Supplemental text 1. Data collection instruments used to collect data for the presented study.

1. PIPES Surgical Assessment

This survey is made to assess the gaps in availability of Surgical Care at resource constraint health facilities. This novel Surgical Care Analysis (SCA) survey was developed by modifying the WHO tool to include absolute numbers of hospital beds and operating rooms; a binary system of measurement to enable easier counting of items; omitting reasons for not performing procedures; and restructuring and streamlining individual questions. The final SCA survey had 105 total data items compared to the 256 of the WHO tool. The 105 data items were divided into five sections: Personnel, Infrastructure, Procedures, Equipment and Supplies (PIPES).

COUNTRY:	
Interviewer: Name/contact info	
Health Care Facility: Name/address	
Phone interview or site visit:	
Respondent: Name/contact info:	
Type of Healthcare Facility: (Health Center, District, Tertiary, Univ, Private, NGO, Mission)	
Hospital beds (total numbers)	

PERSONNEL (4)	**Total number**
General surgeon	
Anesthesiologists (MD)	
Medical doctors (doing surgery)	
Nurse anesthetists	
TOTAL P-score: (add all the numbers of Personnel)	

INFRASTRUCTURE (13)	**Always available (1)**	**Not always available (0)**
Running water?		
External electricity?		
Functioning back-up generator?		
Incinerator?		
Medical records?		
Emergency department?		
Postoperative care area?		
Intensive Care Unit?		
Pretested blood available (blood bank)?		
Lab to test blood and urine?		
Functioning X-ray machine?		
Functioning ultrasound machine?		
Functioning CT scan?		
Sub TOTAL I score: (give 1 point to each available)		
Number of functioning operating rooms:		
TOTAL I-score: (add subtotal + # operating rooms)		

SOS
SURGEONS OVERSEAS

PIPES Surgical Assessment

PROCEDURES (40)	Done (1)	Not done (0)
Resuscitation		
Suturing		
Wound debridement		
Incision & drainage of abscess		
Laparotomy		
Cricothyroidotomy		
Tracheostomy		
Chest tube insertion		
Burn management		
Cesarean Section		
Dilatation & Curettage		
Tubal ligation		
Hysterectomy		
Obstetric fistula repair		
Appendectomy		
Hernia repair – elective		
Hernia repair –strangulated		
Hydrocele		
Bowel resection and anastomosis		
Male circumcision		
Biopsy (lymph node, mass, other)		
Cholecystectomy		
Skin grafting		
Pediatric hernia repair		
Pediatric abdominal wall defects		
Repair Imperforate anus		
Splinting		
Casting		
Traction (closed fracture)		
Open Treatment of Fracture		
Management of Osteomyelitis		
Amputation		
Clubfoot repair		
Cleft lip repair		
Contracture release/		
Laparoscopic surgery		
Regional anesthesia blocks		
Spinal anesthesia		
Ketamine anesthesia		
General anesthesia		
TOTAL Pr-score: (add all procedures done)		

SOS
SURGEONS OVERSEAS

PIPES Surgical Assessment

Equipment (22)	**Always available (1)**	**Not always available (0)**
Oxygen: compressed (cylinder)		
Oxygen: concentrator		
Resuscitator bag valve & mask (adult)		
Resuscitator bag valve & mask (paediatric)		
Oropharyngeal airway (adult size)		
Oropharyngeal airway (paediatric)		
Endotrachael tubes (adult)		
Endotrachael tubes (pediatric)		
Anesthesia machine		
Pulse oxyimeter		
Oxygen mask & tubing		
Stethoscope		
Blood pressure measuring equipment		
Thermometer		
Instrument sets (abdominal, c-section)		
Kidney dish stainless steel		
Sterilizer (autoclave)		
Suction pump (manual or electric)		
Electrocautery machine		
Vaginal speculum		
Endoscopes (gastro, colon, broch)		
Operating room lights		
TOTAL E-score: (add all Equipment available)		

SOS
SURGEONS OVERSEAS

PIPES Surgical Assessment

SUPPLIES (25)	**Always available/ sufficient (1)**	**Not always available/ sufficient (0)**
Gloves (sterile)		
Gloves (examination)		
Nasogastric tubes		
Intravenous fluid infusion sets		
IV cannulas		
Syringes		
Disposable needles		
Tourniquet		
Sterile gauze		
Bandages sterile		
Adhesive Tape		
Suture (absorbable)		
Suture (non-absorbable)		
Urinary catheters		
Sharps disposal container		
Scalpel blades		
Face masks		
Eye protection (goggles, safety glasses)		
Apron		
Boots (theatre shoes)		
Gowns (for surgeon/scrub nurse)		
Drapes (for operations)		
Chest tubes		
Trach tubes		
Laparoscopic supplies		
Total S-score: (add all supplies sufficient available)		

A total PIPES score is calculated by summing the number of the Personnel, Infrastructure and number of operating rooms, Procedure, Equipment and Supplies scores. This number was then divided by the total number of data items (105) and multiplied by 10 to create the PIPES index. For a maternity hospital or otherwise categorical hospital with a lower possible Procedure score the number of reduced data items is used. There is no maximum number for the PIPES index.

P-score: (no maximum)
I-score: (maximum 13 plus numbers of functioning operating rooms)
Pr-score: (maximum of 40)
E-score: (maximum of 22)
S-score: (maximum of 25)

TOTAL PIPES SCORE:

Divide the total score by 105 and multiply by 10 for the PIPES- index:
(TOTAL PIPES SCORE / 105) x 10 =

Questions regarding PIPES or access to an iPad application can be forwarded to: reinou@humanitariansurgery.org

2. Complementary annex to the PIPES Surgical Capacity Tool

01. Do you have anaesthesia capacity to deliver all surgeries this hospital should normally do?

❑ Yes ❑ No

If NO:

a) Why……

b) For what procedures is capacity missing?

i. ……

ii. ……

iii. ……

02. Is the anaesthetic machine always functional?

❑ Yes ❑ No

If NO, what do you do when the anaesthetic machine is not functional:

❑We stop conducting surgery

❑We improvise using other anaesthetic methods (e.g. ketamine)

❑Other….

03. Are C/section sets always available?

❑ Yes ❑ No

If NO, what do you do when the C/section sets are not available:

❑We stop conducting surgery

❑We improvise using other sets

❑Other….

04. Are drugs and other consumables such as sutures, syringes, gloves, etc. always available?

❑ Yes ❑ No

If NO, what do you do when consumables such as sutures, syringes, gloves are not available:

❑We stop conducting surgery

❑We improvise using others

❑Other….

05. Is the hospital's operating theatre currently functional?

❑ Yes ❑ No

If NO:

a) Please explain what the problems are:……

b) What do you do when the operating theatre is not functional:

❑We stop conducting surgery

❑We take emergency patients to nearby hospitals and operate them there

❑Other….

06. Do you think the level of surgical skills at this hospital is adequate to deal with the types of cases that present to this hospital?

❑ Yes ❑ No

If NO, why? ……..

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07. What procedures, for which you have infrastructure, equipment and supplies, are you not currently doing because of lack of expertise?
    i. ……
    ii. ……
    iii. ……

08. How many staff in your hospital can perform a Caesarean Section: ……...

09. How many staff in your hospital can perform an Elective Hernia: ……..

10. How many staff in your hospital can perform a Hysterectomy: …….....

11. How many staff in your hospital can perform a Laparotomy: ……...

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Provision of surgical services

12. List 3 main factors impairing provision of surgical services at this hospital in the order of importance.
    i. ……
    ii. ……
    iii. ……

13. Does your hospital refer surgical patients to other district level hospitals?
    ❑ Yes ❑ No ❑ N/A
    If YES:
    a. Why?.....
    b. To which hospitals? .....
    c. What surgical cases do you commonly refer:
        i. ……
        ii. ……
        iii. ……

14. Does your hospital refer surgical patients to secondary/regional/general hospitals?
    ❑ Yes ❑ No ❑ N/A
    If YES:
    a. Why?.....
    b. To which hospitals? .....
    c. What surgical cases do you commonly refer:
        i. ……
        ii. ……
        iii. ……

15. Does your hospital refer surgical patients to tertiary level hospitals?
    ❑ Yes ❑ No
    If YES:
    a. Why?.....
    b. To which hospitals? .....
    c. What surgical cases do you commonly refer:
        i. ……
        ii. ……
        iii. ……

16. Do you think this hospital refers some patients unnecessarily?
    ❑ Yes ❑ No
    If YES:
    a. what cases?
        i. ……
        ii. ……
        iii. ……
        iv. ……
        v. ……
        vi. ……
    b. Why?.....

17. What are the most common reasons for surgical referrals? (open)
        i. ……
        ii. ……
        iii. ……

18. Do you think this hospital refers surgical cases that should normally be done at this level of care?
    ❑ Yes ❑ No
    If YES, why?.....

19. What is the average cost (estimate) for referring one surgical patient to *insert name of (usual) referral hospital*?.....

Workforce

20. Do you have the following cadres in your hospital:
    a. Non Physician Clinicians (CO/AMO/ML) doing surgery:
    ❑ Yes ❑ No
    How many……

    b. Non Physician Clinicians (CO/AMO) administering anaesthesia:
    ❑ Yes ❑ No
    How many……

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c. Nurses working in theatre:

❑ Yes ❑ No

How many qualified……; How many trained on-the-job:……..

d. Postoperative care nurses:

❑ Yes ❑ No

How many qualified:……..; How many trained on-the-job:……..

e. Foreign surgeons doing surgery:

❑ Yes ❑ No

How many……

f. Local surgeons:

❑ Yes ❑ No

How many……

21. Do you have an anaesthetist always available for elective surgery?

❑ Yes ❑ No

If NO, why……

22. Do you have an anaesthetist always available for emergency surgery?

❑ Yes ❑ No

If NO, why……

23. Does this hospital have a supervision system in place for the surgical team?

❑ Yes ❑ No

If YES, what are the systems?……

24. Is there a person in charge of:

a. Staff deployment

❑ Yes ❑ No

b. Maintenance of the Operating Theatre

❑ Yes ❑ No

c. Ensuring supplies are in stock

❑ Yes ❑ No

Information management

25. Are there any measures to control data collection quality?

❑ Yes ❑ No

26. How many registers are there in place to record surgical procedures done **in the Operating Theatre**? Please list them:
    a. ……..
    b. ……..
    c. ……..

27. How many registers are there in place to record surgical procedures done **outside** the Operating Theatre (e.g. OPD, wards etc.)?
    a. ……..
    b. ……..
    c. ……..

28. Do you have a register where **surgical** referrals are captured?
    ❑ Yes ❑ No

Surgical quality control measures

29. Are the following forms of quality control in place in your hospital?
    a. Infection control measures
       ❑ Yes ❑ No
    b. Surgical checklists in use in the operating theatre
       ❑ Yes ❑ No
    c. Audits for surgical adverse events
       ❑ Yes ❑ No
    d. Supervision for junior staff
       ❑ Yes ❑ No
    e. Surgical case reviews
       ❑ Yes ❑ No
    f. Surgical morbidity and mortality reports (not just maternal mortality reviews)
       ❑ Yes ❑ No

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3. Interview guide for situation analysis

Surgical capacity

1. Does this hospital operate at its maximum surgical capacity in terms of responding to the demand for surgery?
   a. If not, why?

2. What are the main obstacles and/or bottlenecks in order of importance?

3. *Probe for* shortages of essential surgical supplies (for doing anaesthesia and surgery)?
   a. What are the reasons? (Probe for problems to be solved locally, e.g. through better management practices, and/or those to be solved at higher levels)
   b. If they answer lack of funds, probe for additional reasons
   c. What steps are taken to solve these problems and how effective are they?

4. *Probe for* surgical equipment shortages and functioning? (e.g. autoclave, anaesthetic machine, oxygen, oximeter, X-Ray, blood bank / group and x match, lab tests).
   a. What are the reasons? Probe for problems to be solved locally, e.g. through better management practices, and/or those to be solved at higher levels
   b. If they answer lack of funds, probe for additional reasons
   c. What steps are taken to solve these problems and how effective are they?

Provision of surgical services

5. Is there any unmet surgical need in the community you serve? Please explain.
   a. If yes, why the need is not met?

6. What would be required for your hospital to address this unmet need?

7. Why do surgical patients need to be referred from here to other hospitals?
   a. Does the hospital refer some patients unnecessarily?
   b. Why / What are the reasons?
   c. How this should be addressed?

Workforce

8. Who is in charge of ensuring essential supplies are available and surgical equipment is functioning?
   a. Is this person able to carry out these functions?

9. What types of training of staff would improve the surgical service at this hospital
   Probe for surgical, anaesthetic, management, other trainings

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10. What additional surgical workforce (surgeons, anaesthetists, theatre nurses, post-op nurses) would your facility need to better address the demand for surgery?

11. Does your facility face any problems in terms of recruiting and retaining surgical workforce?
    a. What steps do you take to attract and retain staff?
    b. How do you deal with shortages of surgical staff? (*probe for local training / task shifting solutions*)

Information Management

12. Who is responsible for entering surgical data into theatre registers?
    a. Does anyone at the hospital analyse the data (*probe*)?
    b. Does anyone utilise the data?

Surgical quality control measures

13. What systems do you have in place to ensure quality of surgical care at this facility?

14. What are the main surgical quality issues?

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