

Estimation of Surgery Capacity in Haiti: Nationwide Survey of Hospitals

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Abstract

Background Haiti's surgical capacity was significantly strained by the 2010 earthquake. As the government and its partners rebuild the health system, emergency and essential surgical care must be a priority.

Methods A validated, facility-based assessment tool developed by WHO was completed by 45 hospitals nationwide. The hospitals were assessed for (1) infrastructure, (2) human resources, (3) surgical interventions and emergency care, and (4) material resources for resuscitation. Fisher's exact test was used to compare hospitals by sectors: public compared to private and mixed (public–private partnerships).

Results The 45 hospitals included first-referral level to the national referral hospital: 20 were public sector and 25 were private or mixed sector. Blood banks (33 % availability) and oxygen concentrators (58 %) were notable infrastructural deficits. For human resources, 69 % and 33 % of hospitals employed at least one full-time surgeon and anaesthesiologist, respectively. Ninety-eight percent of hospitals reported capacity to perform resuscitation. General and obstetrical surgical interventions were relatively more available, for example 93 % provided hernia repairs and 98 % provided cesarean sections. More specialized interventions were at a deficit: cataract surgery (27 %), cleft repairs (31 %), clubfoot (42 %), and open treatment of fractures (51 %).

Conclusion Deficiencies in infrastructure and material resources were widespread and should be urgently addressed. Physician providers were mal-distributed relative to non-physician providers. Formal task-sharing to mid-level and general physician providers should be considered. The parity between public and private or mixed sector hospitals in availability of Ob/Gyn surgical interventions is evidence of concerted efforts to reduce maternal mortality. This ought to provide a roadmap for strengthening of surgical care capacity.

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Introduction

Surgically treatable conditions contribute significant proportion to burden of disease in low- and middle-income

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countries (LMICs) [1–4]. A global estimate suggests that 11 % of all disability-adjusted life years are attributed to surgical conditions [5]. The rising prevalence of non-communicable diseases and incidence of serious injuries will lead to greater surgical need [6, 7], while already high burden conditions require surgical management at some stage for prevention or treatment of sequela: HIV/AIDS, birth complications, reducing maternal and infant mortality, and correction of congenital anomalies [8]. It has been estimated that 5 billion people lack access to safe, affordable surgical and anesthesia care [9]. To address burden of surgical conditions, investigators over the past decade began assessing baseline capacity for surgical care. The most commonly used assessment tool became the WHO's validated tool for situational analysis to assess emergency and essential surgical care (TSAAEESC) and adaptations of the tool [10–16]. In Haiti, the earthquake of 2010 was an impetus for deploying the TSAAEESC to inform health system rebuilding for provision of basic surgical care even to the poorest, as exemplified by Zanmi Lasante/Partners in Health [17].

In Haiti, surgical care is delivered by a mix of public and non-public sector actors. The Ministère de la Santé Publique et de la Population (MSPP) categorizes facilities into four sectors: public, private (not-for-profit), private (for-profit), and mixed (public–private partnership). At the first-referral level, there are “Hôpitaux Communautaires de Référence (HCR)”; at the secondary level, there are ten “Hôpitaux Départementaux” and larger hospitals providing specialty care. Tertiary is designated only for university hospitals and highly specialized centers. Together, 121 hospitals are distributed across the ten Départements (administrative regions) [18]. There are 2422 physicians (922 in the public sector) for a population of 10,579,230 or 2.3/10,000 compared to the global average of 14.2/10,000 and low-income country average of 5.1/10,000 [19–21]. Essential medicines are lacking and generally unaffordable [22]. However, where there are investments, such as in maternal and child health programs, steady improvements have been noted. The under-5 child mortality rate has declined from 112/1000 in 2002 to 88/1000 in 2012 [23]. Maternal mortality rate has decreased by 43 % from 620/100,000 in 1990 to 350/100,000 in 2010 [24]. In 2012, the Government of Haiti approved the Politique Nationale de Santé calling for accessible universal health coverage with provisions for a trauma care system [25]. Universal health coverage should eventually include safe, affordable emergency and essential surgical care. Therefore, the objective of this study was to identify gaps in existing capacity, inform resource allocation, and inform future research efforts.

Methods

This was a cross-sectional survey of hospitals between the months of April 2012 and August 2012 (40 submissions), with an additional five submissions in October 2012 and July 2013. Regardless of timing, all submissions were requested to provide statistics using April 2012 as the date of reference. The French version of the WHO TSAAEESC (<http://www.who.int/surgery/publications/AnalyseSituationnelle.pdf>) was distributed to Medical Directors and the chief administrative officers of 52 hospitals in 10 Départements. Forty-five (45) completed the questionnaire; thirty were visited by the data collection team and complemented by interviews with the Medical Director and/or chief administrative officer of the health facility (lead respondent). Visits were arranged if the hospital's lead respondent accepted a request to visit. The data collection team consisted of one surgeon, one resident in surgery, one general physician, and one data manager. A test data collection was trialed at the national referral hospital (Hôpital de l'Université d'Etat d'Haiti—HUEH) before visiting other hospitals.

The sample was identified with the MSPP using data from the Carte Sanitaire project (<http://www.mspp.gouv.ht/cartographie/index.php#>). Given limited resources, an exhaustive survey was not pursued. All health facilities reporting surgical activity (74) were identified with MSPP and 52 (70 %) were selected for sampling by convenience with the following priorities: departmental referral hospital and equivalent size hospital in private sector, expert-guided knowledge of high surgical volume, and adherence of the 2:1:1 ratio of public–mixed–private sectors observed in the sampling frame of 74 facilities. For 3 Départements (Grande Anse, Nippes, and Sud-Est), we sampled all hospitals with surgical capacity. All three sectors were represented in the sample and all levels, from first-referral hospital to the national referral hospital, were represented.

The questionnaire included 134 questions representing in 4 sections: (1) 27 questions on infrastructure such as running water, electricity, anesthesia machines; (2) 8 on quantity and availability of human resources providing surgery and anesthesia services; (3) 35 on availability and referral activity for emergency care, surgical and anesthesia interventions; (4) 64 on availability of emergency equipment and supplies for resuscitation. Five (5) questions in the fourth section were omitted from analysis after the WHO EESC Program updated the questionnaire. Each assessed resource in the questionnaire was dichotomized into available or not available; a resource was available if and only if it was available at all times and for all patients without interruption. Descriptive statistics and significance

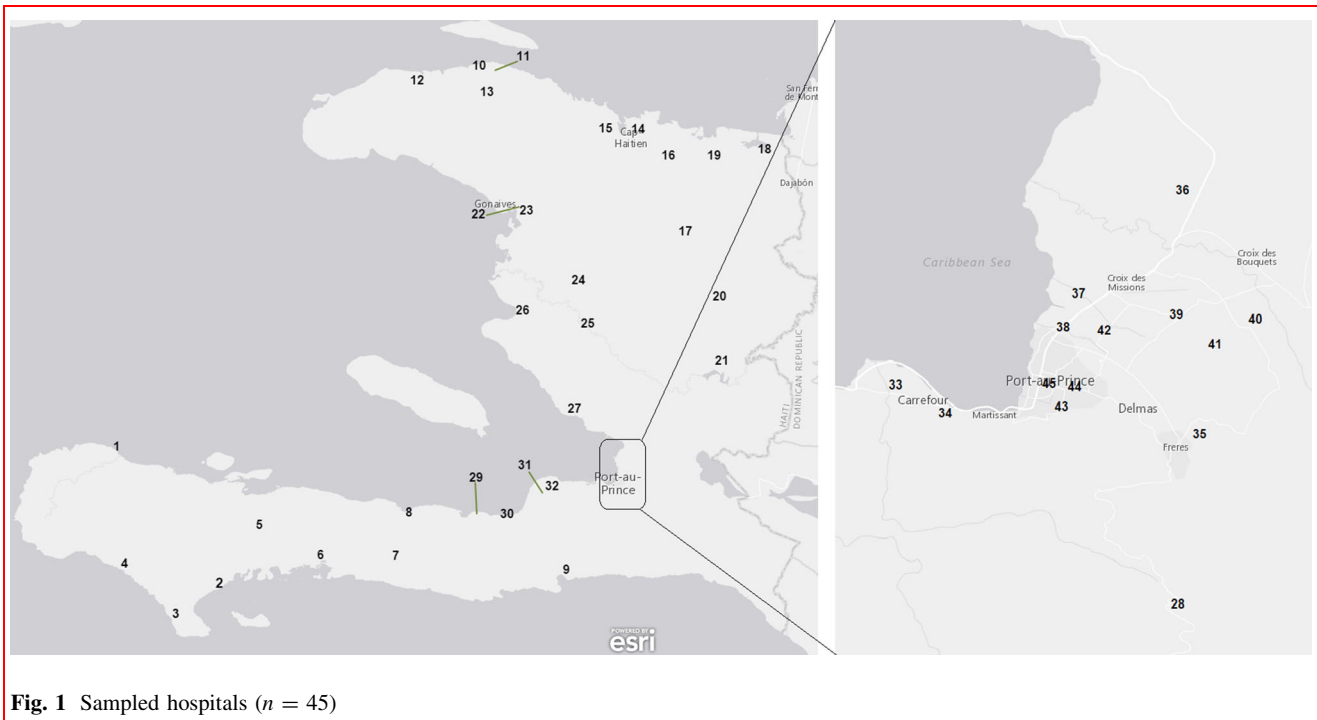


Fig. 1 Sampled hospitals ($n = 45$)

testing was performed using STATA 11.2 SE (StataCorp, College Station, Texas, USA) and maps were created using ArcGIS (ESRI, Redlands, California, USA). This study was approved by the MSPP's National Bioethics Committee (1213-16) and the UC San Francisco Committee on Human Research (12-08,804).

Results

The 45 sampled hospitals are mapped in Fig. 1. Twenty were public sector; 14 were private, and 11 were mixed (public–private partnership). Three hospitals were university hospitals and one was a specialty surgical care center. There were 16 “Hôpitaux Départementaux” or equivalent, and 25 hospitals were at the first-referral level. Forty-two of these hospitals (93 %) possessed a designated area for emergency care. The catchment population ranged from 10,128 to 10,000,000 (for the national referral hospital HUEH).

Infrastructure

For basic infrastructure, continuous water supply and on-grid electricity were available in 89 % and 78 % of hospitals, respectively. Ninety-three percent reported at least one functional power generator. One hospital reported having no functional operating room (OR). Eleven reported one OR, 20 reported 2 ORs, 12 reported 3–4 ORs, and HUEH reported 6 ORs. Please view Supplement Figure S1

for distribution of ORs sampled. The HUEH had 700 total inpatient beds and was the only hospital with over 500 beds, while 8 hospitals reported 101–200 beds. The remaining 36 hospitals (80 % of the sample) had less than 100 beds. Blood banks were available in only 33 % of all hospitals. Guidelines for surgery (69 % availability), anesthesia (67 %), pain management (58 %), and emergency medicine (56 %) were not widely available. Post-operative care area was reported in 82 % of hospitals. At least one functional anesthesia machine and pulse oximeters were available in 89 % of hospitals. Oxygen cylinders were more available (87 %) than oxygen concentrators (58 %). Table 1 depicts percentage of hospitals sampled that reported having each assessed resource always available.

Human resources

Table 2 displays total number of healthcare providers by category and sectors. This was reported as the percentage of hospitals that employed at least one full-time worker per category. Sixty-six percent of hospitals employed at least one full-time surgeon, 33 % employed an anaesthesiologist, and 71 % employed an obstetrician/gynecologist (Ob/Gyn). General physicians performing surgery were mostly limited to the West Department albeit at low overall frequency nationally (12 full-time total). The Port-au-Prince hospitals (15 of 45) handled 29.5–31.0 % of surgical caseload while employing 69 % of surgeons, 70 % of Ob/Gyns, and 85 % of anaesthesiologists reported.

Table 1 Availability of infrastructure

Facilities with uninterrupted access Percentage (%) of facilities	Private + mixed sector (<i>n</i> = 25) (%)	Public sector (<i>n</i> = 20) (%)	Overall (<i>n</i> = 45) (%)	SPA 2013 [18] (<i>n</i> = 121) (%)
Emergency room	96	90	93	
Post-operative care area	92	70	82	
Blood Bank	40	25	33	48 ^c
Laboratory	100	80	91	62 ^c , 68 ^d
X-ray	88	65	78	35
Oxygen cylinder	96	75	87	47 ^a
Oxygen concentrator	68	45	58	47 ^a
Pulse oximeter	100	75	89	
Running water	92	85	89	93
Electricity (on-grid)	88	65	78	95 ^b
Power generator	100	85	93	95 ^b
Anesthesia machine	100	75	89	
Medical records	96	90	93	
Emergency medicine guidelines	64	55	56	
Surgery guidelines	76	60	69	
Anesthesia guidelines	72	60	67	
Pain relief guidelines	56	60	58	

^a Combined oxygen concentrator, oxygen cylinder, and piped oxygen into one availability rate

^b Combined on-grid electricity, fuel generator, and solar power backup system into one availability rate

^c Hemoglobin test availability

^d Urinalysis availability

^e Transfusion was specifically assessed

Table 2 Human resources for emergency and essential surgical care

Healthcare providers	Private + mixed sector (<i>n</i> = 25)		Public sector (<i>n</i> = 20)	
	Full-time	Part-time	Full-time	Part-time
Surgeon	51	45	26	117
Anaesthesiologist	20	40	18	92
Obstetrician/gynecologist	41	29	56	98
General physician providing surgery	4	4	4	0
General physician providing anesthesia	0	0	3	0
Non-physician anaesthesiologist	32	5	19	21
Surgical technician/nurse	5	0	29	2
Paramedic and midwife	194	4	31	85

Supplemental figures S2A–S2D show distribution of reported full-time providers. Fifty percent of hospitals reported employing at least one full-time non-physician anesthesia provider. The public sector hospitals employed more surgical technicians with 33 compared to 5 for all private and mixed hospitals. There was no consistent scope of work defined for a surgical technician. Port-au-Prince hospitals employed 26 % of all reported non-physician

anesthesia providers and 34 % of all reported midwives and paramedics.

Interventions

Twenty-two hospitals reported up to 500 minor and major surgical interventions per year; nine reported 500–1000, 9 others reported 1000–2000, and 5 hospitals reported

Table 3 Availability of emergency and essential surgical interventions

Facilities providing intervention Percentage (%) of facilities	Private + mixed sector (<i>n</i> = 25) (%)	Public sector (<i>n</i> = 20) (%)	Overall (<i>n</i> = 45) (%)	SPA 2013 [18] (<i>n</i> = 121) (%)
Resuscitation	100	80	98	66 ^a
Cricothyroidotomy/tracheostomy	84	50	69	
Chest tube insertion	88	55	73	
Removal of foreign body (from throat/eye/ear/nose)	76	65	71	
Acute burn management	100	95	98	
Incision and drainage of abscess	100	95	98	
Suturing (for wounds, episiotomy, cervical/vaginal and lacerations)	100	100	100	
Wound debridement	100	100	100	
Cesarean section	100	95	98	78
Dilatation and curettage	96	95	96	
Obstetric fistula repair	84	85	84	
Tubal ligation and vasectomy	80	75	78	
Appendectomy	92	80	87	
Hernia repair (strangulated and elective)	100	85	93	
Hydrocele	92	85	89	
Cystostomy	88	75	82	
Urethral stricture dilation	64	45	56	
Laparotomy (treat uterine rupture, ectopic pregnancy, acute abdomen, intestinal obstruction, perforation, injuries)	92	80	87	
Male circumcision	92	80	87	
Congenital hernia repair	84	65	76	
Neonatal surgery (abdominal wall defect, colostomy, imperforate anus, intussusception)	60	35	49	
Cleft lip/cleft palate repair	44	15	31	
Clubfoot	56	25	42	
Contracture release/skin grafting	84	35	62	
Closed treatment of fractures	88	50	62	
Open treatment of fractures	64	35	51	
Joint dislocation treatment	88	60	76	
Drainage of osteomyelitis/septic arthritis	64	50	58	
Amputation	92	50	73	
Biopsy (lymph nodes, mass, others)	92	60	78	
Cataract surgery	40	10	27	
Regional anesthesia blocks	96	65	82	
Spinal anesthesia	100	95	98	
Ketamine IV anesthesia	100	95	98	
General inhalation anesthesia	100	80	91	

^a Specifically assessed neonatal resuscitation

2000–2500; of these five, four were in the West Department and one in Central Plateau.

Thirty-five interventions were assessed (Table 3). All hospitals reported suturing and wound debridement. Forty-four hospitals (98 %) reported resuscitation capacity. Anesthesia availability was as follows: spinal and IV ketamine (98 %), general (91 %), and regional (82 %). Acute

burn management was available in 98 % of hospitals. Interventions with lowest reported availability tended to be more specialized. Four interventions below 50 % availability included treatment of cataract (27 %), cleft lip/cleft palate repair (31 %), clubfoot repair (42 %), and neonatal abdominal surgeries (49 %). Five interventions were below 70 % availability: open treatment of fractures (51 %),

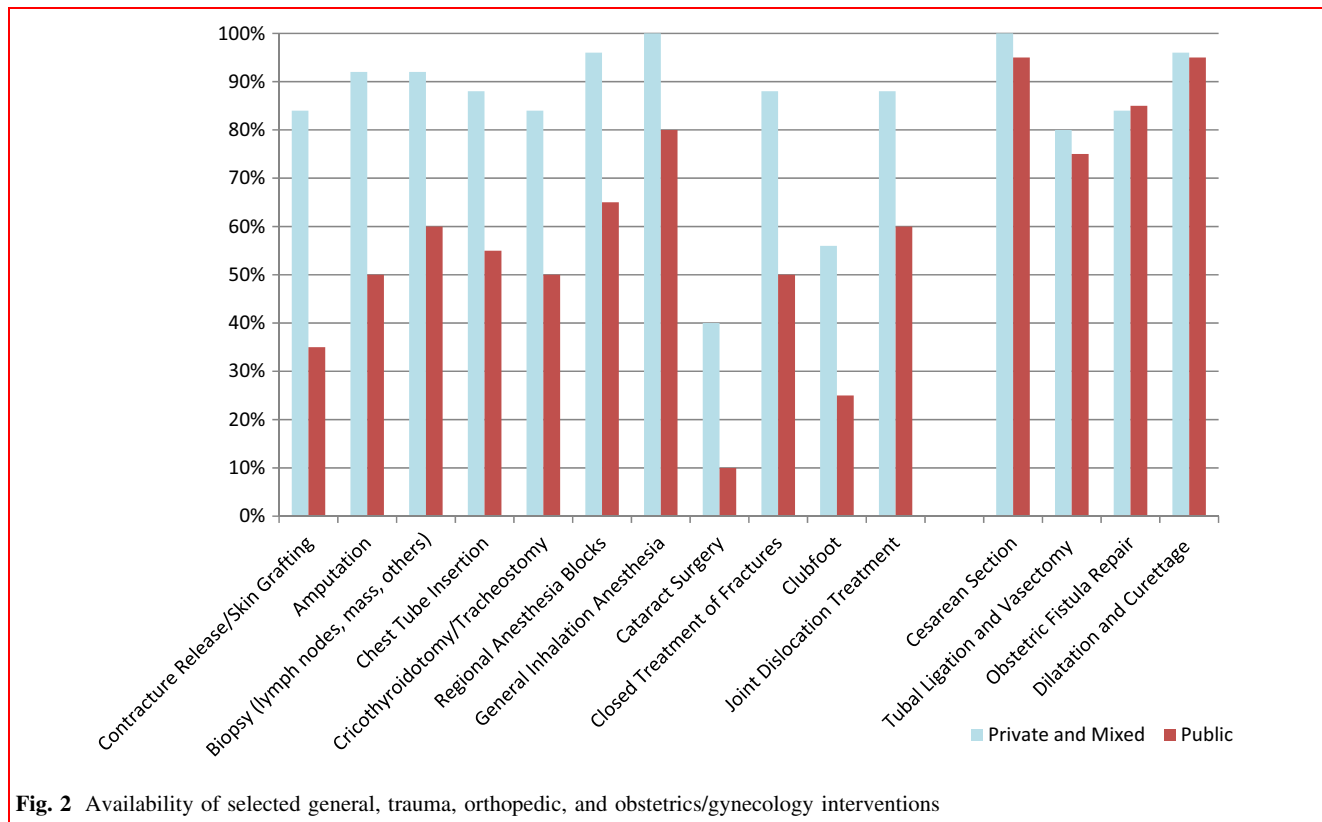


Fig. 2 Availability of selected general, trauma, orthopedic, and obstetrics/gynecology interventions

urethral stricture dilation (56 %), drainage of osteomyelitis (58 %), contracture release and skin graft (62 %), and cricothyroidotomy/tracheostomy (69 %). Appendectomy and laparotomy were available in 87 % and strangulated hernia repair in 93 %. Ob/gyn interventions were as follows: cesarean (98 %), dilatation/curettage (96 %), obstetric fistula repair (84 %), and tubal ligation (78 %) (Table 3). Ob/Gyn interventions had nearly the same availability when stratified by sectors and differences were not statistically significant, while there were significant differences in availability of the majority of major surgical interventions (Fig. 2).

Material resources—emergency equipment and supplies for resuscitation

Only three hospitals reported having all assessed resources for resuscitation available. Eighty percent of hospitals reported at least one functional sterilizer; suction pumps (76 %), sterile bandages and gauze (78 %), sterile gloves (82 %), and scalpel (89 %). Three items were under 50 % availability: cricothyroidotomy set (42 %) and Magill forceps for pediatrics (42 %) and for adults (47 %). Chest tube insertion equipment was available in only 53 %. Supplement Table S1 lists the availability of material resources.

Discussion

The deployment of TAAEESC in Haiti is the second baseline assessment of surgical capacity in the Latin America and Caribbean region and the first in Haiti [12]. It is envisioned that this baseline assessment can inform targeted interventions and capacity building strategies at the national level. In alignment with capacity assessments performed in other LMICs, the rate-limiting conditions of infrastructure and material resources deficits exist in Haiti as well [5, 11, 12, 26–31]. As for appropriateness of our sampling, the MSPP indicated all hospitals sampled have surgical capacity; our results confirmed some combination of resuscitation, wound care, ketamine and spinal anesthesia, incision and drainage, cesarean sections, and hernia repairs.

Infrastructure and material resources

Addressing deficits in infrastructure and material resources is critical to avoid inefficient utilization of healthcare providers and as the results suggest, may have resulted in delivery of interventions below basic requirements. Forty-four hospitals (98 %) reported resuscitation capacity; however, availability of necessary equipment was all much lower, for instance even resuscitation bags (73 %). This

leads us to question if all hospitals have the same standards for resuscitation. The low availability of emergency medicine, surgery, and anesthesia guidelines is a relatively inexpensive problem to address with existing human resources. Five hospitals lacked consistent access to anesthesia machines, which was corroborated by similar level of availability in general anesthesia intervention. Despite these deficits, the gap is not insurmountable and comparing Haiti to other analogous surveys should fuel this optimism. Pulse oximetry has been suggested as surrogate indicator of surgical capacity: Funk et al. estimated 19.2 % of operating rooms globally lack pulse oximeters [32]. In this study, 11 % of hospitals lacked pulse oximeters. Relative to other countries, a selection of 16 tertiary hospitals across 9 LMICs showed 12 % lacked pulse oximeters while all tertiary hospitals in Haiti reported pulse oximeters [31].

Deficits in basic infrastructure such as continuous water source, on-grid electricity, and back-up power generators reduce effectiveness of all clinical services. Our statistics were consistent with the 2013 Haiti Service Provision Assessment [18], and qualitatively with surgical capacity assessments from other LICs [33]. Deficiency in facility-based blood banks must also be addressed to amplify surgical volume. Recent renovations and establishments of new blood transfusion centers represent progress achieved through international cooperation and MSPP leadership [34].

Distribution of human resources

Brain drain from Haiti has been well reported [17, 21]. Concentration in the Port-au-Prince metropolitan area is a barrier to equitable distribution of surgical care nationally. Port-au-Prince hospitals comprise one-third of the sample but employed 70 % of the reported physician providers. Dual-practice challenged how to make definitive assignments of each provider by facility. For example, the HUEH employs a majority of physician providers on part-time consultative basis who also have positions in nearby health facilities. The more proportionate distribution of non-physician providers is an opportunity for strengthening surgical care capacity.

Consider the 77 reported non-physician anesthesia providers (NPAs). MSF's experience in Haiti with NPAs demonstrated comparatively similar outcomes to cases under management of anaesthesiologists (mortality rate of 0.3 %). It is possible for NPAs to be safe and effective alternatives for a narrow set of high burden operations [35, 36]. They can also be cost-effective to train [37] leading to more efficient utilization of operative staff while potentially minimizing delays in emergent cases. One major barrier to scale NPA employment is professional

acceptance. In this study, NPAs were mainly reported outside of Port-au-Prince, which is likely due to concentration of the very few practicing anaesthesiologists in Port-au-Prince.

Only 12 general physicians were reported providing surgery and 4 providing anesthesia. The shortage and maldistribution of practicing surgeons and anaesthesiologists is an impetus for formal task-sharing to general physicians, at least in the short-term. Our study approximates 6.1 per 100,000 surgeons (general and specialist), anaesthesiologist, and Ob/Gyn, far below the Lancet Commission's optimum of 40 per 100,000 (Table 2). Task-sharing is endorsed by the WHO and is viewed as necessary in low-resourced settings [38]. Long-term human resources for surgery should involve expansion of midlevel providers. A cost-effective orthopedic officer training program developed in Haiti [39] may guide efforts to scale similar training of surgical providers.

Maternal and child health and role of international collaborations

The global agenda to lower maternal mortality can provide a roadmap for addressing burden of surgical conditions [40]. The parity between public and private/mixed sector hospitals in availability of Ob/gyn operations is one piece of evidence for its success. Obstetric emergency care is included in the basic healthcare package (Paquet Minimum de Services) and has drawn significant development assistance, such as the Program Services de Sante de Qualite pour Haiti [41]. Amplification and improving quality of emergency and obstetric surgical care likely require a combination of Government of Haiti investment and international cooperation. Twenty-two of the 45 sampled hospitals have active, robust international collaborations, which have led to improved training, increased operative volume and complexity. International partners have an important role in sustained surgical capacity building through support of capacity-building and targeted interventions such as skills transfer [42, 43]. Hôpital Bienfaisance de Pignon is a prime example of an institution that contributes to advancing surgical training by offering surgeons and surgical trainees exposure to laparoscopic technique and subspecialty cases. Going further, the Hôpital Universitaire Mirebalais established a new general surgery residency program in Fall 2013. As facility-level reporting systems become a reality in Haiti, improvements in surgical capacity should be tracked to evaluate and continuously build upon gains. One possible solution is the *Integrated Management for Emergency and Essential Surgical Care* (IMEESC) toolkit (<http://www.who.int/surgery/publications/imeesc/en/>).

Limitations

This study has two limitations. The sample is not exhaustive. In terms of non-response, there are 7 hospitals of 52 that did not respond: five are in the Port-au-Prince metropolitan area, 1 in Central Plateau, and 1 in Artibonite. A second limitation is the data collection team visited two-third of the sampled facilities. The visitations allowed for verification, especially human resource overlaps. We suspect facilities in Port-au-Prince metropolitan area which are double counting specialist human resources since many surgical providers work at multiple facilities; since no registry of surgeons exist, it is hard to estimate the impact of double count on inflating the actual number of surgeon providers, but the upward bias implies that surgical capacity might be even more limited than what was reported. Despite these limitations, our study provides a reasonable baseline of surgery capacity in calendar year 2012 for 45 nationally representative hospitals. From 2011 to 2014, the Government of Haiti has overseen 4 new hospital construction projects, such as the Hôpital Universitaire Mirebalais and 20 hospital renovations; it has made operational 7 obstetric and neonatal emergency care centers and 10 transfusion centers [34]. Measurable improvements in surgical capacity can be ascertained most efficiently through an integrated M&E system for routine monitoring of surgical capacity.

Conclusion

An assessment of emergency and essential surgical care capacity in Haiti showed deficits in availability of infrastructure and material resources for provision of surgical care. Not only were physician-level providers mal-distributed relative to midlevel providers, but there are not enough physician-level providers and far fewer midlevel providers. A coordinated government led initiative to strengthen surgical capacity is required to meet objectives outlined in the 2012 Politique National de Santé to realize universal health coverage. Infrastructure and material resources should be addressed urgently, while other short-term measures may include better utilization and training of midlevel providers and task-sharing to general physicians.

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Conflict of interest The authors declare no conflict of interest.

Disclaimer The authors include WHO staff. The views in this publication reflect their views and not necessarily that of WHO.

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