014 | 34 | 36 days | NA | 17/34 (50.0%) | NA |

**General reconstructive missions**

Continued
### Table 1. Continued

| Authors (year) | Affiliated organisations | Country of mission | Year of mission | Number of patients treated\(^a\) | Length of follow-up\(^b\) | Follow-up rate | Complication rate\(^c\) | Health gains |
|----------------|-------------------------|--------------------|-----------------|-------------------------------|----------------------------|---------------|------------------------|-------------|
| Baran et al (2007)\(^{29}\) | Physicians for Peace and Interplast | Multiple countries | 1985–2004 | 4736 | NA | NA | NA | NA |
| Figus et al (2009)\(^{37}\) | Interplast Italy | Multiple countries | 1988–2008 | 5235 | NA | NA | NA | NA |
| McClennagan et al (2013)\(^{31}\) | Project Harar | Ethiopia | 2012 | 40 | 21 days | 30/30 (100%) | 7/30 (23.3%) | NA |
| Merrel et al (2007)\(^{54}\) | Operation Smile | Vietnam | 1990–2004 | 266 | NA | NA | 6/266 (2.3%) | NA |

Authors were contacted when data were missing for follow-up. Of note, in several studies (indicated with an \(*\)), the follow-up rate or complications rate were calculated over different subgroups; therefore, columns may not add up or correlate. \(^a\)When available, this review reports the number of patients who received surgery; when not available, the number of procedures was used; when not available, the number of diagnosis was used. \(^b\)When studies reported a range of follow-up intervals, the shortest length of follow-up was used for calculations. \(^c\)When the total number of patients who completed follow-up was not available, the total number of patients included was used (in line with the cited articles). \(^d\)The complication rate cited was calculated over the total number of procedures.

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**Affiliated organisations:** Physicians for Peace and Interplast

**Country of mission:** Multiple countries

**Year of mission:** 1985–2004

**Number of patients treated:** 4736

**Length of follow-up:** NA

**Follow-up rate:** NA

**Complication rate:** NA

**Health gains:** NA

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**DISCUSSION**

Several systematic reviews about short-term missions have been published in the past. However, none of the studies published empirical data on the effects of training or elaborated on how the training of local healthcare personnel was organised.

Four cost-effectiveness studies were available for short-term cleft missions. Three studies reviewed the effectiveness per DALY averted, reporting US$33.94/DALY, US$56.0/DALY, and US$247.42/DALY. The variation is explained by the differences in study populations, sample sizes, effectiveness measurements, and costing approaches used. However, none of the studies published empirical data on the effects of training or elaborated on how the training of local healthcare personnel was organised.
which is lower than the rates of their counterpart short-term missions.³⁹ Smile Train studies report lower rates, between 0.88% and 3%.⁷⁰ ⁷¹ ⁷³ ⁷⁸ However, they note that there might be a risk of under-reporting or selection bias due to a dependence of Smile Train surgeons on payment-per-patient (risking fewer referrals when higher complication rates are reported) and a limited capacity of surgeons to treat complex cases.⁷⁰ ⁷¹ ⁷³ ⁷⁸ Furthermore, with only one Smile Train study reporting on follow-up lengths,⁷⁵ these complication rates should be interpreted with caution. To be able to compare the strengths and weaknesses of different approaches of providing surgical

Figure 1  Flow diagram. LMIC, low-income and middle-income country.

| Type of missions                     | Number of studies included | Oxford CEBM Level of Evidence | Average GRADE score |
|-------------------------------------|---------------------------|-------------------------------|---------------------|
| Cleft care mission studies          | 28 studies                | 24 Level IV studies (case series) 4 Level IIB (economic studies) | 2.6 (quality: low–moderate) |
| Post-burn contractures mission studies | 5 studies                | 5 Level IV studies (case series) | 3.4 (quality: moderate) |
| Noma mission studies                | 4 studies                 | 4 Level IV studies (case series) | 4.3 (quality: high) |
| General reconstructive surgery mission studies | 4 studies                | 4 Level IV studies (case series) | 1.3 (quality: very low–low) |
| Overall quality and level of recommendation | 41 studies              | 37/41 Level IV studies 4/41 Level IIB studies Level C recommendations | 2.7 (quality: low–moderate) |

Information listed per condition. Quality assessment of included studies was performed using the GRADE system⁶⁸ and Oxford CEBM Level of Evidence.
### Table 3 (A) Overall outcomes on basic characteristics of missions

| Length of mission                  | Total number of patients | Gender distribution | Age |
|------------------------------------|--------------------------|---------------------|-----|
|                                    | Studies (n) | Total length (days) | Average (days) | Studies (n) | Patients (n, %) | Female (n, %) | Male (n, %) | Studies (n) | Mean (years) | Studies (n) | Median (years) |
| Clefts                             | 18          | 168                 | 9               | 28          | 37642 (78)     | 1344          | 18          | 12210 (45.8) | 14435 (54.2) | 12          | 9.22          | 3              | 4.5          |
| Post-burn contractures             | 3           | 23                  | 8               | 5           | 358 (1)        | 72            | 4           | 143 (44.8)   | 176 (55.2)   | 2           | 27.6          | 1              | 4.0          |
| Noma                               | 2           | 28                  | 14              | 4           | 269 (1)        | 67            | 3           | 102 (58.6)   | 72 (41.4)    | 1           | 23.9          | 1              | 17.0         |
| General reconstructive             | 4           | 57                  | 14              | 4           | 10277 (21)     | 2569          | 1           | 143 (44.8)   | 176 (55.2)   | 1           | 24.0          | NA             | NA           |
| Totals                             | 27          | 276                 | 41              | 48546 (100) | 26           | 12598 (45.9)  | 14859 (54.1) | 16          | 13.4 (SD+/- 8.5) | 4.5 (Q25-75 2.9-13) |

Overall mean or median

- Overall follow-up length: 10 (+/-SD 3.8)
- Overall follow-up length: 1184 (+/-SD 2134.4)

### Table 3 (B) Overall outcomes on patient safety

| Follow-up length not reported | Follow-up length<180 days | Follow-up length>180 days |
|-------------------------------|---------------------------|---------------------------|
| Studies (n)                  | Follow-up rate* (%)       | Follow-up rate† (n, %)    | Follow-up rate* (%)       | Follow-up rate† (n, %)    | Follow-up rate* (%)       | Follow-up rate† (n, %)    |
| Clefts                       | 7                         | 111/11 992 (0.9)          | 6                         | 81.0                      | 739/12 513 (5.9)          | 9                         | 54.3                      | 181/887 (20.4) |
| Post-burn contractures       | 3                         | 24/383 (6.3)              | 1                         | 77.4                      | 9/31 (29.0)               | 1                         | 100.0                     | 28/50 (56.0)  |
| Noma                         | 1                         | 17/34 (50.0)              | 3                         | 97.6                      | 158/240 (65.8)            | 0                         | NA                       | NA                    |
| General reconstructive       | 1                         | 6/266 (2.3)               | 1                         | 100                       | 7/30 (23.3)               | 0                         | NA                       | NA                    |
| Total studies                | 12                        | 11                        | 10                        |

Overall rate: 158/12 675 (1.25) 81.3 913/12 814 (7.1) 56.0 209/937 (22.3)

*The follow-up rate: the number of patients who completed follow-up divided by the total number of patients included for follow-up. For clarity reasons only percentages are displayed, patient numbers are omitted.

†The complication rate: the number of patients with complications divided by the total number of patients who completed follow-up. Displayed are the patient numbers, between brackets the complication percentage.

NA, not available.
Table 4  Sustainable characteristics of short-term missions

| Authors (year) | Years       | Number and frequency | Consecutive missions to the same country | Consecutive missions to the same region/city | Consecutive missions with (part of the) same team | Partnership | Long-term relationship | Teaching objective | Advancement of local staff | Quality follow-up and sustainable characteristics† |
|----------------|-------------|----------------------|-----------------------------------------|---------------------------------------------|--------------------------------------------------|-------------|------------------------|----------------------|---------------------------|--------------------------------------------------|
| Aziz et al (2009) | 2006–2008   | 3 (annual)           | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Bello et al (2018) | 2011–2017   | 17                   | ✓                                       | ✓                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Baran et al (2007) | 2007        |                       | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Bermudez et al (2009) | 2007      |                       | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Borghese et al (2005) | 2002–2003  | ✓                    |                                         |                                             |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Bouman et al (2010) | 2007–2008   | 4 (biannual)         | ✓                                       | ❑                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Calis et al (2016) | 2009–2014   | 6 (annual)           | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Daniels et al (2016) |            | ✓                    |                                         |                                             |                                                   |             |                        | ✓                    | ✓                         | ❑                                                 |
| El Ezzi et al (2017) | 2002–2011   | 9 (biannual)         | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Fayyaz et al (2015) | 2004–present| 130                  | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Figus et al (2009) | 1988–present| 47                   | ✓                                       | ❑                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Fuzaylov et al (2015) | 2011–2013  | 3 (annual)           | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Guneen et al (2015) | 2007–2014   | 27                   | ✓                                       | ❑                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Hughes et al (2012) | 1996–2011   | 16 (annual)          | ✓                                       | ❑                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Macintosh et al (2013) | 1993–present| (biannual)           | ✓                                       | ❑                                           |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |
| Madsen et al (2015) | 2005–2009   | (annual)             | ✓                                       | ✓                                           | ✓                                                 | ✓           | ✓                      | ✓                    | ✓                         | ✓                                                 |
| Mane et al (2012)  | 2000–2005   | ✓                    |                                         |                                             |                                                   |             |                        | ✓                    | ✓                         | ■                                                 |

Continued
Table 4  Continued

| Authors (year) | Years          | Number and frequency | Consecutive missions to the same country | Consecutive missions to the same region/city | Consecutive missions with (part of) the same team | Partnership | Training local staff | Lectures/workshops/education | Advice on logistics within healthcare system | Encouraging medical independence of local staff | Participation of local staff in surgical care and pre-op and/or post-op care | Fellowship abroad | Providing medical supplies | Studies that reported both on follow-up details and sustainable characteristics† |
|----------------|----------------|----------------------|-----------------------------------------|---------------------------------------------|-------------------------------------------------|-------------|---------------------|-------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|----------------|-----------------------------|-------------------------------------------------|
| Marck et al   | 2007–2008      | 2 (annual)           | ✓                                       | ✓                                           | ✓                                               | ✓           | ✓                   | ✓                             | ✓                                             | ✓                                             | ✓                                             | ✓             |                            | ■                                                            |
| McClenaghan et al (2013) | 2012           |                       | ✓                                       | ✓                                           |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| McQueen et al | 2005           |                       |                                         |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| Merel et al   | 1990–2004      | 11                   | ✓                                       | ✓                                           | ✓                                               | ✓           | ✓                   | ✓                             |                                               |                                               |                                               |               |                            | ■                                                            |
| Moon et al    | 2007–2010      | 4 (annual)           | ✓                                       |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| Navarro (2015) | 1994–2014     | 141 (10 annually)    | ✓                                       |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| Park et al    | 2010–2011      | 2                    | ✓                                       | ✓                                           | ✓                                               | ✓           | ✓                   | ✓                             | ✓                                             |                                               |                                               |               |                            | ■                                                            |
| Rivera et al | 2007           | 1                    |                                         |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| de Buys Roessingh et al (2012) | 1993–2008     | (annual)             | ✓                                       | ✓                                           | ✓                                               | ✓           | ✓                   | ✓                             |                                               |                                               |                                               |               |                            | ◊                                                            |
| Rosell-Perry et al (2015) | 2002–2012   |                       | ✓                                       | ✓                                           | ✓                                               |             |                     |                               |                                               |                                               |                                               |               |                            | ◊                                                            |
| Uemura et al  | 1988–2008      | 458                  | ✓                                       |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |
| Uetani et al  | 1993–2003      |                       |                                         |                                             |                                                  |             |                     |                               |                                               |                                               |                                               |               |                            | ■                                                            |

In order to determine whether or not missions were sustainable, the data were collected and allocated to three groups, ie, building long-term relationships, teaching objectives during the mission and the advancement of local staff. Each sustainability group is divided into different subsets. A checkmark (✓) means the study describes the concomitant form of sustainable health care.

*Part of the Operation Smile International (OSI) programme.
†Added to this table were studies that reported both on sustainable characteristics and on quality of follow-up (including length and rate of follow-up and complication rate). Eight studies with follow-up shorter than 180 days (■ marks), seven studies with follow-up up longer than 180 days (◊ marks). Five studies reported on quality of follow-up, but did not report on sustainable characteristics.
care in a LMIC, there is a need for more high-quality studies. Apart from registrations of complications, such studies should assess long-term outcome using validated outcome measures and PROMs. Specialty hospitals, which provide services all year round, could provide good conditions for longer-term outcome research.

Several studies in this review consistently report on follow-up, showing that substantial efforts are being made to improve the data output of missions. Ten studies reported significant follow-up lengths of more than 6 months and high numbers of patients returning for follow-up were shown. The majority of these missions were engaged in long-term partnerships. This included training of local healthcare personnel, which was likely to improve the feasibility of organising follow-up. Several strategies were implemented to ensure the quality of follow-up. Some missions deployed medical students to assess palatal fistulas or sent a speech pathologist in-country to review outcomes. The relatively high number of complications seen in noma missions could be partly explained by a stringent follow-up, done by an independent researcher who consistently reported on follow-up. All the studies mentioned above provide examples of how to ensure patient safety during and after missions.

Although some studies reported on health gains, with several studies reporting positive functional outcomes, the methods and evidence are heterogeneous and results are too limited to draw conclusions. The role of PROMs is effective in reconstructive surgery to assess the quality and outcomes of healthcare. Only a few of the studies included reported successfully on outcomes using PROMs and none assessed the quality of care experienced by patients. Patient experience of outcomes and quality is important. Future studies should include PROMs on surgical outcomes and quality of care. Only a few studies report on the sustainable characteristics of missions. Data on this topic are usually qualitative and highly variable. It is noteworthy that reporting on sustainability and higher quality of patient follow-up often go hand in hand. This suggests that more sustainable missions may be better able to follow their patients for a longer period. However, as empirical evidence on sustainability is still non-existent, there is an urgent need for further studies.

**Limitations**

This systematic review has several limitations. Literature on short-term reconstructive missions is scarce and of limited quality, limiting the strength of this review. As the majority of studies are cleft studies, the conclusions and recommendations of this review may not be fully applicable to other types of reconstructive surgical missions. The studies included represent just a small proportion of the many reconstructive surgical missions conducted worldwide. This may introduce a potential bias. It is likely that the small proportion likely does not fully represent the actual effect of all reconstructive surgical missions. In our view, this emphasises the need to incorporate standard monitoring and evaluations into missions.

Furthermore, this review addresses only short-term missions and does not attempt to make a direct comparison with long-term surgical platforms such as specialty hospitals. It is often argued that specialty hospitals are safer and have a more positive effect on local healthcare systems. Comparative studies of short-term missions and specialty hospitals can identify strengths and weaknesses of each approach. However, a definitive comparison between missions and specialty hospitals seems to be premature at present given the lack of comparative studies.

Concerns regarding the use of DALY metrics are applicable to the studies included in this review. It is argued that surgical conditions are underestimated in the global burden of disease studies. Attempts to estimate the surgical burden across all disease conditions have been challenging. In a recent study, it was argued that the current DALY approach is inadequate to quantify the burden of paediatric surgical conditions.

**Recommendations**

There are opportunities for NGOs to develop short-term missions towards more sustainable partnerships. In the past, missions have been a ‘vertical’ approach to healthcare development. Such missions have limitations, for example in building local capacity of surgical services. The results of this study indicate that longer-term follow-up is frequently lacking, with complications being potentially missed. To address these shortcomings, the ‘diagonal development’ approach has been proposed. It combines the short-term vertical inputs of missions with longer-term horizontal benefits, with the ultimate aim of improving access to, and surgical capacity of, the local healthcare system. Such goals may be achieved through long-term development of surgical infrastructure, continued training of the local surgical workforce or building an academic culture.

One example of such a diagonal approach is to aim for standardised tracking of longer-term outcomes of missions in strong collaboration with local partners. This might yield several advantages. Besides empowering local researchers and building an academic culture, outcomes can be reported back to patients and healthcare authorities. This will enhance the accountability of NGOs and allow for evaluations of the quality of care provided.

Another example of long-term investments in the local surgical capacity is strengthening of the training activities of surgical NGOs. Such activities should be integrated into existing national or regional training activities. The training should be adapted to local settings, needs-driven and should focus on bilateral knowledge exchange.
CONCLUSION
This review shows that evidence for the effectiveness of short-term reconstructive surgical missions is both of limited substance and quality. Given the overall lack of evidence, there is an urgent need to incorporate outcomes research in future missions. This should include longer-term complication registration and measurements of health gains among individual patients. The effectiveness of training activities should also be evaluated. One approach to achieve this is to develop short-term missions towards diagonal development missions, which aim to build surgical capacity of local healthcare systems through long-term investments.

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