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MINISTRY OF HEALTH - ETHIOPIA

SUMMARY FINDINGS OF THE INVENTORY ASSESSMENT FOR BIOMEDICAL EQUIPMENT FOR COVID-19 CASE MANAGEMENT IN ETHIOPIA



July 31, 2020
Addis Ababa,
Ethiopia

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Executive Summary

An inventory assessment was conducted in Ethiopia in all public and functional COVID-19 treatment facilities between June 06, 2020-July 23, 2020. The purpose of the assessment was to understand readiness and capacity of these facilities in terms of biomedical equipment availability for COVID-19 case management. Through this assessment, 83 facilities that are currently active treatment centers in the country were included in all regions the country. The World Health Organization (WHO) “Biomedical Equipment for COVID-19 Case Management Interim Guidance Inventory tool for facility readiness and equipment re-allocation” was employed as the main assessment tool for this duty. The data collection was conducted using SurveyCTO electronic real-time data collection application.

Out of the total 83 facilities 37% of them are dedicated for COVID-19/infectious diseases treatment centers now, which were university/college campus, secondary schools, meeting halls and even lodging houses. The rest 63% are different health facilities like health centers (12%), primary hospitals (17%), general hospitals (18%) and referral/specialized hospitals (16%). During the assessment a total of 9223 beds were dedicated for COVID 19 treatment centers with 556 beds for intensive care unit (ICU) for COVID 19 patients. There were a total of 157 ambulances in 71 (86%) visited facilities, of which nearly half (47%) of them were equipped with oxygen devices. About 72% of visited facilities have a dedicated staff to the management, installation, and maintenance of medical equipment. Likewise, 64% of the facilities do have a clinical staff that has experience in invasive mechanical ventilation / intubation.

Majority (90%) of the facilities have some type of functional pulse oximeters on the time of the assessment. However, there are 8 facilities with no any form of pulse oximeters at all whether it is functional or not. In those 75 facilities, there are 1357 POx (1222 functional and 135 nonfunctional) pulse oximeters. But, their distribution across the regions is wide ranging that Addis Ababa takes the lion share (62%) of functional POxs while the sum of seven emerging and other regions account only 6%. Associating with the type of the facilities, about 64% of POxs were found in COVID-19/infectious diseases dedicated treatment centers followed by tertiary hospitals (17%) and general hospitals (12%).

In comparison of functionality against type of POx, Tabletop POxs are found more nonfunctional from Portable handheld and fingertip POxs that 35% Tabletop POxs were nonfunctional. A total of 1160 (952 functional and 208 nonfunctional) concentrators were found in 62 (75%) of the facilities visited. The rest 21 (25%) of the facilities do not have any form of oxygen concentrator. Respectively, 41%, 27% and 22%

of concentrators were found in in COVID-19 infectious diseases dedicated treatment centers, tertiary hospitals and general hospitals. About 95% of the facilities have oxygen cylinders on the time of the assessment. Amhara Region shares the highest (33%) of total cylinders, followed by Oromia and Addis Ababa that 23% and 21% of total cylinders, respectively. However, four facilities do have substandard cylinders that are out of list of cylinders by WHO. Unfortunately, those hospitals do not have also concentrators to supplement their oxygen need. In about 71 (86%) of the facilities a total of 2951 (2549: functional and 402: nonfunctional) cylinder assembly units were identified during the assessment. Similarly, a total 2748 (84%) functional oxygen flowmeters were available in 75 (90%) of the facilities. However, the rest 8 facilities do not have any form of flowmeter, Thorpe Tube at all whether it is functional or not. On the other hand only in 8% of the facilities 130 oxygen flow-splitters are found during the assessment. Of which, 85% of flow-splitters are available in one facility (Adama Hospital Medical Collage). About sixty five percent of the visited facilities do have at least one age category of nasal cannula/prongs (adult). From the total of 9300 nasal cannula (nasal prongs) reviewed during the assessment, 85%, 12% and 3% were adult, pediatric and neonate age categories, respectively. But, limited number (25%) of the visited facilities have at least one age category of nasal catheter with a total of 5141 nasal catheters in the proportion of 79%, 17% and 5% for adult, pediatric and neonate age categories, respectively. About, 60% of the facilities have at least one type of oxygen mask and/or Venturi mask on the time of the assessment. However, availability of Venturi masks is very low (about 5% of the facilities). A total of 204 (173-functional and 31-nonfunctional) BiPAP & CPAP Machines were found in 27 facilities, of which in 24(29%) of the facilities do have functional BiPAP & CPAP Machines. A sum of 1584 resuscitation bags and masks were available in 51 (61%) of visited facilities in the proportion of 68%, 22% and 10% for adult, pediatrics and neonatal age categories respectively. Correspondingly, there were 433 laryngoscopes in 48 (58%) of visited facilities. Of which, 428 were Macintosh (Curved blade) while 54 of them were Miller (Straight blade) Laryngoscopes. Out of the visited 83 facilities, 50 (60%) of them have some type of patient ventilator, of which 48(58%) of them were with functional ventilators. A total of 429 ventilators were identified with 73% of functionality in the visited facilities. About 42% patient ventilators were found in tertiary hospitals; however, those referral hospitals account only 16% of the facilities visited. Only, 4(<5%) of the facilities oxygen plants that two of them are currently functional while the other two were not working. For the existence of nonfunctional biomedical equipment and devices, major reasons stated by study participants were absence of spare parts followed by lack of consumables like cables, cables, sensors etc. are among others.

In line with large numbers of COVID 19 cases are identified in Addis Ababa, large number of COVID 19 related biomedical equipment and devices are concentrated in Addis Ababa. On the other hand in emerging/pastoralist regions those biomedical equipment and devices were not available in most COVID

19 treatment facilities. Therefore, equipping all COVID 19 treatment centers with reasonable quantity of essential biomedical equipments is recommended.

Acronyms

BiPAP	Bilevel Positive Airway Pressure
CHAI	The Clinton Health Access Initiative
CO ₂	Carbon dioxide
CPAP	Continuous Positive Airway Pressure
ECG	Electrocardiogram
EOC	Emergency Operations Center
FMOH	Federal Ministry of Health Ethiopia
HC	Health Center
HFNC	High-Flow Nasal Cannula
HL	Hospital
ICU	Intensive care unit
PO _x	Pulse Oximeter
PSA	Pressure Swing Absorption Oxygen Plant
Pt.	Patient
SNNPR	Southern Nations and Nationals People Region
TC	Treatment Center
WHO	The World Health Organization

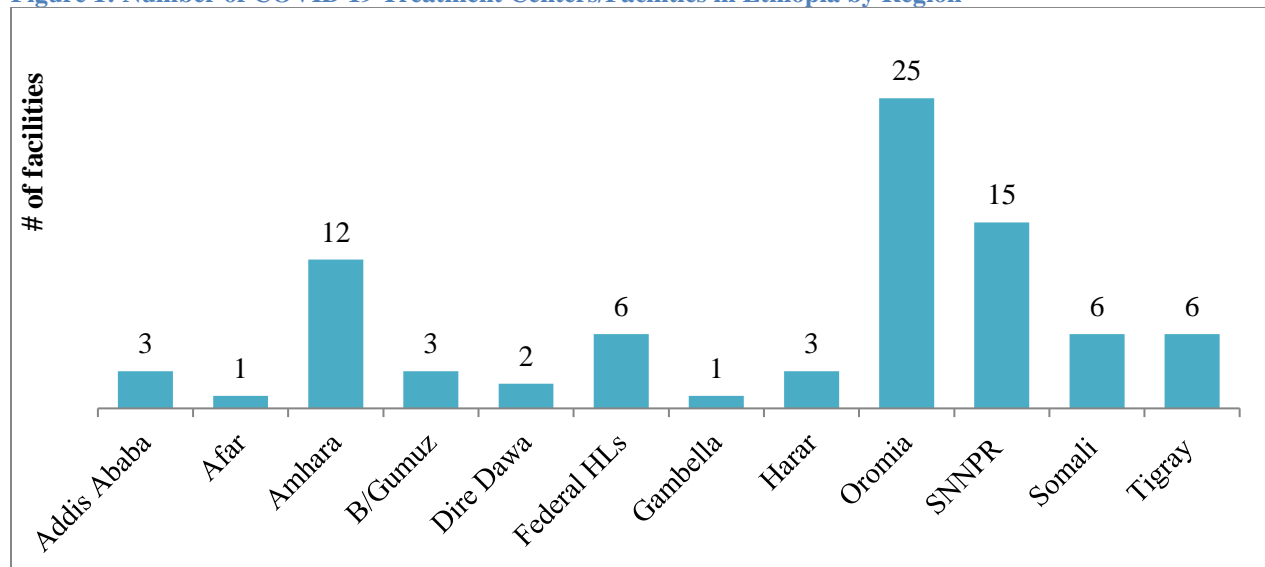
1 Approach

This rapid inventory assessment was conducted in Ethiopia in all public and functional COVID-19 treatment facilities during the assessment. The assessment was conducted between June 06, 2020-July 23, 2020. The purpose of the assessment was to understand readiness and capacity of these facilities in terms of biomedical equipment availability for COVID-19 case management. Through this assessment, 83 facilities that are currently active treatment centers in the country were included in this assessment in all regions. The targets of this assessment were public facilities. The World Health Organization (WHO) “Biomedical Equipment for COVID-19 Case Management Interim Guidance Inventory tool for facility readiness and equipment re-allocation” assessment tool was employed for this duty. The data collection was conducted using SurveyCTO electronic real-time data collection application. Electronic data collection system also improves data quality. Descriptive statistical analysis conducted using SPSS version 24 and MS-Excel and presented in the forms of frequencies, tables and graphs.

2 General Information

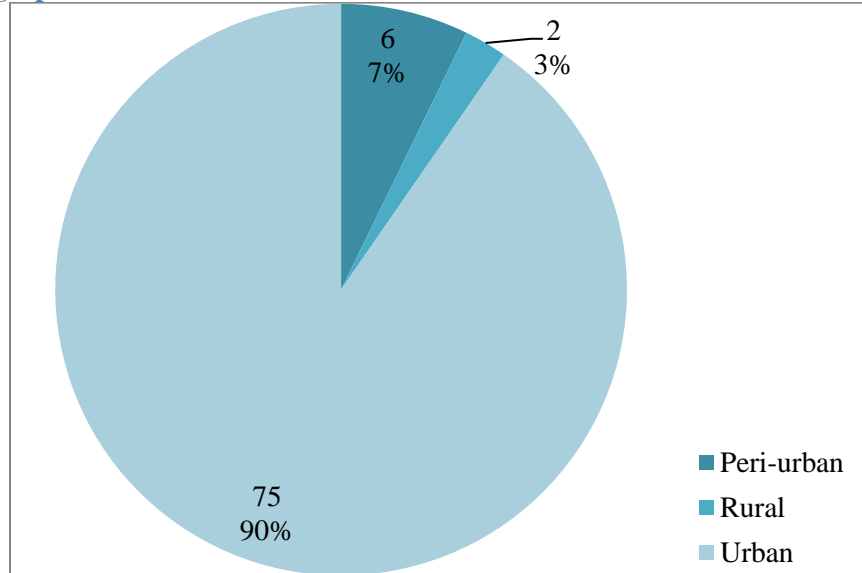
The assessment was conducted in a total of 83 COVID-19 treatment centers/facilities in all regions including federal hospitals across the country Figure 1. List of all visited hospitals is found at Annex-1.

Figure 1: Number of COVID 19 Treatment Centers/Facilities in Ethiopia by Region



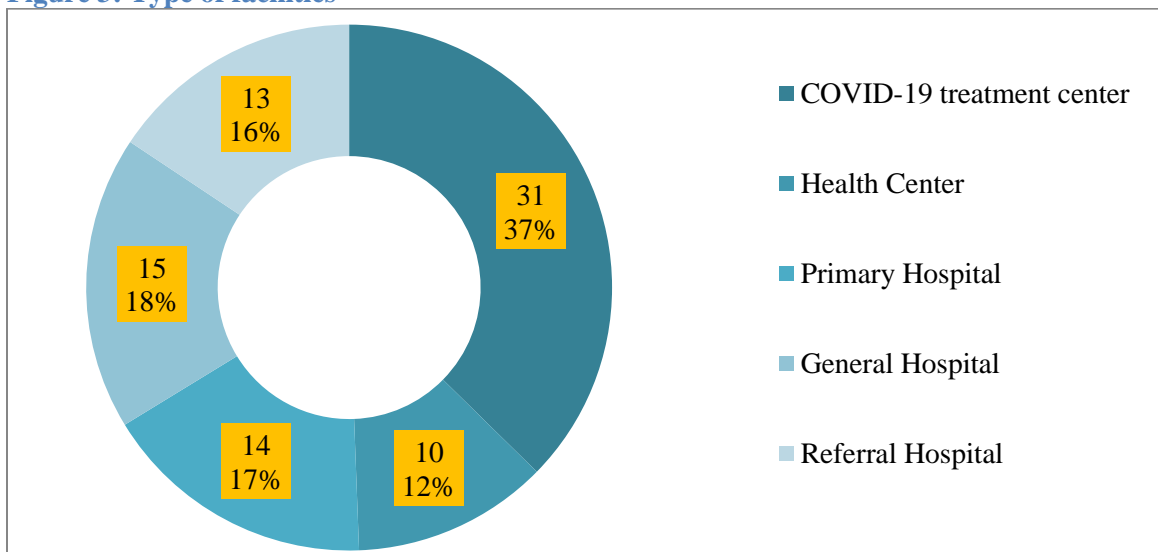
In terms of geographical area, majority of the facilities were situated in urban areas Figure 2. But, Dawalle Health Center and Dollo Ado COVID-19 Treatment Centers are categorized as rural areas.

Figure 2: Geographical area of the assessed facilities



Out of the total 83 facilities 37% of them are dedicated for COVID-19/infectious diseases treatment centers now, which were university/college campus, secondary schools, meeting halls and even lodging houses. The rest 63% are different health facilities from health center to specialized referral hospitals Figure 3.

Figure 3: Type of facilities



More than 96% of the facilities are governmental public facilities. The remaining 2% and 1% are private for-profit and government non-public (military) owned facilities respectively.

3 Beds and Utility Readiness

In the reviewed facilities there were 16,373 patient beds including 653 regular ICU beds. Of those beds, 56% (9223) of them were dedicated for COVID 19 treatment centers including 556 COVID 19 specific ICU beds Figure 4 and Figure 5. Parallel to number of facilities more than 68% beds dedicated for COVID 19 treatment are found in three regions namely, Oromia, Addis Ababa and Amhara Regions with 25%, 23% and 20% of total beds respectively. The Millennium COVID-19 Care Center has the largest number of beds (1040 beds) while Tirunesh Bejing General Hospital has only 5 beds for COVID 19 treatment without ICU beds for COVID treatment.

Figure 4: Total beds available in the facilities

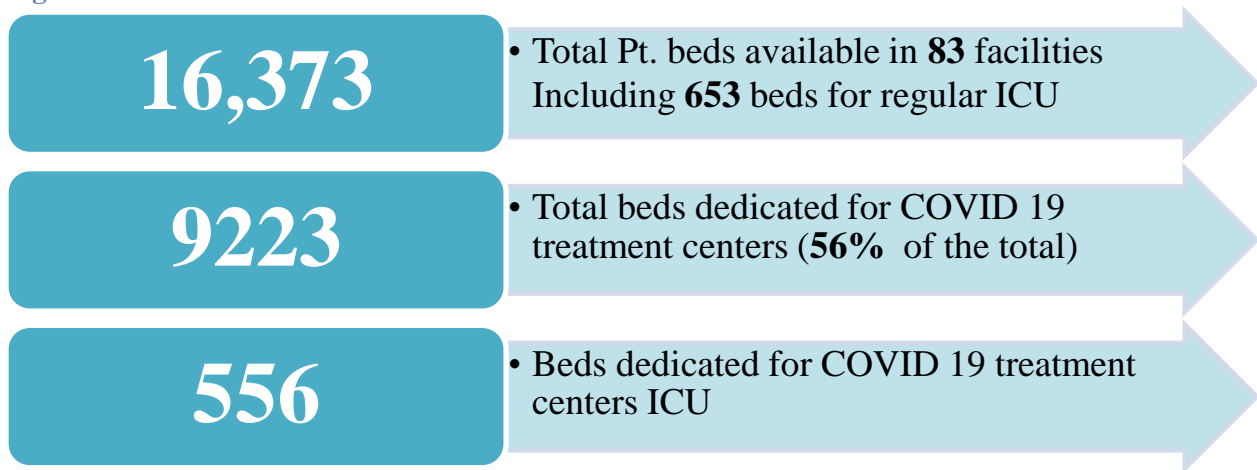
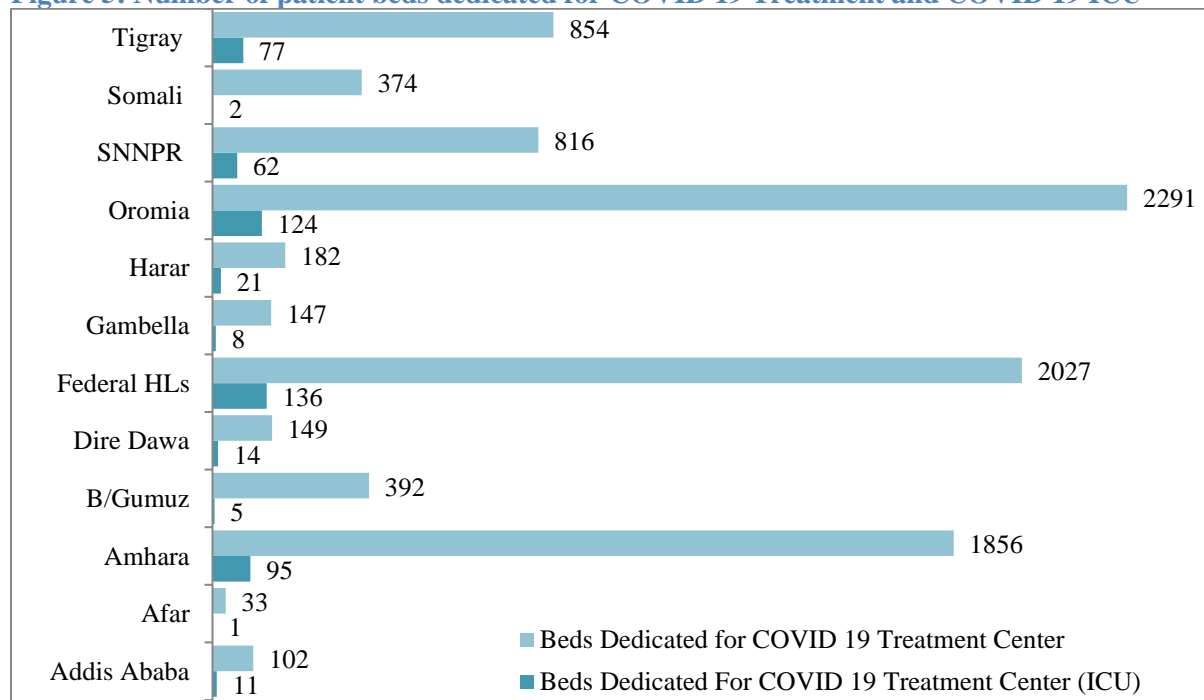


Figure 5: Number of patient beds dedicated for COVID 19 Treatment and COVID 19 ICU



Almost all (98%) of the facilities have access to running water. But, two facilities, Bore Primary Hospital in Oromia Region and South Gondar Zone COVID-19 Treatment Center in Amhara Region lack access to running water. Similarly, all 83 facilities are connected to central grid electricity. Besides that 67 (81%) of them have one or more stand by generator. Specially, two facilities; Alert Specialized Hospital and Tirunesh Bejing General Hospital have five generators each. About 17 facilities have 2-4 generators whereas 48 facilities have one. Moreover, 57% of laboratory, 45% of ICUs, 41% of imaging, 36% of emergency rooms, 33% of surgery (ORs) and 23% of wards have dependable voltage stabilization; double conversion uninterruptible power supply (UPS). With regard to wall pipe network of medical gases only seven (8%) facilities have the infrastructure like Turkish Hospital in Harari, Wollega University Hospital in Oromia, St. Poul Hospital Millennium Medical College in Addis Ababa and Enjibara General Hospital in Amhara Region linked with Oxygen, Air and Vacuum while Millennium COVID 19 TC, Tirunesh Bejing General Hospital and Yekatit 12 General Hospital in Addis Ababa have with Oxygen only.

4 Emergency Transport Vehicles or Ambulances

Majority of the facilities have at least one or more emergency transport vehicles or ambulances. But, 12 facilities do not have any means of emergency transport vehicle or ambulance. From those facilities that have ambulances 31 of them have ambulances with oxygen while 40 of the facilities have ambulances without oxygen devices. On the other hand in the reviewed facilities there are a total of 157 ambulances, of which 47% and 53% of them are equipped with oxygen and without oxygen devices Table 1.

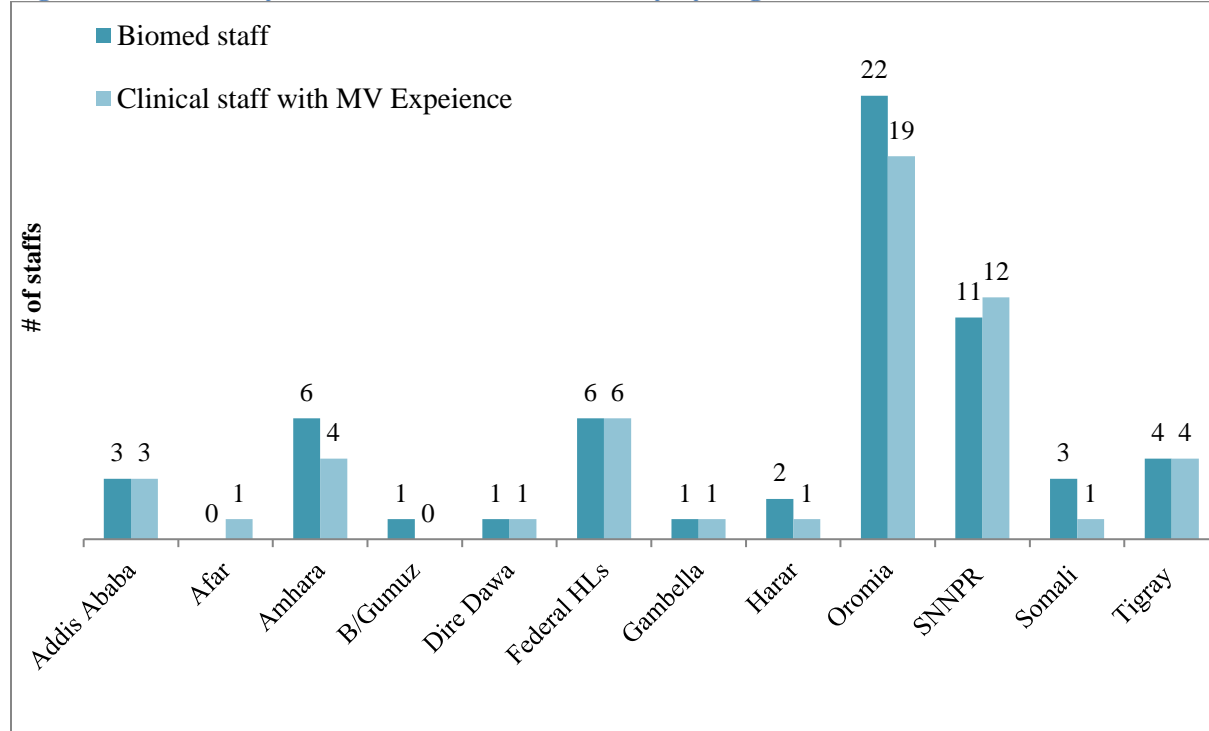
Table 1: Availability of Ambulances in the Facilities by Region

Region	Facilities			Ambulances			
	No ambulance	Ambulance with oxygen	Ambulance without oxygen	Total	Have oxygen	Don't have oxygen	Total
Addis Ababa	0	3	0	3	14	0	14
Afar	1	0	0	1	0	0	0
Amhara	3	4	5	12	11	7	18
B/Gumuz	0	3	0	3	5	0	5
Dire Dawa	1	0	1	2		2	2
Federal HLs	0	4	2	6	12	13	25
Gambella	0	0	1	1		1	1
Harari	0	1	2	3	6	4	10
Oromia	2	9	14	25	14	35	49
SNNPR	3	6	6	15	9	11	20
Somali	0	0	6	6	2	6	8
Tigray	2	1	3	6	1	4	5
Total	12	31	40	83	74	83	157

5 Availability of Relevant Staff

Nearly in 72% of the facilities visited, there is a dedicated staff to the management, installation, and maintenance of medical equipment. Likewise, 64% of the facilities do have a clinical staff that has experience in invasive mechanical ventilation / intubation. However, 23, 30 and 16 facilities do not have relevant biomedical, clinical and both staff respectively Figure 6.

Figure 6: Availability of Relevant Staff in the facility by Region



6 Vital Sign Monitoring Devices

6.1 Patient Monitor

About 60 (72%) of the facilities have some type of functional patient monitor on the time of assessment. The rest 23 facilities do not have any form of patient monitor at all whether it is functional or not. A total of 872 patient monitors were available, of which 733(84%) are functional. From the functional patient monitors 648 (88%) are integrated ECG while 85(12%) of them are not integrated ECG. Rate of non-functionality for integrated ECG and without integrated ECG patient monitor are 15% and 22% respectively Table 2.

Table 2: Patient monitor availability by region

Region	FUNCTIONAL - Pt. monitor with ECG	NON-FUNCTIONAL - Pt. monitor with ECG	FUNCTIONAL - Pt. monitor without ECG	NON-FUNCTIONAL - Pt. monitor without ECG	Total FUNCTIONAL - Pt. monitor	Total NON-FUNCTIONAL - Pt. monitor	TOTAL Pt. monitors in the facility	Percentage of FUNCTIONAL
Addis Ababa	58	19	25	13	83	32	115	72%
Afar	0	0	8	0	8	0	8	100%
Amhara	52	6	1	1	53	7	60	88%
B/Gumuz	0	0	0	0	0	0	0	
Dire Dawa	12	0	0	0	12	0	12	100%
Federal HLs	191	33	0	0	191	33	224	85%
Gambella	0	0	0	0	0	0	0	
Harari	6	5	0	0	6	5	11	55%
Oromia	250	30	38	10	288	40	328	88%
SNNPR	75	18	6	0	81	18	99	82%
Somali	2	4	0	0	2	4	6	33%
Tigray	2	0	7	0	9	0	9	100%
Total	648	115	85	24	733	139	872	84%

6.2 Pulse Oximeters

Majority (90%) of the facilities have some type of functional pulse oximeters on the time of the assessment. However, there are 8 facilities with no any form of pulse oximeters at all whether it is functional or not. In those 75 facilities, there are 1357 POx (1222 functional and 135 nonfunctional) pulse oximeters. But, their distribution across the regions is wide ranging that Addis Ababa takes the lion share (62%) of functional POxs while the sum of seven emerging and other regions account only 6% as summarized in Figure 7 and Figure 8. Associating with the type of the facilities, about 64% of POxs were found in COVID-19/infectious diseases dedicated treatment centers followed by tertiary hospitals (17%) and general hospitals (12%).

Figure 7: Pulse Oximeters Availability

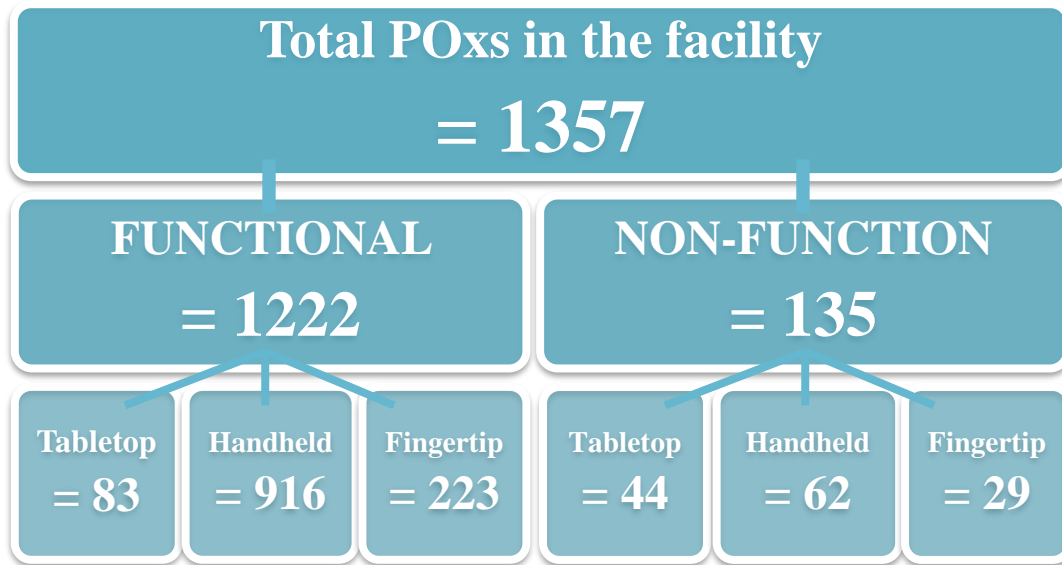
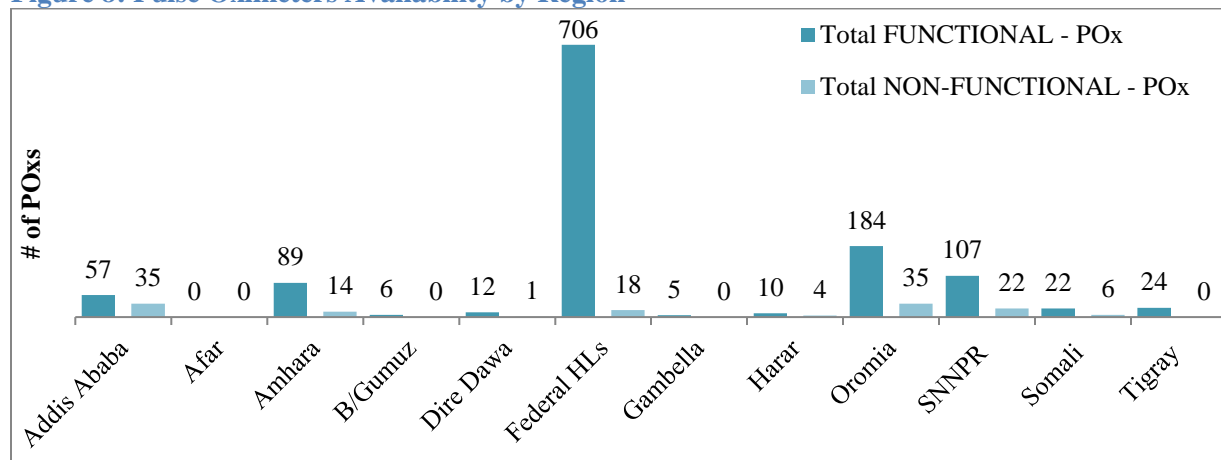


Figure 8: Pulse Oximeters Availability by Region



When comparing functionality against type of POx, Tabletop POxs are found more nonfunctional from Portable handheld POxs that 35%, 12% and 6% of tabletop, self-contained fingertip and portable handheld POxs are nonfunctional respectively from the reviewed POx within their categories.

7 Oxygen Concentrators

Concentrators were disaggregated based on their maximum flow rate capacity. To distinguish their functionality, each reviewed concentrators were running for >5 minutes on the time of assessment. If the output of oxygen concentration is equal to or greater than 82%, the device is considered as functional.

A total of 1232 (1024 functional and 208 nonfunctional) concentrators were found in 62 (75%) of the facilities visited. **The rest 20 (24%) of the facilities do not have any form of oxygen concentrator** Figure 9 and Figure 10.

Although the age concentrator is not well taken into consideration, there is substantial variation in functionality of concentrators at different capacity of maximum flow rate. For instance non-functionality rate for 10L/min, 5L/min and 3L/min flow rate capacity concentrators is 28%, 23% and 21% respectively. But, non-functionality for 8L/min and >10 L/min is found to be 1%. Correspondingly, 41%, 27% and 22% of concentrators were found in in COVID-19 infectious diseases dedicated treatment centers, tertiary hospitals and general hospitals.

Figure 9: Availability of concentrators by Region

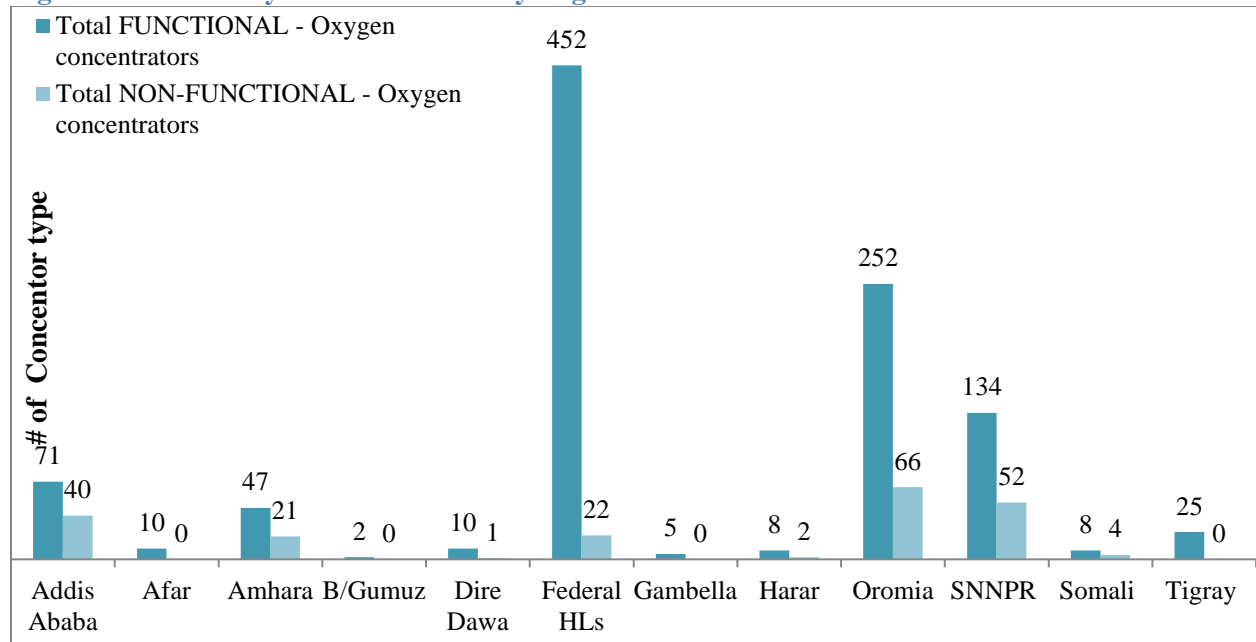
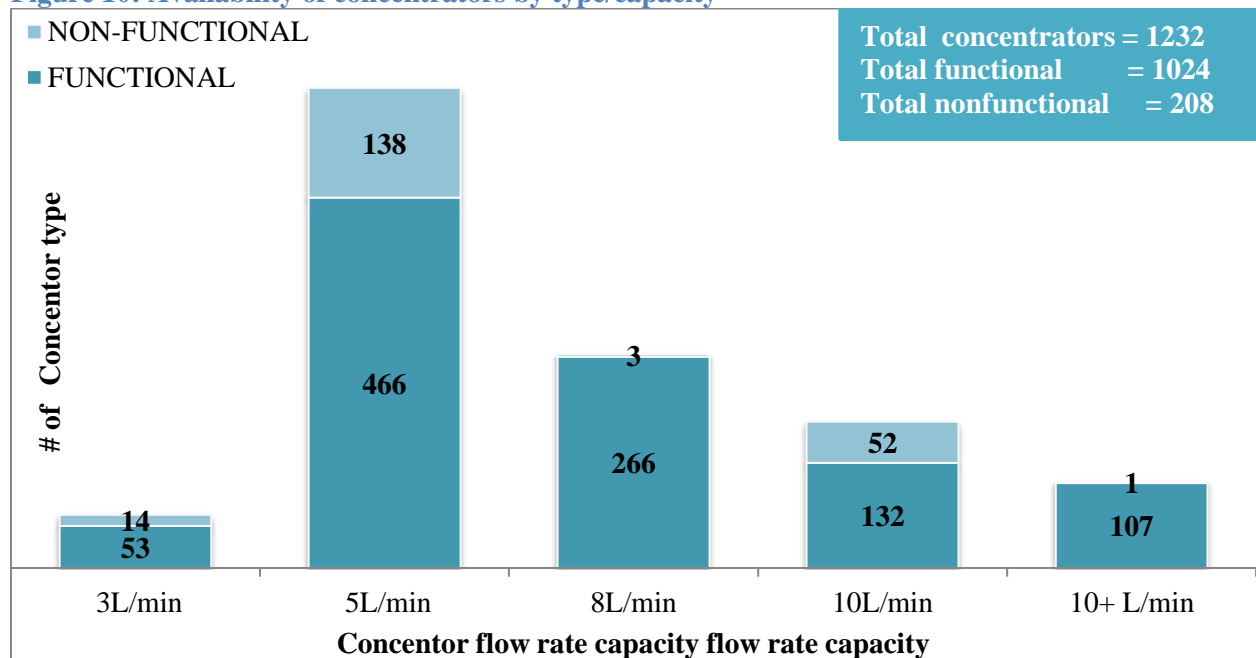


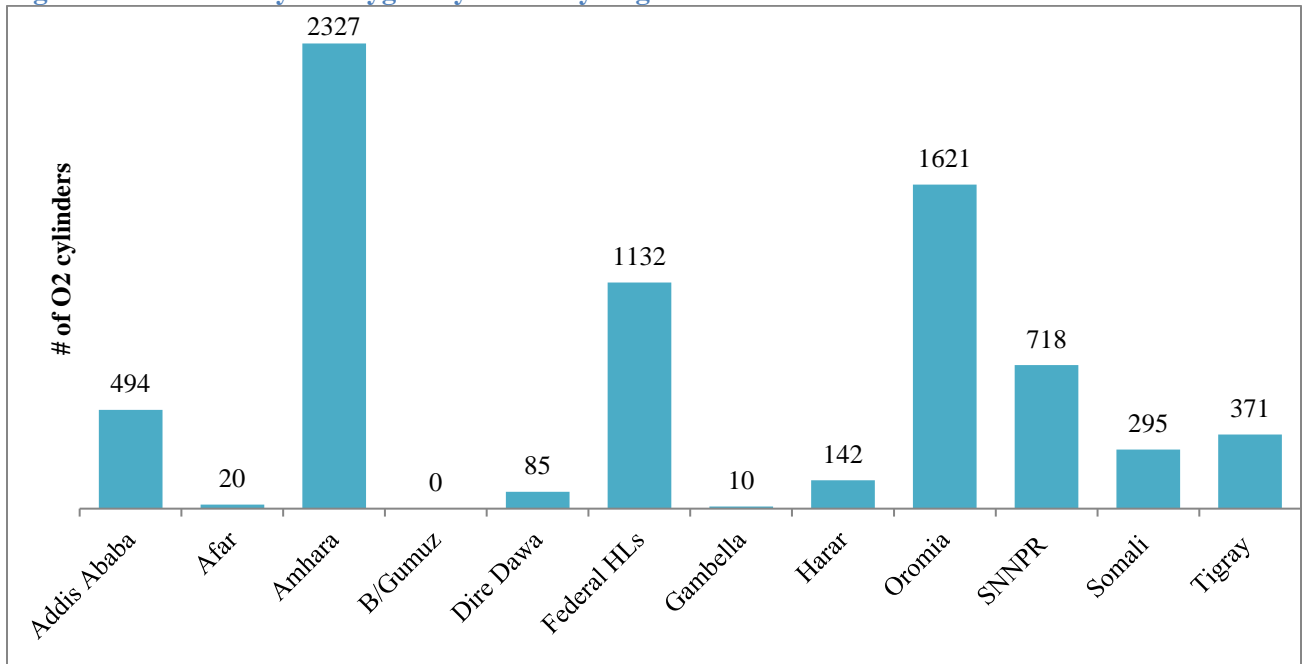
Figure 10: Availability of concentrators by type/capacity



8 Oxygen Cylinders

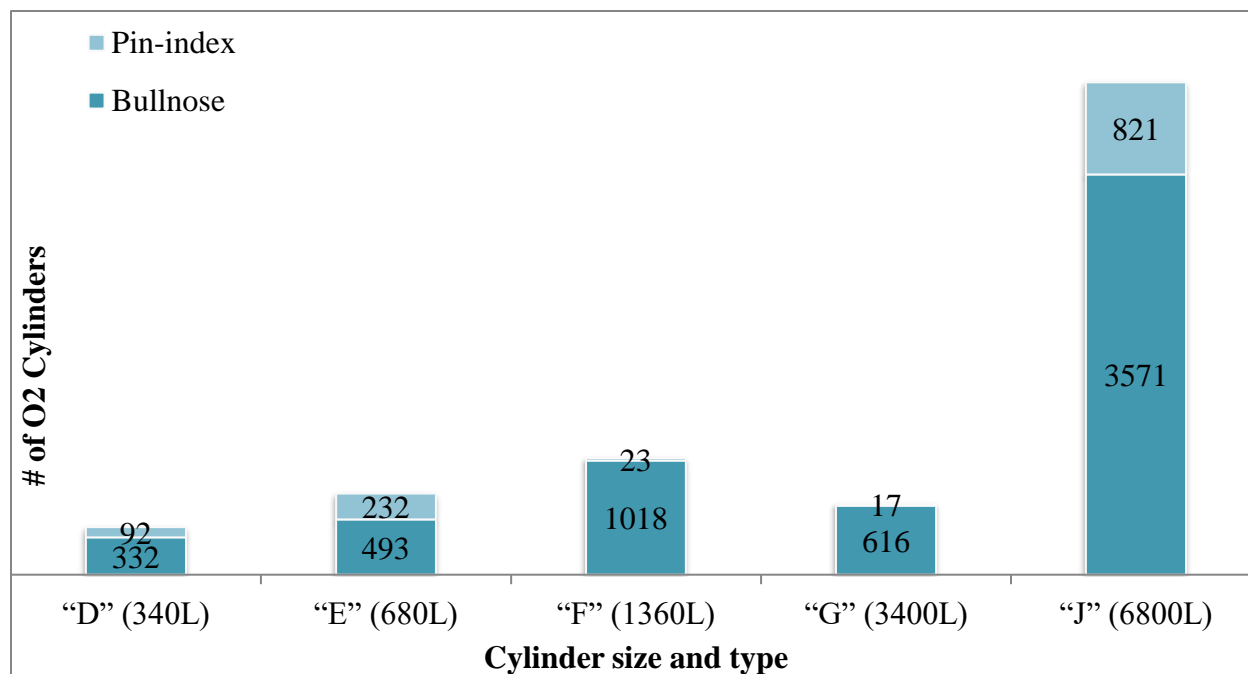
About 95% of the facilities have oxygen cylinders on the time of the assessment Figure 11. Amhara Region shares the highest (32%) of total cylinders, followed by Addis Ababa and Oromia that 23% and 22% of total cylinders, respectively. However, four facilities; Selgelu Health Center, Pawe Health Science College and Kamash Male Boarding School COVID Treatment Centers in B/Gumuz and Axum University Shirie Campus COVID Treatment Center in Tigray Region do not have any oxygen cylinder. Unfortunately, two of them (Selgelu and Pawe Health Science College) do not also have any concentrator or oxygen plant. However, in Selgelu and Pawe Health Science College COVID Treatment Centers there are few cylinders, but they are very small in size, which are below the standard of WHO recommended cylinders. Unlike, POxs and concentrators, more than half (53%) of the total cylinders were also found in tertiary hospitals, followed by COVID-19/infectious diseases dedicated treatment centers (20%) and general hospitals (16%).

Figure 11: Availability of Oxygen Cylinders by Region



A total of 7215 cylinders were available in those 79 facilities. Cylinder type “J” (6800L) the most commonly available type that is found in 63% of the facilities and accounts nearly 61% all cylinders **Error! Reference source not found.**

Figure 12: Availability of Oxygen Cylinders by type/capacity



Some consumption and costing related question were incorporated, although the collected data for those questions were incomplete to give clear picture of the situation. The reason may be poor documentation of facilities on oxygen consumption and mostly oxygen supplied freely. From the existing data the findings are summarized in Table 3 below.

Table 3: Average number of oxygen cylinders consumed per week with respective costs

Variable	Average number of oxygen cylinders consumed per week in the facility	Total cost of cylinders/week in ETH Birr in the facility
Number of facilities	58	46
Mean	117	25,235.70
Median	14.5	6,750.00
Mode	2	600.00
Maximum	2100	226,800.00
Minimum	1	250.00

About 77 facilities have some form of cylinder assembly units. Bonga Health Center and Wolkite University specialized hospital in SNNPR and Axum University Shirie Campus in Tigray Regions treatment centers do not have any form of cylinder assembly units. Moreover, Hawagalan Health Center and Gimbi General Hospital in Oromia Region and Zewditu Memorial Hospital Addis Ababa have some

cylinder assembly units, but all of them are nonfunctional. A total of 2951 (2549: functional and 402: nonfunctional) cylinder assembly units were identified during the assessment Table 4.

Table 4: Cylinder Assembly Units by Type and Functionality Status by Regions

Region	FUNCTIONAL Pin-index	NON-FUNCTIONAL Pin-index	FUNCTIONAL Bullnose	NON-FUNCTIONAL Bullnose	Total FUNCTIONAL assembly units	Total NON-FUNCTIONAL assembly units	TOTAL Cylinder assembly units
Addis Ababa	0	0	78	48	78	48	126
Afar	0	0	1	0	1	0	1
Amhara	22	0	88	5	110	5	115
B/Gumuz	0	0	40	0	40	0	40
Dire Dawa	0	0	40	0	40	0	40
Federal HLs	0	0	504	14	504	14	518
Gambella	0	0	10	0	10	0	10
Harari	0	0	18	0	18	0	18
Oromia	159	165	652	129	811	294	1105
SNNPR	80	0	410	28	490	28	518
Somali	0	0	235	13	235	13	248
Tigray	112	0	100	0	212	0	212
Total	373	165	2176	237	2549	402	2951

9 Flow Meter, Thorpe Tube

About 75 (90%) of the facilities have some type of functional Flowmeter, Thorpe Tube on the time of assessment. **The rest 8 facilities do not have any form of Flowmeter, Thorpe Tube at all whether it is functional or not.** A total of 3274 Flowmeter, Thorpe Tubes were available, of which 2748 (84%) are functional Figure 13 and Figure 14.

Figure 13: Availability of Flow Meter, Thorpe Tube by Region

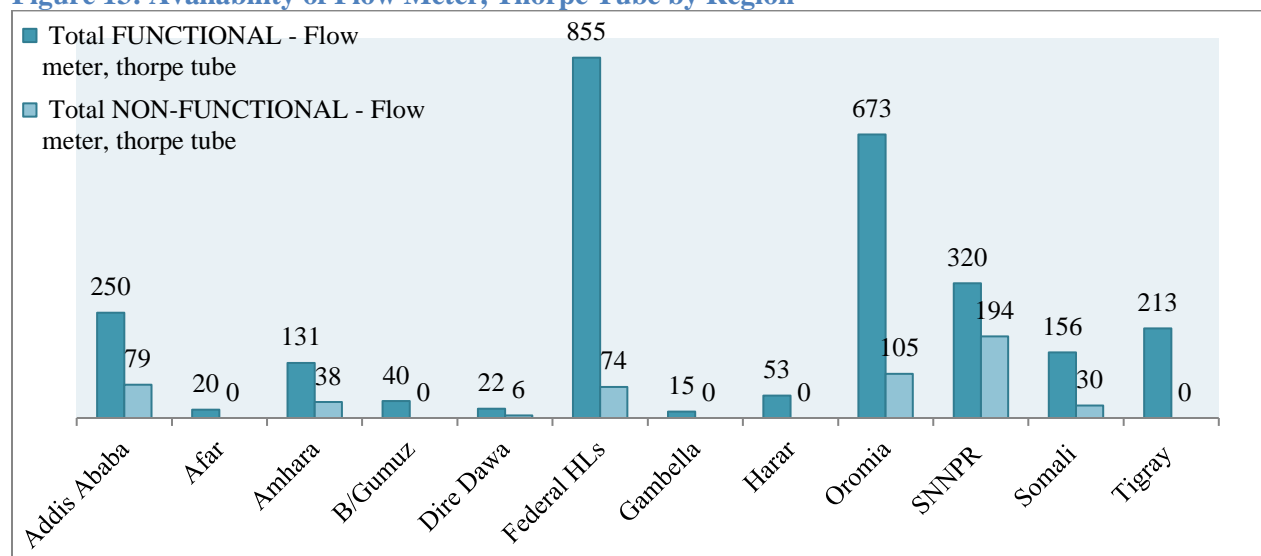
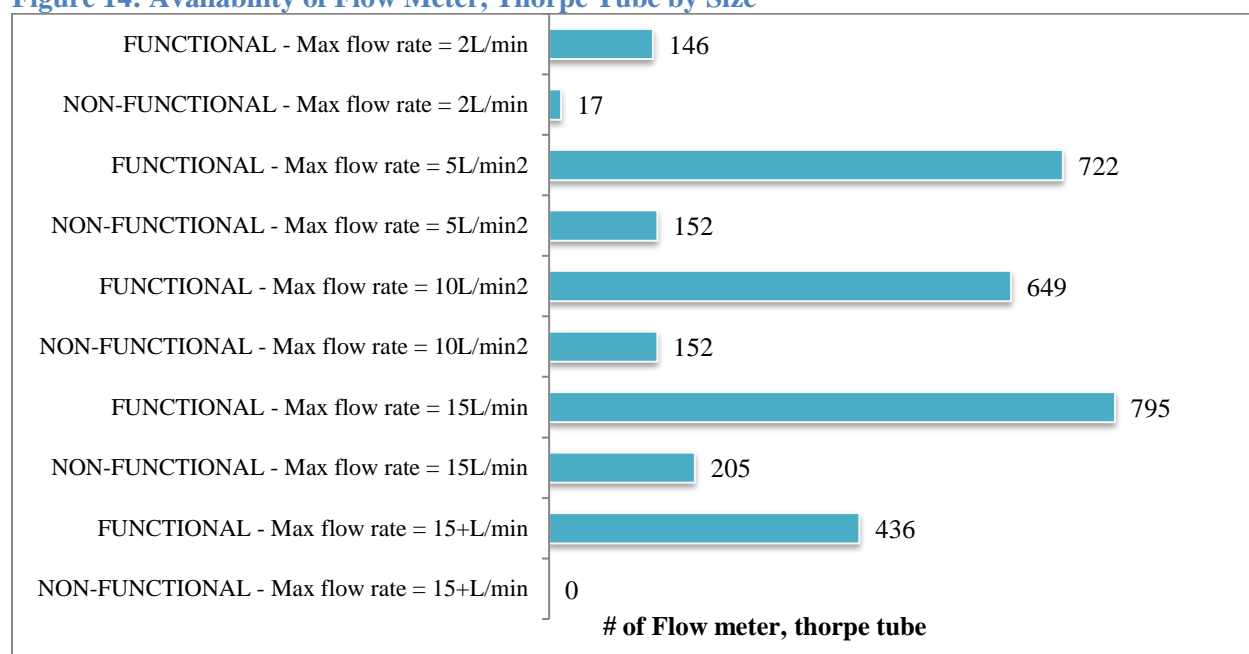


Figure 14: Availability of Flow Meter, Thorpe Tube by Size



10 Flow-splitter

Only in 8% of the facilities 130 oxygen flow-splitters are found during the assessment. Of which, 85% of flow-splitters are available in one facility (Adama Hospital Medical Collage) Table 5.

Table 5: Availability of Flow-splitters in the Facility

S/N	Region	Name of the facility	Number of Splitters
1	Oromia	Shambu	1
2	Oromia	Asela University Referral Hospital	5
3	Oromia	Holota Primary Hospital	1
4	Oromia	Adama Hospital Medical Collage	110
5	Addis Ababa	Zewditu Memorial Hospital	4
6	Tigray	Humera EOC	2
7	Tigray	Axum University EOC	7
Total			130

11 Oxygen Delivery Interface

11.1 Nasal Cannula/Prongs and Nasal catheters

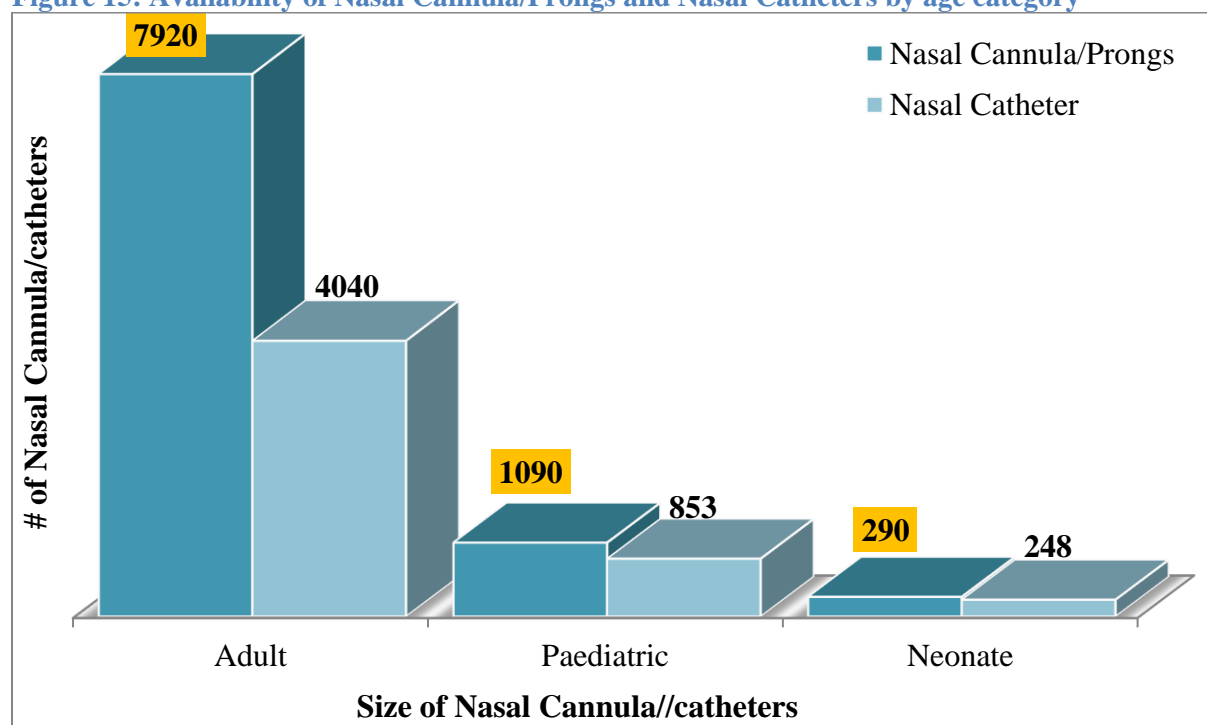
About 65% of the visited facilities do have nasal cannula (nasal prongs) at least one age category of nasal cannula/prongs (adult). A total of 9300 nasal cannula (nasal prongs) were available with the proportion of 85%, 12% and 3% for adult, pediatric and neonate age categories, respectively. But, limited number (25%)

of the visited facilities have nasal catheters at least one age category of nasal catheter (adult) with a total of 5141 nasal catheters in the proportion of 79%, 17% and 5% for adult, pediatric and neonate age categories, respectively Table 6 and Figure 15.

Table 6: Availability of Nasal Cannula/Prongs and catheters in the Facilities by Region

Region	Availability of Nasal Cannula			Availability of Nasal catheters		
	Adult	pediatric	Neonate	Adult	pediatric	Neonate
Addis Ababa	3	1	0	1	1	0
Afar	1	0	0	0	0	0
Amhara	10	1	1	2	1	1
B/Gumuz	1	0	0	0	0	0
Dire Dawa	2	0	0	0	0	0
Federal HLs	3	1	0	2	1	0
Gambella	1	1	1	1	1	1
Harari	0	0	0	0	0	0
Oromia	18	6	4	7	6	4
SNNPR	12	4	2	4	4	2
Somali	3	0	0	1	0	0
Tigray	3	1	0	3	1	0
Total	57	15	8	21	15	8
Percentage	69%	18%	10%	25%	18%	10%

Figure 15: Availability of Nasal Cannula/Prongs and Nasal Catheters by age category



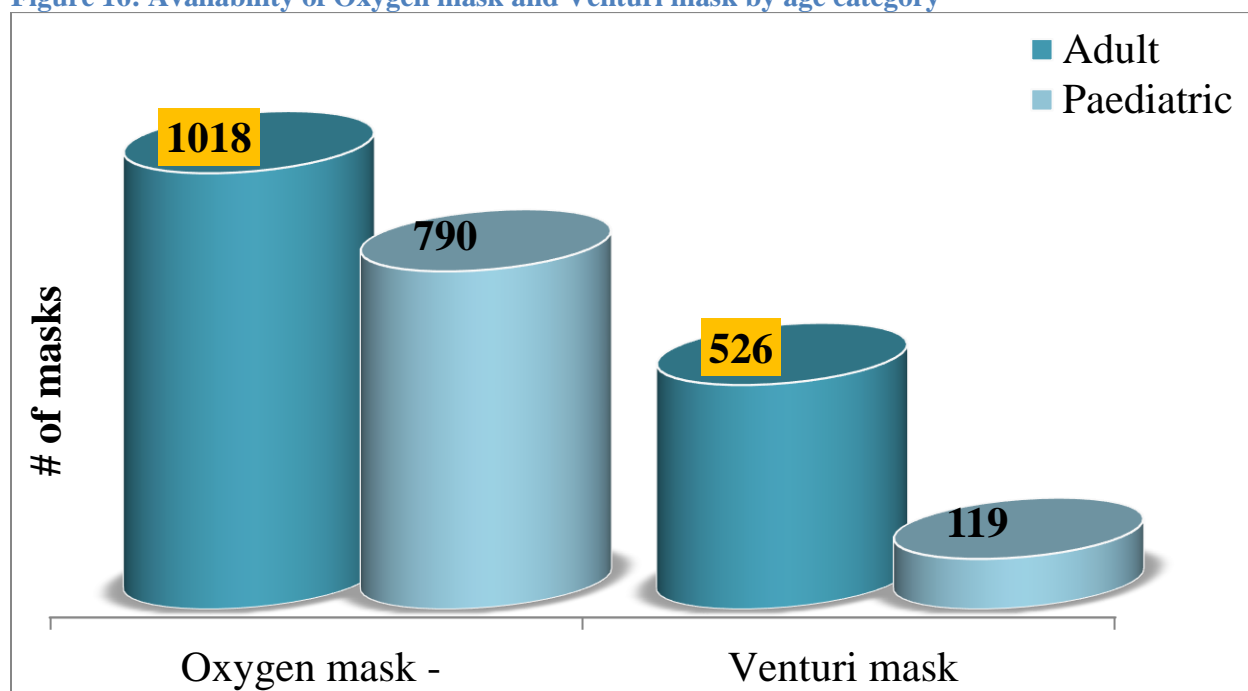
11.2 Oxygen mask and Venturi mask

Sixty percent of the facilities have at least one type of oxygen mask and/or Venturi mask on the time of the assessment. However, availability of Venturi masks is very low (about 5%) as presented on Table 7 and Figure 16.

Table 7: Availability of Oxygen mask and Venturi mask in the Facilities by Region

Region	Availability of Oxygen mask		Availability of Venturi mask	
	Adult	pediatric	Adult	pediatric
Addis Ababa	3	3	0	0
Afar	0	0	0	0
Amhara	6	2	0	0
B/Gumuz	0	0	0	0
Dire Dawa	1	1	0	0
Federal HLs	2	3	1	1
Gambella	1	0	0	0
Harari	2	0	0	0
Oromia	15	10	4	3
SNNPR	7	8	0	0
Somali	5	2	0	0
Tigray	3	1	0	0
Total	45	30	5	4
Percentage	54%	36%	6%	5%

Figure 16: Availability of Oxygen mask and Venturi mask by age category



12 BiPAP & CPAP Machines

A total of 204 (173- functional and 31-nonfunctional) BiPAP & CPAP Machines were found in 27 facilities, of which in 24(29%) of the facilities do have functional BiPAP & CPAP Machines as depicted on Figure 17 and Figure 18 below.

Figure 17: Availability of BiPAP & CPAP Machines by Functionality and Region

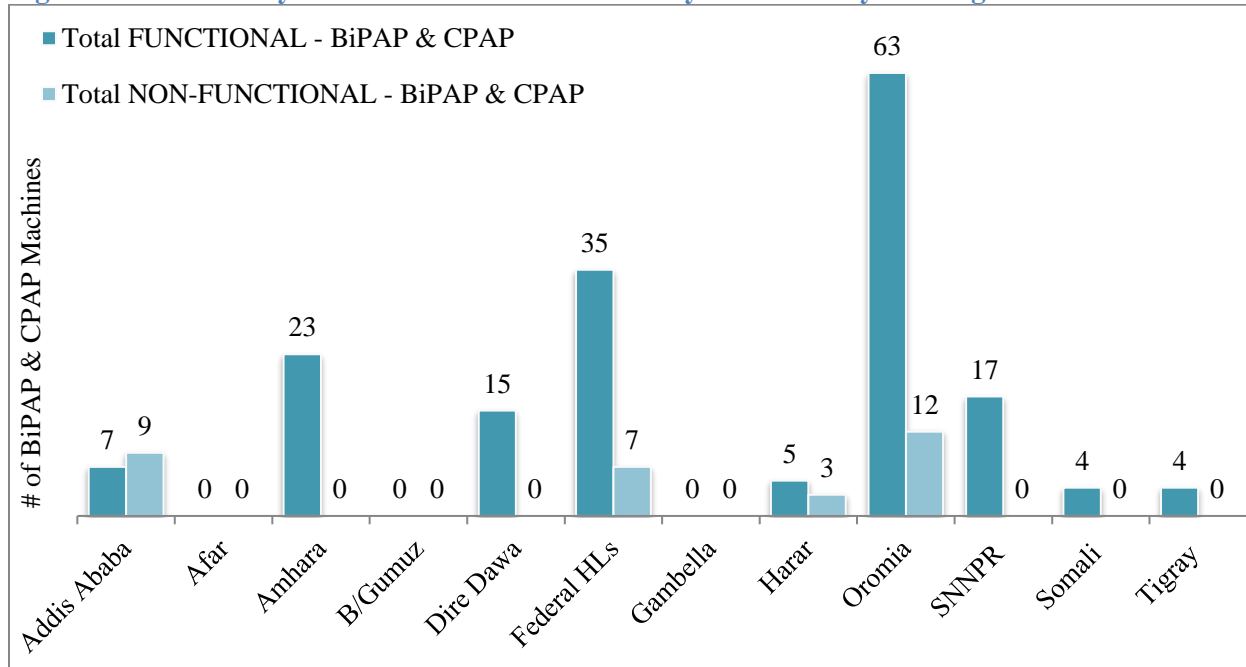
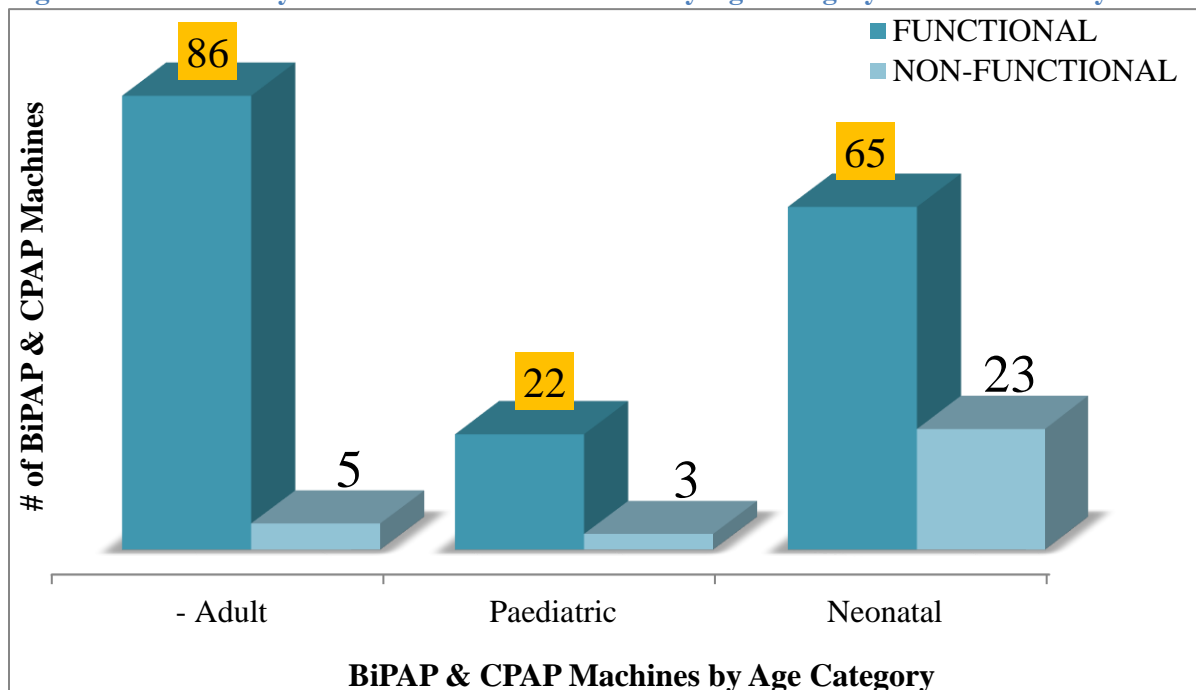


Figure 18: Availability of BiPAP & CPAP Machines by Age Category and Functionality



13 High-Flow Nasal Cannula (HFNC)

A total of 443 (280- adult and 163- pediatric) high-flow nasal cannula (HFNC) oxygen delivery interface were available in 10 facilities, which is 12% of the total reviewed facilities. Moreover, 99% of the HFNC were found only in Oromia Region. The remaining 1% was one device in Harari and one device in Tigray Regions.

14 Resuscitation Bags and Masks

A sum of 1584 resuscitation bags and masks were available in 51 (61%) of visited facilities in the proportion of 68%, 22% and 10% for adult, pediatrics and neonatal age categories respectively Table 8. Afar and B/Gumuz Regions do not have any resuscitation bags and masks in the visited facilities. Apart from that 28 facilities do not have any resuscitation bags and masks in some facilities of Amhara, Dire Dawa, Harari, Oromia, SNNP, Somali and Tigray Regions.

Table 8: Availability of Resuscitation Bags and Masks by Age Category and by Region

Region	Adult	Pediatrics	Neonatal	TOTAL
Addis Ababa	30	11	0	41
Afar	0	0	0	0
Amhara	50	19	24	93
B/Gumuz	0	0	0	0
Dire Dawa	8	3	3	14
Federal HLs	691	117	16	824
Gambella	2	1	0	3
Harari	2	5	10	17
Oromia	197	74	58	329
SNNPR	35	12	33	80
Somali	4	5	4	13
Tigray	64	101	5	170
Total	1083	348	153	1584
Percentage	68%	22%	10%	100%

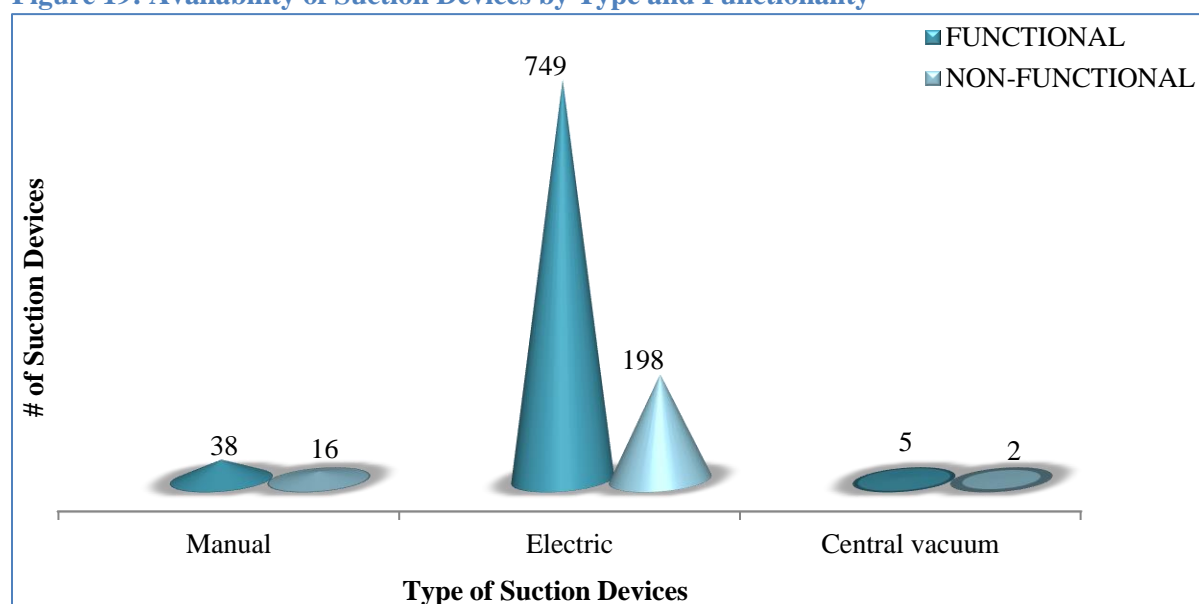
15 Suction Devices

About 82% of the facilities have functional suction devices on the time of visit. A total of 1008 suction devices were available in the facilities during the assessment, of which 79% were functional. In Afar, B/Gumuz, Dire Dawa, Gambella and Tigray Regions all suction devices were functional, on the other hand in Harari and SNNP Regions nearly 39% and 36% of suction devices were not functional Table 9 and Figure 19.

Table 9: Availability of Suction Devices by Region

Region	Total FUNCTIONAL -Suction Devices	Total NON-FUNCTIONAL - Suction Devices	TOTAL Suction Devices in the Facility
Addis Ababa	54	16	70
Afar	5	0	5
Amhara	83	12	95
B/Gumuz	6	0	6
Dire Dawa	13	0	13
Federal HLs	289	73	362
Gambella	2	0	2
Harari	11	7	18
Oromia	250	77	327
SNNPR	47	27	74
Somali	16	4	20
Tigray	16	0	16
Total	792	216	1008

Figure 19: Availability of Suction Devices by Type and Functionality



16 Laryngoscope

There were 433 laryngoscopes were available in 48 (58%) of visited facilities. Of which, 428 were Macintosh (Curved blade) while 54 of them were Miller (Straight blade) Laryngoscope Table 10. B/Gumuz and Gambella Regions do not have any type laryngoscope in the visited facilities. In addition to that 32 facilities in Amhara (7), Dire Dawa (1), Federal HLs (2), Oromia (7), SNNPR (8), Somali (5) and Tigray (2) facilities do not have any type of laryngoscope.

Table 10: Availability of Laryngoscope by Region

Region	Macintosh (Curved blade) Laryngoscope	Miller (Straight blade) Laryngoscope	Total-Laryngoscopes
Addis Ababa	57	2	57
Afar	3	0	3
Amhara	28	0	28
B/Gumuz	0	0	0
Dire Dawa	2	0	2
Federal HLs	91	9	91
Gambella	0	0	0
Harari	7	2	7
Oromia	206	40	211
SNNPR	19	1	19
Somali	3	0	3
Tigray	12	0	12
Total	428	54	433

17 Intubation Sets

There were 3875 intubation sets in the visited facilities, as summarized on Table 11 below. Except Gambella Region, all other regions have endotracheal tube and guide (stylet or bougie) in a total of 41 (49%) health facilities. On the other hand in Addis Ababa, Amhara, Oromia and SNNPR Regions 12 (14%) facilities do have Laryngeal mask. Lastly, only three facilities (2 in Amhara and 1 in Addis Ababa) have Colorimetric end-tidal CO₂ detector on the time of this assessment.

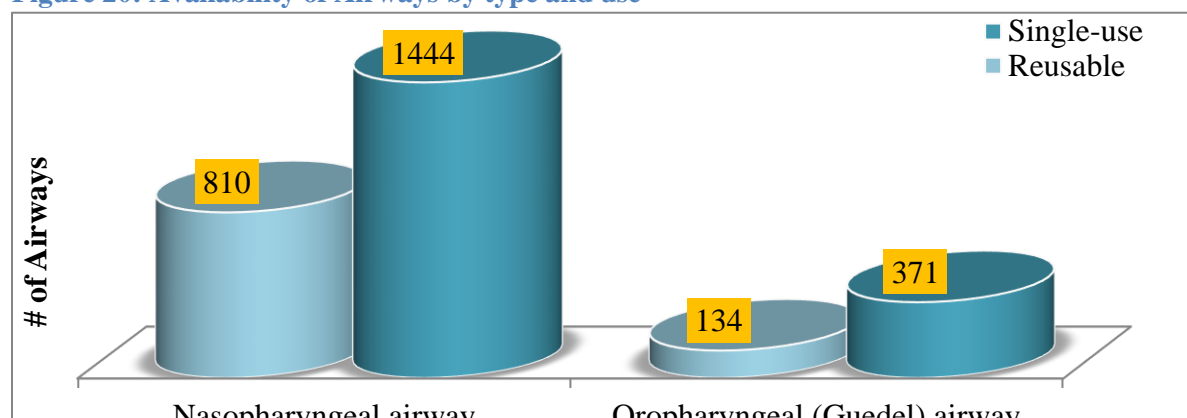
Table 11: Availability of Intubation Sets by Age Category and Component

Age Category	Endotracheal tube and guide (stylet or bougie)	Laryngeal mask	Colorimetric end-tidal CO ₂ detector
Adult	2540	385	24
Pediatric	834	87	5
Total	3374	472	29

18 Airways

A total of 2759 different types airways were available in 33 (40%) of the facilities that are found eight regions, namely Addis Ababa, Afar, Amhara, Dire Dawa, Oromia, SNNPR, Somali and Tigray Regions Figure 20.

Figure 20: Availability of Airways by type and use



19 Patient Ventilator

Out of visited 83 facilities, 50 (60%) of them have some type of patient ventilator, of which 48(58%) of them have functional ventilators. A total of 444 ventilators were identified with 74% of functionality in the visited facilities Table 12 and

Region	Total FUNCTIONAL - Patient ventilator	Total NON-FUNCTIONAL - Patient ventilator	TOTAL Patient ventilators in the facility	% of Functionality
Addis Ababa	23	9	32	72%
Afar	1	0	1	100%
Amhara	23	5	28	82%
B/Gumuz	1	0	1	100%
Dire Dawa	6	0	6	100%
Federal HLs	119	26	145	80%
Gambella	0	1	1	0%
Harari	6	1	7	86%
Oromia	109	69	178	61%
SNNPR	24	6	30	80%
Somali	2	0	2	100%
Tigray	13	0	13	100%
Total	327	117	444	73%
Percentage	74%	26%	100%	

Figure 21. Most of them were intensive care, adult ventilators, followed by transport/ portable and intensive care, pediatric ventilators in the proportion of 81%, 11% and 8% respectively. There were 31 COVID 19 treatment centers with no any means of patient ventilator. Most of them are out of health facility treatment centers, followed by health centers and primary hospitals Table 13. About 42% patient ventilators were found in tertiary hospitals; however, those referral hospitals account only 16% of the facilities visited while COVID-19/infectious diseases dedicated treatment centers account 37% of them.

Table 12: Number of Ventilators by Functionality and by Region

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Region	Total FUNCTIONAL - Patient ventilator	Total NON-FUNCTIONAL - Patient ventilator	TOTAL Patient ventilators in the facility	% of Functionality
Addis Ababa	23	9	32	72%
Afar	1	0	1	100%
Amhara	23	5	28	82%
B/Gumuz	1	0	1	100%
Dire Dawa	6	0	6	100%
Federal HLs	119	26	145	80%
Gambella	0	1	1	0%
Harari	6	1	7	86%
Oromia	109	69	178	61%
SNNPR	24	6	30	80%
Somali	2	0	2	100%
Tigray	13	0	13	100%
Total	327	117	444	73%
Percentage	74%	26%	100%	

Figure 21: Number of Ventilators by Functionality and Type of Ventilators

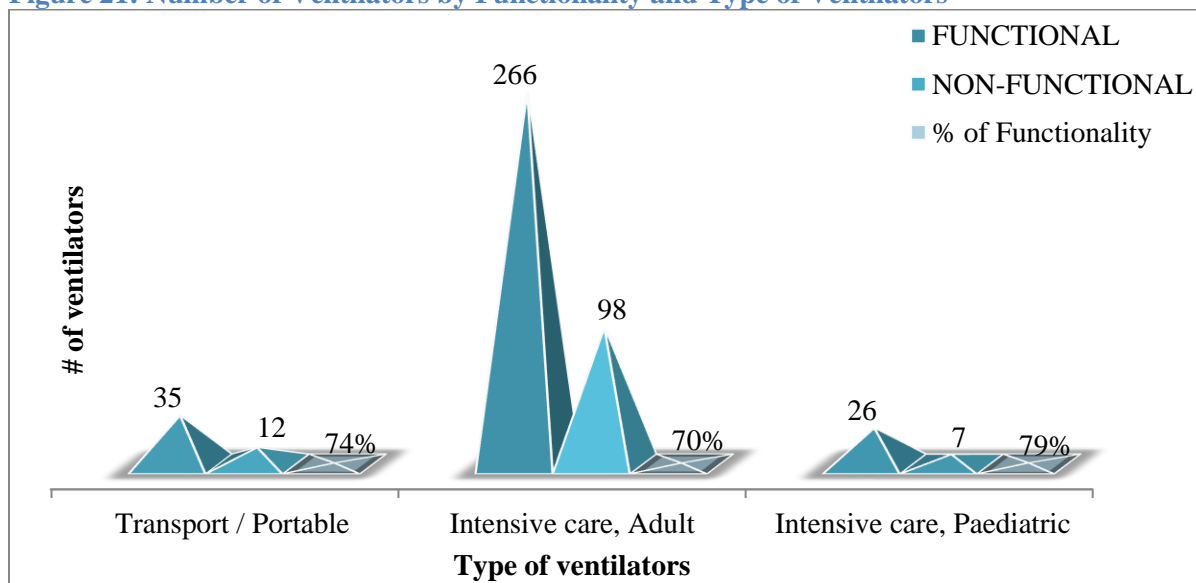


Table 13: COVID 19 Treatment Center with no COVID-19 dedicated Patient Ventilator by Region

Region	# of facilities	Name the facilities with no ventilator
Amhara	7	Waghimra Zone TC, South Gondar Zone TC, Kemissie HC, Kobo Primary Hospital, Metema Primary Hospital, West Gojam Zone TC, Borumeda Primary Hospital
B/Gumuz	2	Pawe Health Science College TC, Kamash Male Boarding School TC
Dire Dawa	1	Ferensay HC

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Harari	1	Yimaj General Hospital
Oromia	3	Sandafa HC, Burayu HC, Woliso Primary Hospital
SNNPR	9	Bonga HC, Ethio China TC, Dongicho TC, Sodo university Tarcha campus TC, Wachamo University Hospital, Wolkite University Hospital, Gamo Zone TC, Halaba zone TC, Jinka TC
Somali	5	Dulkebo HC, Kebridahar Primay Hospital, Dawelle HC, Moyale EOC, Dollo Ado EOC
Tigray	3	Humera EOC, Maichew University, Axum University Shirie Campus TC

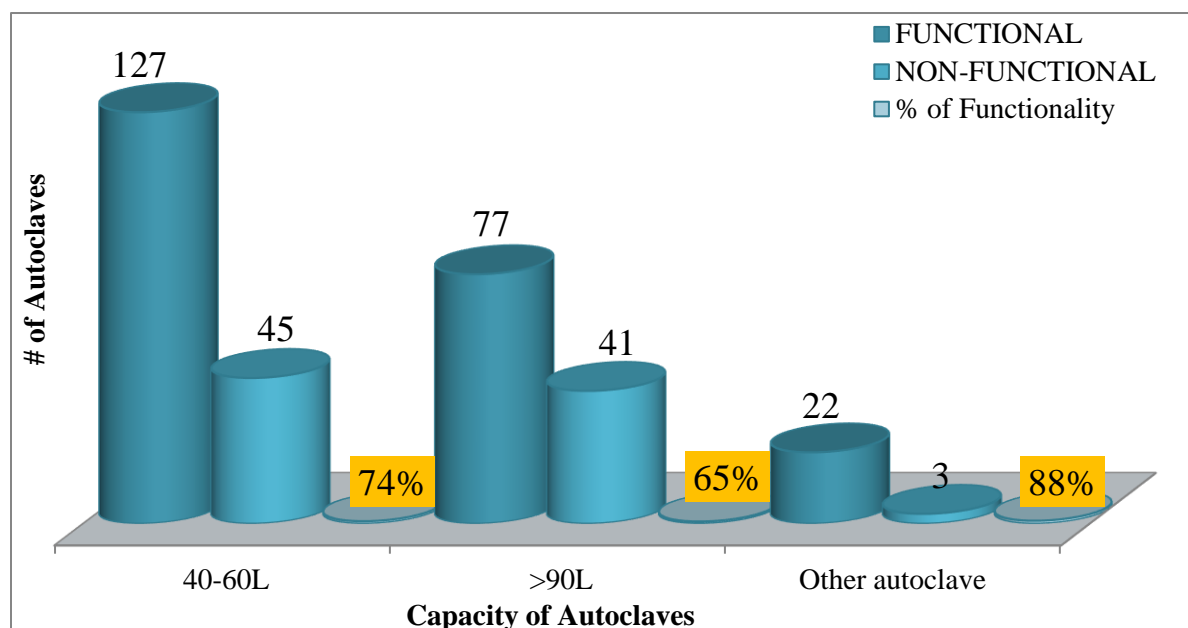
20 Autoclave / Sterilizer

About 64 (77%) of the facilities have some type autoclave/sterilizer during the visit. However, 19 facilities do not have any Table 14. A total of 315 autoclaves were found in those facilities, of which 226 (72%) were functional Figure 22.

Table 14: Number of Autoclaves by Region

Region	Total FUNCTIONAL - autoclave	Total NON-FUNCTIONAL - autoclave	% of Functionality
Addis Ababa	21	12	64%
Afar	2	0	100%
Amhara	16	10	62%
B/Gumuz	1	0	100%
Dire Dawa	4	3	57%
Federal HLs	23	11	68%
Gambella	0	0	
Harari	4	1	80%
Oromia	119	40	75%
SNNPR	24	9	73%
Somali	7	3	70%
Tigray	5	0	100%
Total	226	89	72%

Figure 22: Number of Autoclaves by Capacity



21 Oxygen Cylinder Manifold

A total of 13 manifold with 118 oxygen cylinder capacity were found in 8 (10%) of the facilities under four regions. Majority (84%) of the manifold were concentrated in Addis Ababa Table 15. The type and capacity of the manifolds were manual switch - two cylinder capacity = 17, manual switch - five cylinder capacity = 2, manual switch - eight cylinder capacity = 3 and automatic switch - eight cylinder capacity = 96 cylinders were available.

Table 15: Number of Oxygen Cylinder Manifolds by Facility and Region

REGION	NAME OF FACILITY	Total # of oxygen cylinder manifolds
Addis Ababa	Tirunesh Bejing General Hospital	1
	Yekatit 12 General Hospital	1
	Tikur Anbessa Specialized Hospital	1
	Millennium Covid-19 Care Centre	4
	St. Poul Hospital Millennium Medical College	2
Amhara	Enjibara General Hospital	1
Harari	Turkish Hospital	2
Oromia	Jimma University Medical Center	1
Total		13

22 On-Site Oxygen Plant (PSA)

There were four oxygen plants that two of them are currently functional while the other two were not working. The two nonfunctional hospitals are found in Oromia Region. The concentration of oxygen

produced from those functional plants was stated as between 93 and 96 Table 16. Except Jimma University Medical Center oxygen plant, all other plants were connected to a back-up source of electricity, such as a fuel generator. Similarly, those three plants have a surge suppressor for the oxygen plant. Although two of them are not functional, all of them have direct piping from the oxygen plant to other wards/departments within the facility.

Table 16: Summary On-Site Oxygen Plants

REGION	NAME OF FACILITY	FACILITY TYPE	CURRENTLY FUNCTIONAL	MAXIMUM PRODUCTION CAPACITY IN CUBIC METER PER HOUR.	% OF OXYGEN CONCENTRATION BEING PRODUCED BY THE PLANT
Oromia	Wollega University	Tertiary (Specialized/referral/university) Hospital	No	12	44
Oromia	Jimma University Medical Center	Tertiary (Specialized/referral/university) Hospital	No	100	98
Federal HLs	St. Paul Hospital millennium Medical College	Tertiary (Specialized/referral/university) Hospital	Yes	100	93
Amhara	Enjibara Hospital	Secondary (General) Hospital	Yes	12	96

23 Reasons for availability of Nonfunctional Equipments/Devices

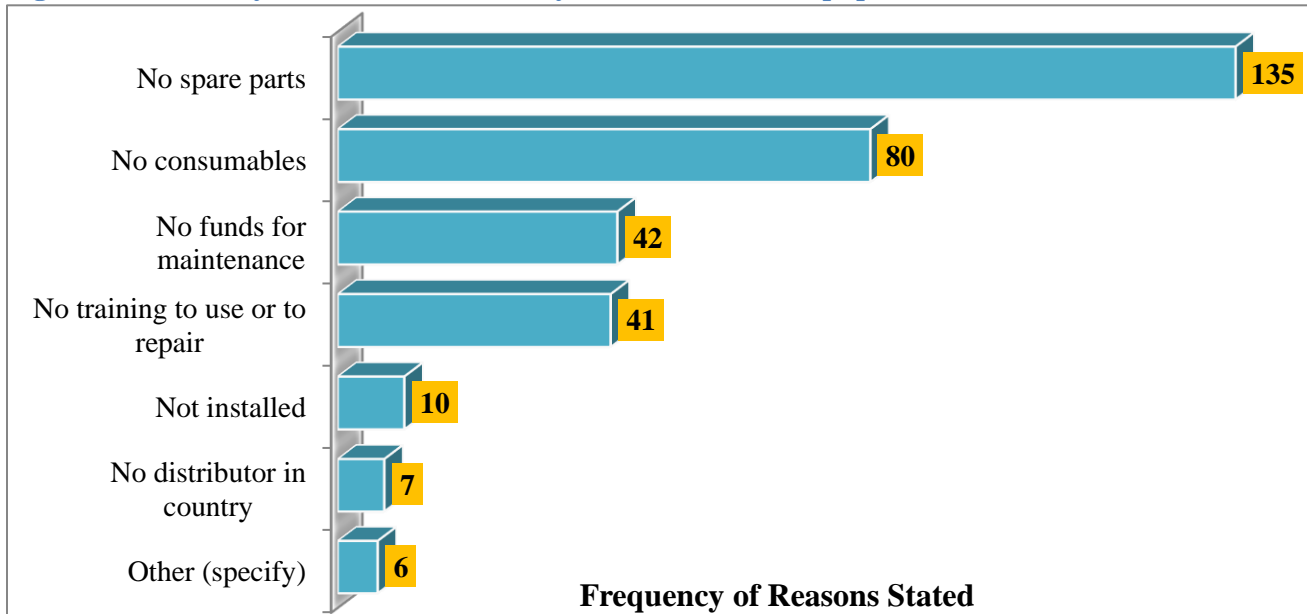
For nonfunctional biomedical equipments and devices that are available in the facility, participants indicated several reasons that hamper to make them functional. The most popular reason that is stated for several nonfunctional devices and by number of facilities is that absence of spare parts followed by lack of consumables like cables, cables, sensors etc. are among others. Unpredictably, some facilities also replied the equipments were not installed yet, even though they reached the facility Table 17 and Figure 23.

Table 17: Reasons indicated for availability of Nonfunctional Equipments in the facility

Equipment Type	Reasons for Nonfunctioning of Equipments						
	No spare parts	No consumables	No funds for maintenance	No training to use or to repair	Not installed	No distributor in country	Other (specify)
Patient Monitors	28	18	6	10	1	2	0
Pulse Oximeters	20	18	6	4	1	1	1
Oxygen Concentrators	33	15	12	9	2	2	0

Suction Devices	35	18	11	9	2	1	3
Patient Ventilator	19	11	7	9	4	1	2
Total	135	80	42	41	10	7	6

Figure 23: Summary Reasons for availability of Nonfunctional Equipments



24 Conclusion and Recommendation

24.1 Conclusion

- Essential COVID 19 related biomedical equipments like patients monitors and pulse oximeters are available in COVID dedicated treatment centers including oxygen concentrators; however, the Millennium COVID-19 Treatment Center took the lion share of all medical equipments disproportionately among COVID-19 dedicated treatment centers
- On the other hand tertiary hospitals have large number of high priced medical equipments like patient ventilators, even including oxygen cylinders disproportionately
- Nearly 40% of all biomedical equipments for COVID-19 case management are concentrated in Addis Ababa either in the Federal Hospitals or Millennium COVID-19 Treatment Center

- Particularly in emerging and pastoralist regions there are COVID-19 Treatment Center without any means of oxygen supply systems that there is neither adequate oxygen cylinder nor oxygen concentrator
- Major reason for nonfunctioning of medical equipment absence spare parts followed by consumables

24.2 Recommendation

- Equip all COVID 19 treatment centers with essential biomedical equipments reasonably. If not it will be better to close those deteriorated center
- Close follow up and intensive technical support is vital to remote and hard to reach COVID 19 treatment centers to fill the gap and take immediate action
-

Annexes

Annex 1: List of COVID 19 Treatment Facilities Visited for the Assessment

S/N.	REGION	ZONE OR SUB CITY	NAME OF FACILITY	FACILITY TYPE
1	Addis Ababa	Akaki Kality	Tirunesh Bejing	General Hospital
2	Addis Ababa	Arada	Yekatit 12	General Hospital
3	Addis Ababa	kirkos	Zewditu Memorial	General Hospital
4	Afar	Zone 1	Logia	COVID-19 treatment center
5	Amhara	Awie	Enjibara	General Hospital
6	Amhara	Bahirdar	Mekod	COVID-19 treatment center
7	Amhara	East Gojam	East Gojam zone	COVID-19 treatment center
8	Amhara	North Gondar	Gondar	Referral Hospital
9	Amhara	North shewa	Tebasie	Health Center
10	Amhara	North wollo	Kobo	Primary Hospital
11	Amhara	Oromia	Kemissie	Health Center
12	Amhara	South Gondar	South Gondar zone	COVID-19 treatment center
13	Amhara	South wollo	Borumeda	Primary Hospital
14	Amhara	Waghimra	Waghimra zone	COVID-19 treatment center
15	Amhara	West Gojam	West Gojam zone	COVID-19 treatment center

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S/N.	REGION	ZONE OR SUB CITY	NAME OF FACILITY	FACILITY TYPE
16	Amhara	West Gondar	Metema	Primary Hospital
17	B/Gumuz	Asosa	Selgelu	Health Center
18	B/Gumuz	Kamash	Kamash Male Boarding School	COVID-19 treatment center
19	B/Gumuz	Metekel	Pawe Health Science College	COVID-19 treatment center
20	Dire Dawa	Dire Dawa	Ferensay	Health Center
21	Dire Dawa	Dire Dawa	Sabyan	Primary Hospital
22	Federal	Bole	Millennium	COVID-19 treatment center
23	Federal	Gulele	St. Peter	COVID-19 treatment center
24	Federal	Gulele	St. Poul	Referral Hospital
25	Federal	Kolfe Keranio	Alert	Referral Hospital
26	Federal	Lideta	Tikur Anbessa	Referral Hospital
27	Federal	Yeka	EKA Kotebe	General Hospital
28	Gambella	Gambella	Gambella University	COVID-19 treatment center
29	Harari	Hakim	Turkish	COVID-19 treatment center
30	Harari	Jinela	Hiwot Fana	Referral Hospital
31	Harari	Jinela	Yimaj	General Hospital
32	Oromia	Arsi	Asela University	Referral Hospital
33	Oromia	Arsi	Bokoji	Primary Hospital
34	Oromia	Bale	Bale Robe	General Hospital
35	Oromia	Borana	Moyale	Primary Hospital
36	Oromia	East Guji	Bore	Primary Hospital
37	Oromia	East Harerge	Haromaya	General Hospital
38	Oromia	East Shoa	Adama	Referral Hospital
39	Oromia	East Shoa	Kurkura	Health Center
40	Oromia	East Shoa	Modjo	Health Center
41	Oromia	East wollega	Wollega University	Referral Hospital
42	Oromia	Horo Guduru	Shambu	General Hospital
43	Oromia	Iluababora	Metu karl	Referral Hospital
44	Oromia	Jima	Shanan Gibe	General Hospital
45	Oromia	Jimma	Jimma University	Referral Hospital
46	Oromia	Kelem Wollega	Hawagalan	Primary Hospital
47	Oromia	North Shoa	Muka turi	Health Center
48	Oromia	South west Shoa	Woliso	General Hospital
49	Oromia	Special zone around Finfinne	Burayu	Health Center
50	Oromia	Special zone around Finfinne	Holota	Primary Hospital
51	Oromia	Special zone around Finfinne	Sandafa	Primary Hospital

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S/N.	REGION	ZONE OR SUB CITY	NAME OF FACILITY	FACILITY TYPE
52	Oromia	West Arsi	Negele Arsi	Primary Hospital
53	Oromia	West Guji	Bule Hora	General Hospital
54	Oromia	West Harerge	Hirna	Primary Hospital
55	Oromia	West Shoa	Guder	Primary Hospital
56	Oromia	West Wollega	Gimbi	General Hospital
57	SNNPR	Bench Sheko	Mizan Tepi	General Hospital
58	SNNPR	Dawro	Sodo University Tarcha campus	COVID-19 treatment center
59	SNNPR	Gamo	Gamo zone	COVID-19 treatment center
60	SNNPR	Gedeo	Nahom pension	COVID-19 treatment center
61	SNNPR	Gofa	Sawla Catholic church	COVID-19 treatment center
62	SNNPR	Guragie	Wolkite university	Referral Hospital
63	SNNPR	Hadiya	Wachamo university	Referral Hospital
64	SNNPR	Halaba	Halaba zone	COVID-19 treatment center
65	SNNPR	Hawassa city	South spring	COVID-19 treatment center
66	SNNPR	Kafa zone	Bonga	COVID-19 treatment center
67	SNNPR	Kambata Tembaro	Dongicho	COVID-19 treatment center
68	SNNPR	Sidama	Yirgalem	COVID-19 treatment center
69	SNNPR	Silte	Ethio China	COVID-19 treatment center
70	SNNPR	South Omo	Jinka	COVID-19 treatment center
71	SNNPR	Wolaita	Wolaita Sodo university	Referral Hospital
72	Somali	Dollo	Dollo Ado	COVID-19 treatment center
73	Somali	Fafen	Dulkebo	Health Center
74	Somali	Fafen	Karamara	General Hospital
75	Somali	Liben	Moyale	COVID-19 treatment center
76	Somali	Qorahay	Kebridahar	Primary Hospital
77	Somali	Shinille	Dawelle	Health Center
78	Tigray	Central	Axum University	COVID-19 treatment center
79	Tigray	Eastern	Adigrat University	COVID-19 treatment center
80	Tigray	Mekele	Queha	COVID-19 treatment center
81	Tigray	North West	Axum U/Shirie Campus	COVID-19 treatment center
82	Tigray	Southern	Maichew University	COVID-19 treatment center
83	Tigray	Western	Humera	COVID-19 treatment center

Annex 2: Raw data of the Inventory Assessment of Biomedical Equipment for COVID-19 Case Management in Ethiopia

Attached on separate excel sheet with the file name “COVID-19 biomed equipment row data facility specific”