

Web Appendix 1: Health Facility Audit

Health Facility Survey

Health facility name _____

Total catchment population _____

Type of health facility _____

Ownership of health facility _____

State _____

LGA _____

Date: _____

Opening hours: 24hrs / 12 hours / 6 hours

Weekend Opening: Yes / No

Human resources

Position	Total numbers		Number currently on duty	Number scheduled to be on duty tonight
	Full time staff	Ad hoc staff*		
Lab Technicians				
Pharmacists (qualified)				
Drugs sales attendant (unqualified)				
Engineers/Technicians/Electrician				
Record / HMIS officer				
Security guards				
Drivers				
Other				

*These are not full time government employed at primary healthcare or are temporary staff brought in for cover

Wards / Departments	Available (Yes/No)	Number of beds
Neonatal ward		
Paediatric ward		
Neonatal intensive care (NICU)		
Paediatric intensive care (PICU)		
General emergency unit		
Paediatric emergency unit		

Infrastructure	Availability (please circle)			
Primary electricity source	Mains	Solar	Generator	None
Back-up power source	Solar	Generator	Battery inverter	None
Facility water supply	Tap	HF borehole	other borehole	
No. of staff houses/accommodation available				
How long does it take to get here from there?				
Is there an on-call room?				
Is there a changing room?				

Health Facility Survey - Inpatient

Health facility name _____

State _____

Date: _____

Infrastructure	Availability (please circle)			Costs	Naira estimate
Hours of power yesterday (primary+back up)?	_____ hours			Admission fee	
Primary source of water at OPD	Tap	Bucket	None	Daily bed fee	
Is there currently access to water?	Yes	No		5-day oral amoxicillin course	
Is there soap currently available?	Yes	No		IV antibiotic treatment	
Data summary at the end of each month	Yes	No		IV fluids	
HMIS data complete for last 3 months	Yes	No		Pulse oximeter measurement	
Toilets	_____ number			Oxygen for 6 hours	
Washrooms/bathrooms	_____ number			Average cost for 5 day severe pneumonia admission	
				Average cost for 5 day severe malaria admission	

Equipment	Number Available	Number Functional	Communication / M&E	Available (Yes/No)	Functional (Yes/No)
Stethoscope			Radio communication		
Thermometer			Telephone		
Functioning clock			Health facility mobile phone		
Weighing Scale			Phone credit / CUG		
Measuring tape for MUAC			Mobile network		
Pulse Oximeter			Referral forms		
Respiratory Rate Timer			Admission book		
Blood Glucose machine			OPD / Under-5 register		
Chest X-Ray machine			Individual facility patient notes		
Ambu Bag			Drug stock register		
Oxygen cylinder			Guidelines / SOPs		
Walled Oxygen			Wall charts (IMCI/under-5)		
Oxygen concentrator					
CPAP machine			Hardware	Available (Yes/No)	Functional (Yes/No)
Sharp bins			Computer		
Drip stand			Fridge		
Sterilizer / disinfectant			Freezer		
Hot water bottle					
Breast pump			Education	Conducted (Yes/No)	Frequency
Incubator			Grand round		Daily / Weekly / Monthly
Phototherapy machine			Morning review		Daily / Weekly / Monthly
Suction machine			Morbidity and mortality reviews		Daily / Weekly / Monthly
Nebulizer					

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Health facility name _____

Date: _____

Drugs and consumables	Availability (Please Tick)			
	Currently available in facility pharmacy	If yes - Quantity (packs/pills)	If no - month it was last available*	Currently available from private seller in facility
Oral amoxicillin				
Oral amoxicillin-clavulanic acid				
Oral cefpodoxime				
Oral cefuroxime				
Oral erythromycin				
Oral cotrimoxazole				
IV gentamicin				
IV benzylpenicillin				
IV amoxicillin				
IV cefotaxime				
IV cloxacillin				
IV cefuroxime				
IV ciprofloxacin				
IV ceftriaxone				
Salbutamol				
Artemether-lumefantrine				
Artesunate-amodiaquine				
IV quinine				
IV artesunate				
IM artemether				
Rectal artesunate				
Oral rehydration salt (ORS)				
ORS + Zinc combined				
IV fluids - Sodium chloride solution				
IV fluids - Ringers lactate solution				
Blood for transfusion				
Dextrose (5%, 10% and 50%)				
Adrenaline				
Diazepam				
Sterile gloves				
Penta (HiB) vaccine				
PCV10 vaccine				
BCG vaccine				
Malaria rapid diagnostic tests (RDTs)				
HIV rapid diagnostic tests				

*Write never if this is not available at this facility

Health facility name _____

Date: _____

Laboratory Services	Available (Yes/No)	If yes - 24hours (Yes / No)	If no - ever available (Yes / No)
Haemoglobin testing			
Blood type cross matching			
CD4 count			
Microscopy (TB)			
Microscopy (CSF)			
Microscopy (malaria)			
Electrolytes			
Urinalysis			
Bacterial cultures			

Transport	Allocated to health facility		Owned by health facility		Cost for transfer to nearest referral facility
	Number available	Number Functional	Number available	Number functional	
Ambulance					
Motorcycle ambulance					
Bicycle ambulance					

Human resources*	Full time staff	Ad hoc staff**		Number currently on duty	Number scheduled to be on duty tonight
Doctors (consultant)			Doctors		
Doctors (senior/principle medical officer)			Nurses		
Doctor (medical officer)			Midwives		
Doctor (intern / youth corps)			CHEWs/CHOs		
Nurses			Pharmacy/drug seller		
Auxillary Nurses			Hospital attendant / Assistants		
Midwives					
Nurse (paediatric/public health diploma)					
Community Health Extension Workers (CHEWs)					
Community Health Officer (CHOs)					
Hospital Attendants / Assistants					

Case Load	Number
Number of <5 consultations in the last month?	
Number of pneumonia/ARI cases in the last month?	
Number of <5 cases referred in the last month?	
Number of pneumonia/ARI cases referred in the last month?	
Number of <5 deaths in the last month?	
Number of pneumonia/ARI deaths in the last month?	

Health Facility Survey - Outpatient

State _____

Health facility name _____

Date: _____

Infrastructure	Availability (please circle)	Costs	Naira estimate
Hours of power yesterday (primary+back up)?	_____ hours	Consultation fee	
Primary source of water at OPD	Tap _____ Bucket _____ None _____	5-day oral amoxicillin course	
Is there currently access to water?	Yes _____ No _____	Malaria treatment course	
Is there soap currently available?	Yes _____ No _____	Pulse oximeter measurement	
Data summary at the end of each month	Yes _____ No _____	Average cost for non-severe pneumonia case	
HMIS data complete for last 3 months	Yes _____ No _____	Average cost for severe pneumonia case	
Toilets	_____ number		
Washrooms/bathrooms	_____ number		

Equipment	Number Available	Number Functional	Communication / M&E	Available (Yes/No)	Functional (Yes/No)
Stethoscope			Radio communication		
Thermometer			Telephone		
Functioning clock			Health facility mobile phone		
Weighing Scale			Phone credit / CUG		
Measuring tape for MUAC			Mobile network		
Pulse Oximeter			Referral forms		
Respiratory Rate Timer			Admission book		
Blood Glucose machine			OPD / Under-5 register		
Chest X-Ray machine			Individual facility patient notes		
Ambu Bag			Drug stock register		
Oxygen cylinder			Guidelines / SOPs		
Walled Oxygen			Wall charts (IMCI/under-5)		
Oxygen concentrator					
CPAP machine					
Sharp bins			Hardware		
Drip stand			Computer		
Sterilizer / disinfectant			Fridge		
			Freezer		

Health facility name _____

Date: _____

Drugs and consumables	Availability (Please Tick)			
	Currently available in facility pharmacy	If yes - Quantity (packs/pills)	If no - month it was last available*	Currently available from private seller in facility
Oral amoxicillin				
Oral amoxicillin-clavulanic acid				
Oral cefpodoxime				
Oral cefuroxime				
Oral erythromycin				
Oral cotrimoxazole				
IV gentamicin				
IV benzylpenicillin				
IV amoxicillin				
IV cefotaxime				
IV cloxacillin				
IV cefuroxime				
IV ciprofloxacin				
IV ceftriaxone				
Salbutamol				
Artemether-lumefantrine				
Artesunate-amodiaquine				
IV quinine				
IV artesunate				
IM artemether				
Rectal artesunate				
Oral rehydration salt (ORS)				
ORS + Zinc combined				
IV fluids - Sodium chloride solution				
IV fluids - Ringers lactate solution				
Blood for transfusion				
Dextrose (5%, 10% and 50%)				
Adrenaline				
Diazepam				
Sterile gloves				
Penta (HiB) vaccine				
PCV10 vaccine				
BCG vaccine				
Malaria rapid diagnostic tests (RDTs)				
HIV rapid diagnostic tests				

*Write never if this is not available at this facility

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Health facility name _____

Date: _____

Laboratory Services	Available (Yes/No)	If yes - 24hours (Yes / No)	If no - ever available (Yes / No)
Haemoglobin testing			
Blood type cross matching			
CD4 count			
Microscopy (TB)			
Microscopy (CSF)			
Microscopy (malaria)			
Electrolytes			
Urinalysis			
Bacterial cultures			

Transport	Allocated to health facility		Owned by health facility		Cost for transfer to nearest referral facility
	Number available	Number Functional	Number available	Number functional	
Ambulance					
Motorcycle ambulance					
Bicycle ambulance					

Human resources*	Full time staff	Ad hoc staff**		Number currently on duty	Number scheduled to be on duty tonight
Doctors (consultant)			Doctors		
Doctors (senior/principle medical officer)			Nurses		
Doctor (medical officer)			Midwives		
Doctor (intern / youth corps)			CHEWs/CHOs		
Nurses			Pharmacy/drug seller		
Auxillary Nurses			Hospital attendant / Assistants		
Midwives					
Nurse (paediatric/public health diploma)					
Community Health Extension Workers (CHEWs)					
Community Health Officer (CHOs)					
Hospital Attendants / Assistants					

Case Load	Number
Number of <5 consultations in the last month?	
Number of pneumonia/ARI cases in the last month?	
Number of <5 cases referred in the last month?	
Number of pneumonia/ARI cases referred in the last month?	
Number of <5 deaths in the last month?	
Number of pneumonia/ARI deaths in the last month?	

Web Appendix 2: Healthcare provider knowledge and training questionnaire

Date: ____/____/____

State: Jigawa / Lagos

Job: 1. Doctor (Consultant) 2. Doctor (Senior/principle medical officer) 3. Doctor (Medical officer) 4. Doctor (Intern/Youth corps) 5. Nurse 6. Midwife 7. CHO 8. CHEW 9. Patient attendant	Facility type: 1. Private Patent Medicine Vendor 2. Pharmacy shop 3. Primary health centre 4. Secondary outpatients 5. Secondary inpatient hospital 6. Tertiary hospital	Facility type 2: 1. Government 2. Private 3. Mission
1. Trainings		
1.1 Have you ever had training in any of the following: (Q 1.2 – Q1.4 will loop for each answer)	1. IMCI 2. iCCM 3. Emergency Triage Assessment and Training 4. Oxygen therapy 5. Pulse oximetry 6. CPAP 7. Resuscitation (LSS) 8. Infection prevention 9. Baby friendly initiative 10. None of these	Select all that apply If "None", go to 1.5
1.2 When was this?	_____ year	
1.3 Have you had a refresher training or active mentorship since?	Y / N	If N, go to 1.5
1.4 Who provided this training?	1. MoH 2. University/research project 3. NGO 4. Employer 5. Other: _____	Select all that apply
1.5 Have you had any other trainings that are relevant for pediatric pneumonia?	Y / N	If N, go to 1.9
1.6 What was it?	Text	
1.7 When was this?	_____ year	
1.8 Who provided this training?	1. MoH 2. University/research project 3. NGO 4. Employer 5. Other: _____	Select all that apply
2. IMCI Knowledge		
2.1 What is a child's classification if he is 10 months old, has had a cough that lasted two days, has a breathing rate of 46 breaths per minute and chest indrawing?	1. Cough or cold 2. Pneumonia 3. Severe pneumonia 4. Very severe febrile disease	Select one
2.2 What are the four main symptoms for which every sick child should be checked?	1. Malnutrition, cough, vitamin A, ear problems 2. Anemia, fever, diarrhea, ear problem 3. Cough, diarrhea, malnutrition, ear problem 4. Cough, diarrhea, fever, ear problem	Select the best answer
2.3 Choose the three best questions for checking the mother's understanding about how to give an antibiotic:	1. How will you give the antibiotic? 2. Will you give the antibiotic three times per day? 3. For how many days will you give antibiotic? 4. Do you understand how to give the antibiotic?	Select three

<p>2.4 A 14-month-old child with cough is brought to an outpatient clinic. You will assess this child for:</p>	<ol style="list-style-type: none"> 1. General danger signs 2. Common serious symptoms such as diarrhea, cough or difficult breathing, fever and ear problems 3. Trauma 4. Malnutrition and anemia 5. Immunization status 6. Developmental milestones 7. Feeding problems 	<p>Select all that apply</p>
<p>2.5 If a child has any of the four general danger signs, you should urgently refer him to hospital for treatment, These signs are:</p>	<ol style="list-style-type: none"> 1. Unable to drink/feed 2. Severe cough 3. Convulsions 4. Vomiting everything 5. Lethargy / unconsciousness 6. Bloody stools 	<p>Select four from the list</p>
<p>2.6 According to IMCI, a mother of a sick child should be counselled about what topics:</p>	<ol style="list-style-type: none"> 1. Importance of fluids and feeding 2. When to return to the clinic immediately 3. Her own health 4. Immunization 5. When to return for a follow-up visit 6. The treatments being given 7. Family planning 	<p>Select all that apply</p>
<p>2.7 What are two signs that are used to classify severe malnutrition</p>	<ol style="list-style-type: none"> 1. Small arm circumference 2. Visible severe wasting 3. Oedema of both feet 4. Severe dehydration 	<p>Select two from the list</p>
<p>2.8 Approximately 70% of all childhood deaths are associated with one or more of 5 conditions. Three of these conditions are diarrhea, measles and malnutrition. The other two are:</p>	<ol style="list-style-type: none"> 1. Acute respiratory infections, primarily pneumonia 2. Malaria 3. Tuberculosis 4. HIV/AIDS 5. Diabetes 	<p>Select two from the list</p>
<p>2.9 A boy is 11 months and weighs 8 kg. His temperature is 37°C. His mother says he has had a dry cough for the last 3 weeks. He does not have any general danger signs. The breathing rate is 41 breaths per minute. There is no chest indrawing. You can hear wheezing when the child breathes out. There is no stridor when he is calm. There is no diarrhea, fever or ear problem. He does not have visible severe wasting. His palms are very pale and appear almost white. There is no oedema of both feet. The child should be classified as having:</p>	<ol style="list-style-type: none"> 1. Pneumonia 2. Severe anemia 3. No pneumonia: cough or cold 4. Severe pneumonia or very severe disease 5. Anemia or very low weight 	<p>Select the best answer</p>
<p>3. Emergency case management</p>		
<p>3.1 Can you define ABCD in relation to emergency cases?</p>	<p>A: B: C: D:</p>	
<p>3.2 How is hypoxemia defined?</p>	<p>_____ %</p>	
<p>3.3 How is hypoglycemia defined?</p>	<p>_____ mmol/L</p>	
<p>3.4 Which three of these are signs of severe respiratory distress?</p>	<ol style="list-style-type: none"> 1. Laboured breathing 2. Cough 3. Head nodding 4. Very fast breathing 5. Convulsions 	<p>Select three from the list</p>
<p>3.5 Does stridor occur in inspiration or expiration?</p>	<ol style="list-style-type: none"> 1. Inspiration 2. Expiration 	
<p>3.6 At what flow (volume/time) should oxygen be started for a child over 2 months?</p>	<p>___ / ___</p>	
<p>3.7 Below what age is a child always a priority?</p>	<p>_____ months</p>	
<p>4. Pneumonia treatment practice</p>		

4.1 When did you last give antibiotics for pneumonia?	1. Today 2. This week 3. Last week 4. This month 5. More than a month ago 6. Never	
4.2 What antibiotic did you give?	TEXT	
4.3 What is the recommended first line treatment for non-severe pneumonia in children?	TEXT	Enter "Don't know" if you are unsure
4.4 What is the recommended first line treatment for severe pneumonia in children?	TEXT	Enter "Don't know" if you are unsure
4.5 When did you last given oxygen treatment?	1. Today 2. This week 3. Last week 4. This month 5. More than a month ago 6. Never	
4.6 When was the last time you gave an IV antibiotic for pneumonia?	1. Today 2. This week 3. Last week 4. This month 5. More than a month ago 6. Never	
4.7 When was the last time you had to resuscitate a child?	1. Today 2. This week 3. Last week 4. This month 5. More than a month ago 6. Never	
5. Current practice		
5.1 When did you last treat a child with a suspected infection?	1. Today 2. Yesterday 3. This week 4. Last week 5. This month 6. More than a month ago	
5.2 How many days a week do you see children clinically?	1. Everyday 2. 4-6 days a week 3. 2-3 days a week 4. 1 day a week 5. Less than once a week	
5.3 How many children do you see a week?	_____ number	Estimate as best you can
5.4 How many children a week are classified as "severe pneumonia"?	_____ number	Estimate as best you can
5.5 How many children a week do you refer? [PRIMARY/SECONDARY ONLY]	_____ number	Estimate as best you can
5.6 When was the last time you referred a child? [PRIMARY/SECONDARY ONLY]	1. Today 2. Yesterday 3. This week 4. Last week 5. This month 6. More than a month ago	
5.7 When was the last time you called an ambulance? [PRIMARY/SECONDARY ONLY]	1. Today 2. Yesterday 3. This week 4. Last week 5. This month 6. More than a month ago 7. Never	
5.8 Does your clinic triage paediatric patients?	Y / N	If N, go to END
5.9 Who conducts the triaging?	1. All staff 2. Doctor 3. Nurse 4. CHEWs/CHOs	

	5. Attendants	
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Web Appendix 3: FGD topic guides for healthcare providers

1. Paediatric Pneumonia

- Can you tell me about a typical day in your setting?
 - o Probe: How many children do you see? How many have pneumonia?
- Can you describe a typical case of pneumonia in your setting?
- How did you decide that this was a pneumonia case in your setting?
 - o Do you use a pulse oximeter? Have you received training in this?
 - o Do you use guidelines to help you diagnose, or your clinical judgment? or both?
- How do you decide if it is a severe or non-severe case of pneumonia?
- Are there other factors which you commonly see in these cases (e.g. malnutrition)?
- What do you do with a pneumonia case? Give any medications?
 - o Do you have oxygen treatment? Have you received training in this? [health facilities only]

2. Current IMCI

- Can you tell me about IMCI? Do you know what this is?
- Have you received training in IMCI? Can you describe the training?
- Do you think you implement IMCI in your setting?

3. Current referral procedure [FOR PHARMACY AND PRIMARY/SECONDARY OUTPATIENT FACILITIES ONLY]

- How often do you refer a child to the hospital or a health facility? For example, this week how many children has everyone referred?
- Can you describe the process of referral?
 - o Probe: documentation, explaining to the caregiver, organizing transport
- Do you think caregivers followed through with these referrals? What do you think influences whether they go or not?
- If you follow guidelines, do you think the correct children are recommended for referral? Why? (or why not?)

4. Hospital admission [FOR SECONDARY AND TERTIARY INPATIENT FACILITIES ONLY]

- How often are children with pneumonia admitted to this hospital? For example, this week how many children have been admitted?
- Do you have the capacity to admit this many cases?
 - o Probe: beds, oxygen concentrators, staff, drugs
- Do all caregivers agree to being admitted? Do they agree to oxygen treatment?
 - o Probe: what do you think influences whether they agree or not?
- If you follow guidelines, do you think the correct children are admitted? Why?
- How many children recover during admission?
- How often are children referred to a different facility? do you think this is too often? or not often enough? why?

5. Emergency cases

- Can you give a recent example of child you saw, that you would describe as an emergency?
 - o Probe: How often do you see children like this? Do others recognize this case?
- Can you describe what you did with this child?
 - o Probe: would everyone do the same, what would they do different
- Were you able to do everything you would have liked to do in this situation? If there were other things you would have liked to do, what were the barriers to doing them?

6. Policy recommendations

- What do you think is going right in your efforts to respond to paediatric pneumonia? What are the main enablers of these efforts?
- What are the main barriers you face in diagnosing paediatric pneumonia?
- What are the main barriers you face in treating paediatric pneumonia?
- What are the main barriers you face in referring cases of paediatric pneumonia?
- What could be done in the communities to improve the health of children and prevent pneumonia?
- What could be done within your setting to improve the diagnosis and management of paediatric pneumonia?
- What could be done in other settings (e.g. referral hospital) to improve the diagnosis and management of paediatric pneumonia?
- What could be done by the government to improve the diagnosis and management of paediatric pneumonia?
- If you could choose one of these interventions (referring to those suggested), which would you prioritize? Why?

Web Appendix 4: Summary of Table 5 results

Jigawa Secondary/Tertiary Facilities

The catchment areas for these facilities ranged from 12,743 for a secondary facility to the whole population of Jigawa (5.6 million) for Dutse General Hospital. These facilities were open 24hrs a day, 7 days a week and all but one (a secondary facility) have staff accommodation and staff on-call rooms. All of these facilities have mains power and back-up power (generator, though one solar) and reported having power available for 14 hours on average out of the previous 24 hours (range 6–24 hours). Three-quarters of these facilities have mains water with the other having a facility borehole. Jigawa secondary/tertiary facilities had all types of staff available except for one secondary facility that didn't have any drugs sales attendants (unqualified) or engineers.

In Jigawa, all secondary and tertiary centres had paediatric wards, but the tertiary centre was the only one with a neonatal ward. A single secondary facility reported having a paediatric intensive care unit, and all three have specific paediatric emergency wards. The tertiary facility has 62 beds available for children; the average (mean) number of paediatric beds was 57 (range 41–71) for secondary facilities in Jigawa.

We found secondary and the tertiary facility in Jigawa that we surveyed to have generally good availability of IMCI and ETAT drugs though there were important exceptions e.g. the tertiary facility does not appear well equipped with oral Amoxicillin and is indicated to be out of stock of IV Benzylpenicillin. Three-quarters of the secondary/tertiary facilities in Jigawa had functional pulse oximeters, functional oxygen, a resuscitation bag and mask, a glucometer and a nebulizer.

Jigawa Primary Facilities

The catchment areas for primary facilities in Jigawa vary considerably from 250 to 36,275 people (median 3200). Half of the primary facilities in Jigawa were open 24hrs a day, 7 days a week and they typically have staff accommodation or staff on-call rooms though not both. More than half of these facilities have mains power and a quarter use a generator as their primary source of power, and more than half have a back-up source of power though one of the 8 primary facilities surveyed reported having no mains power or back-up power at the time of the survey. These facilities reported having power available for only 8 hours on average out of the previous 24 hours (range 0–24 hours). Half of these facilities have mains water and the other half boreholes, mainly shared ones. About half of the primary facilities had each cadre of staff available though without knowing the expected posts at each facility (which we think vary) it's hard to know the proportion that had their full complement of staff cadres.

Half of the primary facilities in Jigawa had paediatric wards and the average (mean) number of paediatric beds was 3 (range 0–8). Only one of the primary facilities in Jigawa had a general emergency unit and three-quarters had outpatient departments.

We found the primary facilities in Jigawa that we surveyed to have moderate availability of IMCI and ETAT drugs, with some stock-outs. None have functional pulse oximeters, or oxygen, available, and they have limited availability of other functioning IMCI and ETAT equipment (Web Table 2a).

Jigawa PPMV/Pharmacy Facilities

These facilities have small catchment areas typically of only 100-800 people though one pharmacy reported a catchment area of 18,000 people. PPMVs and Pharmacies in Jigawa reported being open typically 12 hours a

day, including on weekends, and do not require staff housing or on call rooms. All of these facilities have mains power and a generator as back-up though reported only having power available for 7 hours on average out of the previous 24 hours (range 5–10 hours). These facilities only have access to water via shared boreholes or other sources. These pharmacists only had qualified pharmacists and unqualified drugs sales attendants as available staff cadres as expected. PPMV/Pharmacies in Jigawa had reasonable availability of essential drugs, though no availability of functioning oxygen or other ETAT or IMCI equipment except for one PPMV reporting having a pulse oximeter.

Lagos Secondary Facilities

Secondary facilities in Lagos reported catchment areas ranging from 4800 people to 22 million for General Hospital Ijede – although there are other large secondary and tertiary facilities that also serve this population. These facilities were open 24hrs a day, 7 days a week, and all half of them have both staff accommodation and staff on-call rooms with the other half having one or the other. Nearly all of these facilities have mains power though one reported solar electricity as it's primary power source, and all reported having back-up generator power. These facilities reported having power available for 20 hours on average out of the previous 24 hours (range 13–24 hours), greater than those in Jigawa. Only one of these facilities has mains tap water with the rest accessing water via facility boreholes. In Lagos the two secondary government facilities had all cadres of staff available except drugs sales attendants (unqualified) which they are not expected to have given they have qualified pharmacists, the secondary mission facilities had similar staffing levels, and the secondary private facilities has a lower availability of the different cadres similar to the primary government facilities.

In Lagos, paediatric wards were present in all of the secondary facilities except one private and one of the mission ones; and only one of the secondary government and one of the secondary mission hospitals had neonatal wards. None of the facilities in Lagos had a paediatric intensive care unit though we did not audit a tertiary facility, which should have one. Two secondary (government) facilities had paediatric emergency units, and only two secondary facilities (government, and mission) had neonatal intensive care units. All except one of the secondary facilities in Lagos had general emergency units though, and all had outpatient departments. The average (mean) number of paediatric beds was 18 (range 3–79) for secondary facilities in Lagos.

Secondary facilities in Lagos were well equipped with some drugs e.g. Amoxicillin and IV Gentamicin, though less well equipped with others e.g. IV Benzylpenicillin. Three-quarters of the secondary facilities in Lagos reported having functional pulse oximeters, and all reported having functional oxygen and other ETAT equipment (resuscitation bag and mask, glucometer). The availability of functioning IMCI equipment was mixed (Web Table 2b) at secondary facilities in Lagos.

Lagos Primary Facilities

Primary facilities in Lagos typically reported larger catchment populations than those in Jigawa, ranging from 12,000 to 71,000 people (median 35,000). Like those in Jigawa, half of the primary facilities in Lagos were open 24hrs a day, 7 days a week and though none of them have staff accommodation, half have on-call rooms. Half of these facilities reported having mains power as their primary electricity source and the other half reported solar, three-quarters reported having back-up generator power. These facilities reported having power available for 17 hours on average out of the previous 24 hours (range 4–24 hours) though, greater than those in Jigawa. Three-quarters of these facilities access water via facility or shared boreholes with the other facility having mains tap water. About half of the primary facilities had each cadre of staff available though without knowing the expected posts at each facility (which we think vary) it's hard to know the proportion that had their full complement of staff cadres.

In Lagos paediatric wards were not available in the primary facilities, though all except one had general emergency units, and outpatient departments. The average (mean) number of paediatric beds was 3 (range 0–5) for primary facilities in Lagos.

Primary facilities in Lagos had moderate availability of IMCI and ETAT drugs at the time of the survey, with some stock-outs reported. One of the primary facilities in Lagos reported having a functioning pulse oximeter and two reported having functioning oxygen, and the availability of other functioning IMCI and ETAT equipment was also mixed (Web Table 2b).

Lagos PPMV/Pharmacy Facilities

Pharmacies and PPMVs in Lagos have catchment areas between 1,000 and 5,000 people, larger than those in Jigawa. Though like those in Jigawa, PPMVs and Pharmacies in Lagos reported being open typically 12 hours a day, including on weekends, and do not require staff housing or on call rooms. Both of these facilities also reported having mains power and back-up generator power, though the amount of power in the last 24 hours was not reported. These facilities access water via a shared borehole. These pharmacists only had qualified pharmacists and unqualified drugs sales attendants as available staff cadres as expected. We found the PPMV/Pharmacy facilities in Lagos that we surveyed to have reasonable availability of essential drugs; none reported data on the availability of pulse oximetry, oxygen and other IMCI and ETAT equipment though.

Web Table 1: Amoxicillin, IV Benzylpenicillin and IV Gentamicin Availability by facility

State	Facility Type	Amoxicillin Current stock (number of doses at each facility separated by ,)	IV Benzylpenicillin Current stock (number of doses at each facility separated by ,)	IV Gentamicin Current stock (number of doses at each facility separated by ,)
Jigawa	Tertiary government (n=1)	20	0	400
	Secondary government (n=3)	100, 1000, 1945	0, 0, 180	80, 400, 1100
	Primary government (n=4)	8, 15, 200, 300	0, 0, 0, 100	0, 0, 200, 500
	Primary private (n=4)	2, 12, 30, 80	0, 0, 0, 5	0, 10, 50, 129
	Pharmacy (n=2)	25, 50	15, 100	20, 35
	PPMV (n=2)	1, 20	0, 0	0, 1
Lagos	Secondary government (n=2)	136, 10900	0, 0	400, 1550
	Secondary private (n=4)	12, 20, 48, 168	0, 0, 5, 100	2, 100, 100, 100
	Secondary mission (n=2)	1, 100	0, 0	90, 178
	Primary government (n=4)	0, 370, 1200, 4000	0, 0, 0, 0	0, 0, 60, 215
	PPMV private (n=2)	0, 20	0, 10	0, 10

Web Table 2a Functional Equipment Available in Jigawa health facilities, Q1 2019

		Total N = 16	Tertiary Gov. (n=1)	Secondary Gov. (n=3)	Primary Gov. (n=4)	Primary Private (n=4)	Pharmacy Private (n=2)	PPMV Private (n=1)
Functioning IMCI Equipment								
Thermometer	Yes	10	1	3	3	2	1	0
	No	6	0	0	1	2	1	2
Respiratory rate timer	Yes	3	0	2	0	1	0	0
	No	13	1	1	4	3	2	2
MUAC tape	Yes	8	1	3	3	1	0	0
	No	8	0	0	1	3	2	2
Weighing scale	Yes	11	1	3	4	2	1	0
	No	5	0	0	0	2	1	2
Nebulizer	Yes	3	1	2	0	0	0	0
	No	13	0	1	4	4	2	2
Pulse oximeter	Yes	4	1	2	0	0	0	1
	No	12	0	1	4	4	2	1
Functioning ETAT Equipment								
Oxygen	Yes	3	1	2	0	0	0	0
	No	13	0	1	4	4	2	2
Resuscitation bag and mask	Yes	3	1	2	0	0	0	0
	No	13	0	1	4	4	2	2
Glucometer	Yes	4	1	2	0	1	0	0
	No	12	0	1	4	3	2	2

Web Table 2b Functional Equipment Available in Lagos health facilities, Q1 2019

		Total N = 11*	Secondary Gov. (n=2)	Secondary Private (n=4)	Secondary Mission (n=2)	Primary Gov. (n=3*)
Functioning IMCI Equipment						
Thermometer	Yes	11	2	4	2	3
	No	0	0	0	0	0
Respiratory rate timer	Yes	5	1	4	0	0
	No	6	1	0	2	3
MUAC tape	Yes	8	1	3	1	3
	No	3	1	1	1	0
Weighing scale	Yes	10	1	4	2	3
	No	1	1	0	0	0
Nebulizer	Yes	10	2	4	2	2
	No	1	0	0	0	1
Pulse oximeter	Yes	7	2	3	1	1
	No	4	0	1	1	2
Functioning ETAT Equipment						
Oxygen	Yes	10	2	4	2	2
	No	1	0	0	0	1
Resuscitation bag and mask	Yes	10	2	4	2	2
	No	1	0	0	0	1
Glucometer	Yes	11	2	4	2	3
	No	0	0	0	0	0

* 1 Primary government and the 2 private PPMVs did not have any data on Functional Equipment Available