

Supplementary file
Information on Staffing

Table A1: Staff providing direct* care to COVID-19 patients

Staff	Asymptomatic & mild to moderate COVID patients (home based care)	Asymptomatic & mild to moderate COVID patients (home based care)	Severe COVID patients	Critical COVID patients
Physician/ Medical doctor	-	√	√	√
Clinical officer (diploma level clinicians)	√	-	-	-
Community health worker	√	-		√
Nurse	-	√	√	√
Physiotherapist	-	-	√	√
Anaesthetist	-	-	-	√
Nutritionist	-	-	-	√

*Staff providing laboratory services are costed as part of lab costs while those providing pharmacy, cleaners and porters are costed as part of hotel costs

Table A2: Staff time allocated to a COVID-19 patient per admission day

Staff category	Amount of time spent on a patient in a day	Source of information time spent on patient in a day	Number of days spent on a patient	Source of information on days spent on a patient
Home-based care for asymptomatic patients and patients with mild to moderate disease				
Community health worker	60 mins	Data obtained from home-based care implementation programme	3 days	Data obtained from home-based care implementation programme
Clinical officer	60 mins		3 days	
Institutional care for asymptomatic patients and patients with mild to moderate disease				
Medical doctor	39 mins	Data obtained from actual staff ratios in COVID-19 treatment centers	12 days	Assumption from literature Guan et al. 2020, NEJM https://www.nejm.org/doi/full/10.1056/NEJMoa2002032
Nurse	52 mins			
Institutional care for patients with severe COVID-19 disease managed in general hospital wards				
Medical doctor	39 mins	Data obtained from actual staff ratios in COVID-19 treatment centers	12 days	Assumption from literature Guan et al. 2020, NEJM https://www.nejm.org/doi/full/10.1056/NEJMoa2002032
Nurse	52 mins			
Physiotherapist	48 mins			
Institutional care for patients with critical COVID-19 disease managed in Intensive care units				
Specialist physicians	240 mins			

Medical doctors	240 mins	Data obtained from actual staff ratios in COVID-19 treatment centers COVID-19 human resource management guidelines	12 days	Assumption from literature Guan et al. 2020, NEJM https://www.nejm.org/doi/full/10.1056/NEJMoa2002032
Anaesthetist	240 mins			
Nurse	259 mins			
Physiotherapist	80 mins			
Nutritionist	96 mins			

Table A3: Staff ratios according to the Kenya Human resource guidelines for COVID-19

Cadre of staff	Staff to patient ratio	Shift duration
COVID-19 patients with severe disease		
Medical Officer	1:10	Two 6 hours day shift, and 12 hour night shift or 8 hourly shifts
Clinical Officer	1:10	Two 6 hours day shift, and 12 hour night shift or 8 hourly shifts
Nurse	1:5	Two 6 hours day shift, and 12 hour night shift or 8 hourly shifts
Chest physiotherapist	1:10	Two 6 hours day shift , and 12 hour night shift or 8 hourly shifts
Counselling psychologist	1:10	12 hourly shift
Cleaner	1:10	12 hour shift
Laundry staff	1:10	12 hour shift
Porter		2 per isolation centre
Epidemiologist		2 per isolation centre
Nutritionist		2 per isolation centre
IPC and QA coordinator (nurse)		1 per 8 hours shift
Public health officer		2 per isolation center
Pharmacist	1:50	12 hour shift
Medical lab technologist	1:20	Two 6 hours day shift, and 12 hour night shift or 8 hourly shifts
Mortician		4 per site
Critical care units		
Anaesthesiologist/ Emergency physician/ Family physician	1:6	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift

Physician	1:6	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
ENT Surgeon		1 per site ,On call
Medical Officer	1:6	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
Clinical Officer Anaesthetist	1:6	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
Critical care nurse	1:1	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
Chest Physiotherapist	1:6	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
Clinical Pharmacist	1:50	12 hour shift
Clinical nutritionist	1:10	Two 6 hours day shift , and 12 hour night shift or 8 hourly shift
Cleaner	1:10	Three 8 hour shifts
Laundry staff	1:10	Three 12 hour shifts
Porter		Three 12 hour shifts
Medical lab technologists	1:20	Three 8 hour shifts

Table A4: Medicines used on COVID-19 patient care

Medicine	Asymptomatic COVID-19 patients	Mild COVID-19 patients	Severe COVID-19 patients	Critical COVID-19 patients	Source of information for type of medicine used
Paracetamol	-	√	√	√	Primary data collection from COVID-19 treatment centers
Amoxicillin+clavulanic acid	-	-	√	√	
Azithromycin	-	-	√	√	
Subcutaneous enoxaparin	-	-	√	√	
Dexamethasone	-	-	√	√	
Medicines used for intubation and sedation					
Ketamine	-	-	-	√	
Propofol	-	-	-	√	
Succinylcholine	-	-	-	√	
Rocuronium	-	-	-	√	
Morphine	-	-	-	√	

Table A5: Medicines dose and duration

Medicine	Formulation	Dose	Source of information for type of medicine used
Patients with mild to moderate disease			COVID-19 case management guidelines for Kenya
Paracetamol in asymptomatic patients	Tablet	1 gram three times a day for 12 days	
Patients with severe and critical disease			
Paracetamol in patient	Vial for intravenous administration	1 gram three times a day for 12 days	
Amoxicillin+clavulanic acid		1.2 grams two times a day for 7 days	
Azithromycin		500mg once a day for 7 days	
Subcutaneous enoxaparin	Vial for subcutaneous administration	70mg two times a day for 12 days	
Dexamethasone	Vial for intravenous administration	6mg once a day for 12 days	
Intubation for patients with critical disease			
Ketamine	Intravenous infusion	4.5mg per kilogram during intubation	
Propofol		1mg per kilogram during intubation	
Succinyl choline		2.5mg per kilogram during intubation	
Rocuronium		0.6mg per kilogram during intubation	
Sedation while on ventilation			
Morphine		10mg every 4 hours for 12 days	
Ketamine		45 mcg per kilogram per minute for 12 days	

Table A6: None-pharmaceuticals used on COVID-19 patient care

Medicine	Asymptomatic COVID-19 patients	Mild COVID-19 patients	Severe COVID-19 patients	Critical COVID-19 patients	Source of information for type of medicine used
Fluids (ringers lactate)	-	-	√	√	Primary data collection from COVID-19 treatment centers
IV cannular for fluid management	-	-	√	√	
Parenteral feeds	-	-	-	√	

Table A7: Non-pharmaceuticals dose and duration

Item	Quantity or dose	Source
Severe and critical patients		
Fluids (ringers lactate)	1 ml per kilogram per hour for 12 days	Primary data collection from COVID-19 treatment centers
IV cannular for fluid management	2 over the course of treatment	
Critical patients		
Parenteral feeds	1 per day for 12 days	

Table A8: Laboratory and radiological tests carried out on COVID-19 patients

Test	Frequency per treatment episode	Asymptomatic COVID-19 patients	Mild to moderate COVID-19 patients	Severe COVID patients	Critical COVID patients	Source of information
COVID-19 test	1	√	√	√	√	Primary data collection from COVID-19 treatment centers
Other laboratory tests						
Full hemogram	1	-	-	√	√	
Kidney function tests (UECs)	1	-	-	√	√	
Liver function tests (LFTs)	1	-	-	√	√	
Random blood sugar	Daily	-	-	√	√	
C-reactive protein levels	1	-	-	√	√	
D-dimers	1	-	-	√	√	
Ferritin levels	1	-	-	√	√	
Rapid HIV test	1	-	-	√	√	

Blood gas analysis (BGA)	Daily	-	-	-	√	
Radiology						
Chest X-ray (film)	1	-	-	√	√	

Table A9: Equipment and devices for Oxygen therapy

Equipment	Quantity or dose	Source
Oxygen therapy in patients with severe disease		
Nasal prong	1	
Face mask (simple)	1	
Face mask (non-rebreather)	1	
Oxygen	5litres per min for 12 days	
Advanced oxygen therapy/mechanical ventilation, other equipment and monitoring for patients with critical disease		
Face mask (pre-intubation oxygenation)	1	
Endotracheal tube	1	
Large bore suction catheter (closed circuit)	1	
Mechanical ventilator	Daily	
Central line	1	
Arterial line	1	
Ventilator tubing	1	
ICU monitoring (pulse oximeter, vital signs monitoring)	Daily for 12 days	
Oxygen	15 litres per min for 12 days	

Table A10: PPE's used by a healthcare workers and other staff in a COVID-19 treatment facility

PPE	Days in use before disposal	Quantity used by a healthcare worker per shift	Source of information
N-95 Masks	1 day	4	Primary data collection from COVID-19 treatment centers
Tyvek Suits	1 day	1	
Surgical Gowns	1 day	1	
Nitrile Gloves	1 day	10	
Latex Gloves	1 day	10	
Disposable Head	1 day	4	
Shoe Covers	1 day	4	
Surgical Masks	1 day	4	
Face Shields	5 day	1	
Goggles	90 days	1	

Table A11: Unit prices for inputs

Item	Unit of measure	Item unit cost (KES)	Source
General ward hotel cost	Per admission day	1,903	Value TB
ICU hotel cost	Per admission day	4,000	Billing data from COVID-19 treatment centers
Staff			
Specialist physician	Monthly salary	389,160	Kenya government health worker salary scales
Anaesthetist	Monthly salary	389,160	
Medical doctor	Monthly salary	214,193	
Nurse	Monthly salary	97,728	
Physiotherapist	Monthly salary	92,590	
Nutritionist	Monthly salary	91,390	
Clinical officer	Monthly salary	119,650	
Community health worker	Monthly stipend	5,275	
Medicines			
Paracetamol tablets	500mg tablet	0.4	Market prices from drug price catalogue https://drugindex.it/
Paracetamol infusion	10mg/100ml infusion	467	
Amoxicillin+ clavulanic acid	1.2g vial	638	
Azithromycin		835	
Subcutaneous enoxaparin	60mg/0.6ml vial	832	
Dexamethasone	4mg/ml vial	20	
Ketamine	100mg/5ml	133	
Propofol	1% per 20 ml	579	
Succinylcholine	50mg/ml:2 ml vial	90	
Rocuronium	10mg/ml: 5ml	11,388	
Morphine	10 mg vial	167	
None-pharmaceuticals			
Ringers lactate	500ml	60	Market prices from drug price catalogue https://drugindex.it/
Medical devices			
IV cannular	Piece	34	Market prices from major commercial distributor in Kenya
Nasal prong	Piece	35	
Face mask (simple)	Piece	60	

Face mask (non-rebreather)	Piece	240	Billing information from COVID-19 treatment centers in Kenya
Endotracheal tube	Piece	63	
Large bore suction catheter (closed circuit)	Piece	2500	
Pulse oximeter	Piece	3,133	
Central line	Per day charge	229	
Arterial line	Per day charge	305	
Ventilator tubing	Per day charge	354	
ICU monitoring	Per day charge		
Laboratory tests and radiology			
COVID-19 test	One test	1816.62	Regional COVID-19 testing laboratory
Full hemogram	One test	728.02	VALUE TB
Kidney function tests (UECs)	One test	1664.08	Billing data from COVID-19 treatment centers
Liver function tests (LFTs)	One test	2005.66	
Random blood sugar	One test	160	
C-reactive protein levels	One test	500	
D- dimers	One test	1000	
Ferritin levels	One test	1500	
HIV	One test	500	
Blood gas analysis (BGA)	One test	1000	
Chest x-ray	One test	2961.70	Value TB
PPE's			
N-95 Masks	Piece	495	Market prices from major commercial distributor in Kenya
Tyvek Suits	Piece	1500	
Surgical Gowns	Piece	421	
Nitrile Gloves	Pair	13.2	
Latex Gloves	Pair	9.35	
Disposable Head	Piece	5.50	
Shoe Covers	Pair	17	
Surgical Masks	Piece	22	
Face Shields	Piece	165	
Goggles	Piece	440	

Table A12: Equipment cost

Item	Purchase cost	Source
Mechanical (invasive) ventilator	2,193,179	Market prices from major commercial distributor in Kenya
Infusion pump	125,324	
Suction machine	250,649	
Oxygen cylinders	24,263	

Table A13: Oxygen costs*

Item	Description	Capital cost	Annualized cost
Building	200 square meter facility	685698000.00	34983804.08
Plant	80 cylinder (6.8m ³) per day capacity plant)	47925015.60	2445098.80
Motor vehicle	1 delivery truck (3 tons)	3164760.00	691039.81
Oxygen cylinders	400 cylinders per plant	9705264.00	2119188.76
Recurrent costs		Annual cost	
Staffing			
Administrative staff			5063616.00
Technical staff			1076018.40
Other staff; Manpower 3 shift staff production & transportation, office & admin			6835881.60
Driver			527460.00
Other staff involved			2586663.84
Insurance staff			1308100.80
Other expenditure			
Electricity			8892975.60
Fuel - depends on power outage			1265904.00
Water			1054920.00
Fuel			1339748.40
Vehicle repair			1192059.60

Insurance			817563.00
Printing			1265904.00
Stationery and general office supplies			1054920.00
Internet			158238.00
Telephone			189885.60
Advertising (marketing events)			1582380.00
Printing			527460.00
Security contracts and operational costs			949428.00
Training costs			474714.00
Maintenance- infrastructure, equipment			2215332.00
Piping (installation)			2215332.00
Total annualized cost of oxygen supply			82833636.29
Supply cost per litre			0.11
Oxygen delivery costs			
Capital costs			
Oxygen piping		2109840.00	107642.47
Oxygen manifold		545921.10	119204.37
Total annual delivery equipment cost			226846.84
One-hour delivery cost per patient in general ward			5.18
One-hour delivery cost per patient in ICU ward			31.07
one litre delivery cost per patient in general ward			1.04
one litre delivery cost per patient in ICU			0.35
Total oxygen cost per litre in ICU			0.46
Total oxygen cost per litre in general ward			1.15
Oxygen cost per day in ICU			4,963.59

Oxygen cost per day in general ward			1,656.21
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*These costs were obtained from the financial records of the firm county oxygen plant and delivery

Table A14: Assumptions

Assumption	Source	Source
Exchange rate (KES to the dollar)	105.49	Oanda as at 30/06/2020 https://www1.oanda.com/currency/converter/
Working days per year	260	Kenya public service regulations
Working hours per week	40	Kenya public service regulations
Discount rate	3%	WHO guide on discount rate https://www.who.int/choice/publications/p_2003_generalised_cea.pdf
Useful life years medical equipment	5 years	Expert opinion and WHO choice values for Kenya https://www.who.int/
Useful life years oxygen plant	30 years	
Useful life years Oxygen plant building	30 years	
Useful life years motor vehicle	8 years	
Length of treatment for mild, asymptomatic, severe and critical COVID-19 patients	12 days	Guan et al. 2020 NEMJ https://www.nejm.org/doi/full/10.1056/NEJMoa2002032
Average weight of an adult	70 kg	Ganong textbook of medical physiology