

**Anaesthesia care providers employed in humanitarian settings by Médecins Sans
Frontières: A retrospective observational study of 173,084 surgical cases over 10 years**

APPENDIX

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Appendix Table 1: Variables used in the study

Key characteristic group	Name of variable	Type of data	Description of data	Source																	
Patient	Age	Continuous	For patients below the age of 2 (typed in original data collection sheet as days and months), the age has been converted for analysis to a fraction of a year.	Case-level routine data																	
	Gender	Categorical (binary)	Either male or female	Case-level routine data																	
	Date of procedure	Continuous	Date operation took place	Case-level routine data																	
	ASA grade	Ordinal	American Society of Anaesthesiologists physical status classification system (ASA). Discrete numeric scale between 1 and 5 (1 = normal healthy patient, 5 = moribund patient expected not to survive without surgery) of the patient's physical health prior to surgery.	Case-level routine data																	
	Cause of hospitalisation	Categorical (nominal)	3 letter code used as defined by MSF-OCB operational departmental guideline. A total of 24 codes available, and grouped into 4 distinct categories: <ul style="list-style-type: none"> - Accidental trauma - Violent trauma - Obstetric - Other (including but not limited to tropical disease, tumours, obstruction) 	Case-level routine data																	
Surgery	Urgency	Categorical (ordinal)	3 values available, relating to how soon the surgical procedure has to occur: <ul style="list-style-type: none"> - "Urgent" (labelled "emergent" in manuscript) = requiring immediate surgery - "Delayed" (labelled "urgent" in manuscript) = requiring surgery during current hospital admission - "Planned" (labelled "elective" in manuscript) = elective surgery 	Case-level routine data																	
	Order	Categorical (ordinal)	3 codes available, relating to whether patient has had surgery before during admission: <ul style="list-style-type: none"> - "First" = first time entering theatre - "Unplanned" = unplanned return to theatre - "Re-intervention" = planned return to theatre 	Case-level routine data																	
	Procedure – Main group	Categorical (nominal)	2 letter code used as defined by MSF-OCB operational department guidelines. A total of 36 procedures codes available, and grouped into the main categories of surgery. See appendix table 4 for full breakdown.	Case-level routine data																	
	Lead surgical provider	Categorical (nominal)	A merged variable, based on the presence of local and expatriate providers as outlined below. MD signifies a physician without surgical qualifications but with surgical skills. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Local provider</th> <th>Expatriate provider</th> </tr> </thead> <tbody> <tr> <td rowspan="4">General & specialist surgeon</td> <td>None</td> <td>General & Specialist</td> </tr> <tr> <td>MD</td> <td>General & Specialist</td> </tr> <tr> <td>General</td> <td>Specialist</td> </tr> <tr> <td>General & Specialist</td> <td>Any</td> </tr> <tr> <td rowspan="2">Specialist only</td> <td>None</td> <td>Specialist</td> </tr> <tr> <td>MD</td> <td>Specialist</td> </tr> </tbody> </table>		Local provider	Expatriate provider	General & specialist surgeon	None	General & Specialist	MD	General & Specialist	General	Specialist	General & Specialist	Any	Specialist only	None	Specialist	MD	Specialist	Programme-level routine data (MT)
		Local provider	Expatriate provider																		
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	MD	General																							
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MD	MD	None																							
	Theatre time (min)	Continuous	Time in minutes the patient was occupying theatre. This included anaesthetic and surgical time, as well as any recovery of patient, which occurred in theatre.	Case-level routine data																					
	Intra-operative mortality	Categorical (binary)	Whether the patient was dead or alive by the time they left recovery. For the purpose of the study, this is considered as intraoperative mortality.	Case-level routine data																					
Anaesthesia	Choice of anaesthesia	Categorical (nominal)	List of 7 codes of anaesthesia that can be provided. Only a single code can be used for a surgical procedure: <ul style="list-style-type: none"> - Local anaesthesia - Regional anaesthesia - Spinal anaesthesia - General anaesthesia without intubation or muscle relaxant - General anaesthesia with intubation and/or muscle relaxant - Combined anaesthesia (if more than one code need to be used, e.g. spinal anaesthesia + general anaesthesia) - Other anaesthesia, e.g. sedation 	Case-level routine data																					
	Lead anaesthesia provider	Categorical (nominal)	A merged variable, based on the presence of local and expatriate providers as outlined below. <table border="1"> <thead> <tr> <th></th> <th>Local provider</th> <th>Expatriate provider</th> </tr> </thead> <tbody> <tr> <td rowspan="4">Physician anaesthesiologist (PA) led</td> <td>PA</td> <td>none</td> </tr> <tr> <td>NA</td> <td>PA</td> </tr> <tr> <td>UA</td> <td>PA</td> </tr> <tr> <td>None</td> <td>PA</td> </tr> <tr> <td rowspan="3">Nurse anaesthetist (NA) led</td> <td>NA</td> <td>none</td> </tr> <tr> <td>UA</td> <td>NA</td> </tr> <tr> <td>None</td> <td>NA</td> </tr> <tr> <td>Uncertified anaesthetic provider (UA) led</td> <td>UA</td> <td>None</td> </tr> </tbody> </table>		Local provider	Expatriate provider	Physician anaesthesiologist (PA) led	PA	none	NA	PA	UA	PA	None	PA	Nurse anaesthetist (NA) led	NA	none	UA	NA	None	NA	Uncertified anaesthetic provider (UA) led	UA	None
	Local provider	Expatriate provider																							
Physician anaesthesiologist (PA) led	PA	none																							
	NA	PA																							
	UA	PA																							
	None	PA																							
Nurse anaesthetist (NA) led	NA	none																							
	UA	NA																							
	None	NA																							
Uncertified anaesthetic provider (UA) led	UA	None																							
Setting	Type of care provided by hospital	Categorical (nominal)	Overall type of provision provided during surgical project, based on MSF-OCB brief. 9 separate categories grouped into 5: <ul style="list-style-type: none"> - Emergency only - Capacity to perform both emergency and elective surgery - Maternity care only - Trauma care only - Other specific care provision (wound care, trauma and surgical care, obstetric fistula care, and surgical care of typhoid related complications) 	Programme-level routine data (MT)																					

	WHO region	Categorical (nominal)	The location of each mission was labelled according to the region codes used by the World Health Organisation: <ul style="list-style-type: none"> - AFR - EMR - SEAR - AMR - WPR 	WHO
	Setting	Categorical (binary)	3 variables: <ul style="list-style-type: none"> - Conflict - Natural disaster - Health care gaps 	Programme-level routine data (MT)
	Hospital level	Ordinal (Categorical)	4 distinct categories as per MSF-OCB surgical policy guidelines: <ul style="list-style-type: none"> - Sole remit hospital = hospital that provides care for a specific purpose (i.e. not necessarily a quaternary referral hospital, but a surgical setup for a specific indication). Examples include: Trauma centre, Maternity centre, Fistula repair camp. - Referral hospital = provincial hospital, considered tertiary referral hospital. - District hospital = can manage most, but will refer complex cases on to referral hospitals. - Health centres = small rural health centres with capacity to perform basic surgical operations 	Programme-level routine data (MT)
	Site ID	Character	Anonymous unique code for each site	produced in R 3.6

Appendix Table 2: surgical projects in health care gap settings in the WHO SEA region (2 in total)

Type of anaesthesia provider	Physician anaesthetist only
Type of hospital	- District hospital - Health centre
Type of care provided by surgical project (No. of projects)	- Capacity to perform both emergency and elective surgery - Filariasis-related care
Total duration, months	19
Type of surgical provider for entire duration	- General & specialty surgeons - General surgeon only
Total number of all cases, No.	815
Main cause for hospitalisation, No. (%)	- Other, 482 (59)
Main category of surgery, No. (%)	- Minor Surgery, 507 (62)
Intra-operative mortality, No. (%)	2 (0.2)

Appendix Table 3: Surgical projects in natural disaster settings (5 in total)

Type of anaesthesia provider	Physician anaesthetist only
Type of hospital	- District - Sole remit hospital
Type of care provided by surgical project (No. of projects)	- Capacity to perform both emergency and elective surgery (2) - Trauma care only (1) - Emergency only (2)
Total duration, months	40
Presence of surgical provider, months	
- General and specialty surgeons	23
- General surgeon only	16
- Specialty surgeon only	1
Total number of all cases, No. (%)	3108
Main cause for hospitalisation, No. (%)	- Other, 1144 (37)
Main category of surgery, No. (%)	- Minor surgery, 1608 (52)
Intra-operative mortality, No. (%)	9 (0.3)

Appendix Table 4: Surgical groupings as used in main table 2 (case-level data)

Surgical grouping	Examples of types of surgery included
Minor surgery	<ul style="list-style-type: none"> • Simple wound treatment • Insertion/removal of drain • Burns dressing change • Wound debridement • Removal of foreign body • Amputation of digits or toes <p>Incl. procedure codes with median operative time < 45min within the dataset:</p> <ul style="list-style-type: none"> • Curettage post delivery (GP) • Reduction of fractures (OR) • Removal of osteosynthesis (OX) • Ophthalmic surgery (SO)
Caesarean section	<ul style="list-style-type: none"> • Caesarean section only
Visceral surgery	<ul style="list-style-type: none"> • Exploratory laparotomy • Hernia repair • Resection/repair solid organs (e.g. spleen/liver) or gut
Orthopaedic surgery	<ul style="list-style-type: none"> • External or internal fixation of fracture • Surgery to any joint • Limb amputation (excluding digits or toes) • Curettage for osteomyelitis
Obstetric & gynaecological surgery (excl. Caesarean section)	<ul style="list-style-type: none"> • Management of ectopic pregnancy • Obstetric fistula repair • Hysterectomy
Specialties	<ul style="list-style-type: none"> • Urology • Vascular surgery • Plastic and reconstructive surgery • Ear, nose and throat surgery • Neurosurgery • Thoracic surgery • Maxillofacial surgery • Other specialized surgery

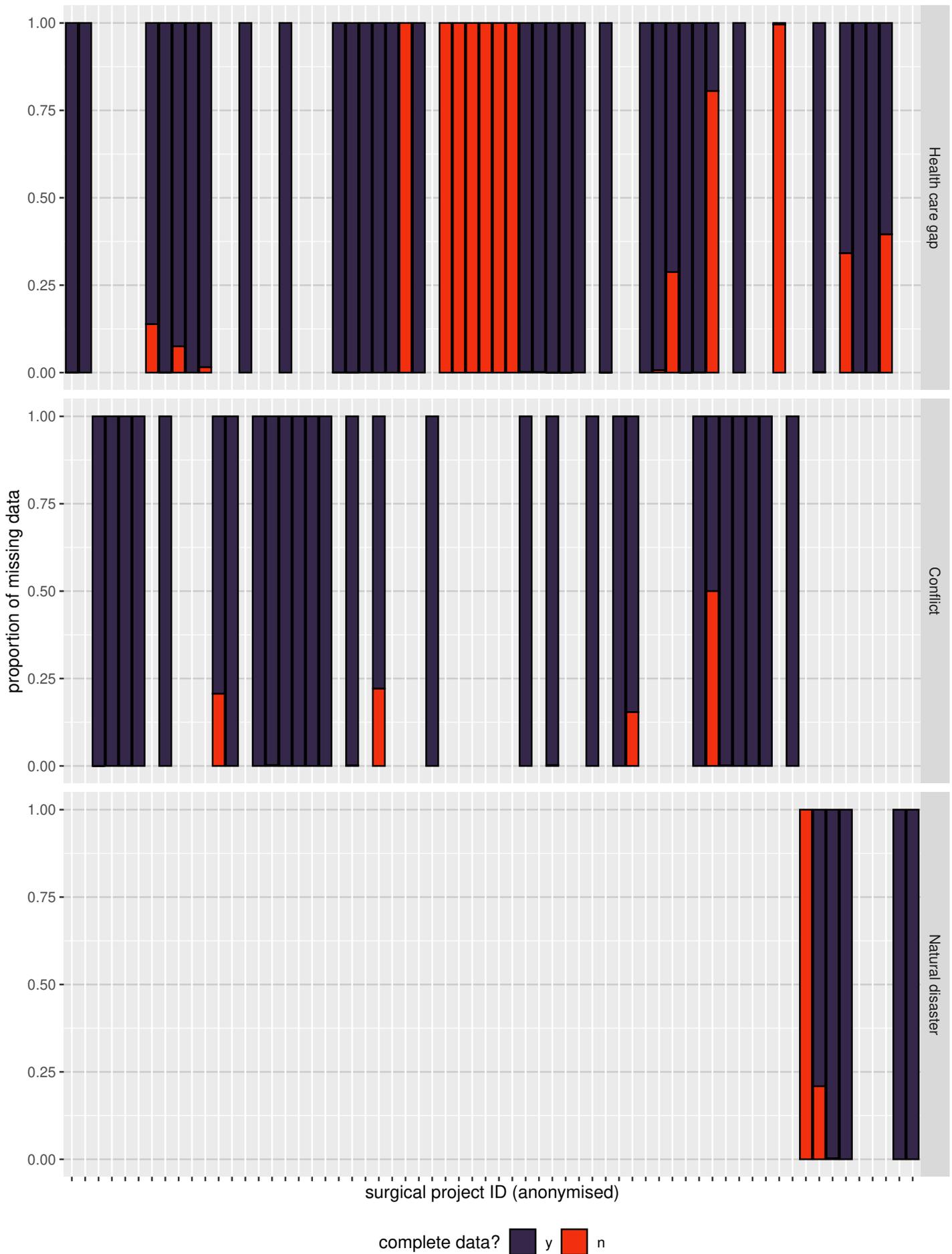
Modified from the original surgical groupings outlined in the “MSF-OCB Operating Department Data Collection Guidelines (2015)”.

Missing data Table 1: Number of missing values within each variable

Variable	Number missing
ASA	3232
Intra-operative mortality	2154
Time in theatre	1922
Age	47
Main procedure	5
Choice of anaesthesia	2
Gender	0
Date of procedure	0
Cause of hospitalisation	0
Urgency	0
Order	0
Surgical provider	0
Anaesthesia provider	0
Who region	0
Setting	0
Type of hospital	0
Type of care provided	0
Site ID	0

Missing Data Figure 1: Proportion of missing data in each surgical project

histogram showing all surgical projects (along x-axis), sorted according to setting, showing proportion of missing cases with any missing data (red indicates data with at least one missing value)



Missing data Table 2: overview of available data

Variable	Value
Median age, years (IQR)	26 (18-36)
Female, no. (%)	2963 (52)
Median ASA (IQR)	1 (1-2)
Emergent surgery, no. (%)	2277 (40)
Cause for hospitalisation, no. (%)	
- Obstetric	1188
- Any trauma	2074
- Other	2468
Main surgical procedure	
- Minor surgery	2854
- Caesarean section	746
- Visceral surgery	1408
- Obstetric and gynaecology	503
- Orthopaedics	177
- Other specialty surgery	37
Intraoperative mortality	
- Alive	3563
- Died	13
Median theatre time, minutes (IQR)	45 (35-60)
Setting	
- Health care gap	3359
- Conflict	1443
- Natural disaster	928