

Biomedical Equipment for COVID-19 Case Management

Interim guidance

Inventory tool for facility readiness and equipment re-allocation

07 April 2020



Introduction

Oxygen is an essential medicine for COVID-19, it is therefore very important to assess availability of different sources of oxygen, as well as the delivery and supply systems to the patient, in order to prioritize, reallocate and compare with calculated numbers to define the needs. As of April 4, 2020, global supply-chain issues remain extremely disrupted as a result of the COVID-19 pandemic. It is strongly recommended that Ministries of Health leverage existing supplies and resources, where possible, in order to enable an immediate response.

This is the first edition of guidance on conducting a rapid inventory assessment to determine readiness of a health facility, as well as capacity to re-allocate biomedical equipment, for COVID-19 case management. This tool will comprise a survey (paper or digital) along with a set of product/device showcards. This tool is to be used in-line with WHO's emergency disease commodities package (DCP) for COVID-19 [1], the WHO Priority List of medical devices for COVID, as well as Technical specifications for oxygen delivery systems[2], Resuscitation devices [3] and Oxygen concentrators[4]. This tool is intended for health facility administrators, clinical decision-makers, procurement officers, planning officers, biomedical engineers, or infrastructure engineers to identify readily available biomedical equipment for immediate use and/or re-allocation.

Please note that WHO will update these recommendations as new evidence and information becomes available.

Instructions

The tool has been developed to facilitate a rapid assessment of facility readiness and existing device availability to accelerate decision making with response-plan roll-out. It will be available for use in both digital and paper format at this time.

1. Paper format

A word document follows this introduction sheet, which requires customization of a few fields prior to printing and completing by hand. An excel file is to be used as part of this package to help support with data "roll-up" or help to aggregate findings from paper surveys after data entry. Another component of carrying out this survey are "showcards", which are images to help data collectors by facilitating correct identification of equipment under assessment that is appropriate for use for COVID-19 case management.

2. SurveyCTO

An electronic data collection software is also available for use on smartphone and tablet (Android or iOS) using an application ("app"). Data is captured digitally, even when offline, and then pushed to a central server when networks become available. As data is already digitized, it can be immediately analysed and reported using any data collection software (e.g. Excel, SPSS, Stata, R, etc.).

Consideration should be given to starting data collection at all higher-level facilities pre-identified for COVID-19 case management, and cascade to lower level facilities where in-patient services are rendered and there is known presence of medical equipment. Inventories should be conducted regardless of whether or not patients are currently being treated for COVID-19.

Information capture, as well as approach for collection, should be the same regardless of format by which inventory is taken. What is most important is that the format used is the most appropriate given the context and what can be most easily used by local response teams. Data collectors using the surveys can be assisted by a set of show-cards, part of this package, to best support the correct identification of equipment being assessed.

Acknowledgements

The inventory tool survey has been adapted from baseline survey tools developed and used by multiple partners across various countries globally. This package was developed in consultation with the WHO Operations Support and Logistics Unit, and WHO Medical Devices and In Vitro Diagnostics Technical Unit. WHO thanks those who have been involved in its adaptation to support the current COVID-19 response. For any technical support, please contact: COVID-MED-DEVICES@WHO.INT

References

1. World Health Organisation, *Disease commodity package - Novel Coronavirus (COVID-19)*. 2020.
2. World Health Organization - UNICEF, *Technical specifications and guidance for oxygen therapy devices*. 2019: p. 164.
3. World Health Organisation, *WHO Technical Specifications of Neonatal Resuscitation Devices*. 2016.
4. World Health Organization, *Technical specifications for oxygen concentrators*. 2015.

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WHO continues to monitor the situation closely for any changes that may affect this interim guidance. Should any factors change, WHO will issue a further update. Otherwise, this interim guidance document will expire 2 years after the date of publication.

INSTRUCTIONS TO DOWNLOAD AND CONFIGURE SURVEYCTO APP ON SMARTPHONE OR TABLET (ANDROID OR IOS)

Go to your AppStore or Google Play Store and download the SurveyCTO Collect app. Once installed, open the app, click on the options button at the top-right corner (3 vertical dots), click on General Settings, and enter the following:

Server Name: o2therapy

Username: *as provided by your WHO Country Office*

Password: *as provided by your WHO Country Office*

Click on Back to return to the Main Menu. Click on Get Blank Form, select WHO COVID Oxygen Therapy SurveyCTO, and click Get selected. You should be taken back to the Main Menu once the download is complete. Click on Fill Blank Form and select WHO COVID Oxygen Therapy SurveyCTO.

Technical support will be available through: COVID-MED-DEVICES@WHO.INT

SECTION I: FACILITY IDENTIFICATION	
QUESTION	RESPONSE
Country	
Province/region name	
Province/region code	
District/county name	
District/county code	
Town/city	
Facility address	
Facility name	
Facility code	
Type of geographical area	<input type="checkbox"/> Urban <input type="checkbox"/> Peri-urban <input type="checkbox"/> Rural
Facility type	<input type="checkbox"/> Primary (health post, health centre) <input type="checkbox"/> Secondary (referral hospital) <input type="checkbox"/> Tertiary (general/university hospital) <input type="checkbox"/> Specialized Hospital <input type="checkbox"/> COVID-19/infectious diseases dedicated treatment center <input type="checkbox"/> Other, specify below (e.g. mobile unit, outreach) -----
Managing authority	<input type="checkbox"/> Government, public <input type="checkbox"/> Government, non-public (e.g. military etc.) <input type="checkbox"/> Private, for-profit <input type="checkbox"/> Private, NGO/religious <input type="checkbox"/> Other, specify below -----
Name of head of facility	
Phone number of head of facility	
Email address of head of facility	
Name of data collector	
Phone number of data collector	

SECTION II: FACILITY READINESS CHARACTERISTICS FOR OXYGEN SUPPLY SYSTEMS

QUESTION	RESPONSE CODE																				
What is the total bed capacity in this facility?																					
Of the total beds, how many can be used for intensive care?																					
Does the facility have access to running water?	<input type="checkbox"/> Yes <input type="checkbox"/> No																				
Does the facility have a wall pipe network of medical gases?	<input type="checkbox"/> Yes, Oxygen, Air and Vacuum <input type="checkbox"/> Yes, Oxygen and Air <input type="checkbox"/> Yes, Oxygen <input type="checkbox"/> No																				
What is the source of electricity for this facility?	<input type="checkbox"/> Central electricity grid <input type="checkbox"/> Power generator <input type="checkbox"/> Both <input type="checkbox"/> Other (specify)_____																				
If 'Power generator' or 'Both' selected above: How many generators are available at the facility?																					
If electrical generator(s) at the facility, please complete the following details for those functional	<table border="1"> <thead> <tr> <th>Generator capacity (kVa)</th> <th>Stabilizer (Y/N)</th> <th>UPS (Indicate Capacity)</th> <th>Inverter (Y/N)</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Generator capacity (kVa)	Stabilizer (Y/N)	UPS (Indicate Capacity)	Inverter (Y/N)																
	Generator capacity (kVa)	Stabilizer (Y/N)	UPS (Indicate Capacity)	Inverter (Y/N)																	
Please list all wards that have dependable voltage stabilization; double conversion uninterruptible power supply	<input type="checkbox"/> Emergency room <input type="checkbox"/> Intensive care <input type="checkbox"/> Surgery <input type="checkbox"/> Hospitalization <input type="checkbox"/> Laboratory <input type="checkbox"/> Imaging <input type="checkbox"/> Other (specify)_____																				
Does Facility have any emergency transport vehicles or ambulances?	<input type="checkbox"/> Yes, with oxygen → If yes, how many? ____ <input type="checkbox"/> Yes, but without oxygen → If yes, how many? ____ <input type="checkbox"/> No																				
Is there a staff at your facility dedicated to the management, installation, and maintenance of medical equipment?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, what is their job title: Title_____ Number_____																				
Is there a clinical staff at your facility that has experience in invasive mechanical ventilation / intubation	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, what is their job title: Title_____ Number_____																				

SECTION IIIa: VITAL SIGN MONITORING DEVICES**Instructions:** Count the number of patient vital sign monitoring devices at the facility by functionality and type.

Type	Number Functional	Number Non-functional
Patient monitor with integrated ECG		

Patient monitor without integrated ECG		
If non-functional for any type is >0, please indicate the reason(s) the devices are non-functional.	<input type="checkbox"/> No spare parts <input type="checkbox"/> No funds for maintenance <input type="checkbox"/> No training to use or to repair <input type="checkbox"/> No consumables (cables, sensors) <input type="checkbox"/> Not installed <input type="checkbox"/> No distributor in country <input type="checkbox"/> Other (specify)_____	

SECTION IIIb: PULSE OXIMETERS

Instructions: Count the number of pulse oximeters at the facility by functionality and type.

TYPE	NUMBER FUNCTIONAL	NUMBER NON-FUNCTIONAL
Table-top pulse oximeter		
Portable handheld pulse oximeter		
Self-contained fingertip pulse oximeter		
If non-functional for any type is >0, please indicate the reason(s) the devices are non-functional.	<input type="checkbox"/> No spare parts <input type="checkbox"/> No funds for maintenance <input type="checkbox"/> No training to use or to repair <input type="checkbox"/> No consumables (cables, sensors) <input type="checkbox"/> Not installed <input type="checkbox"/> No distributor in country <input type="checkbox"/> Other (specify)_____	

SECTION IV: OXYGEN CONCENTRATORS

Instructions: For each concentrator maximum capacity, count the number of functioning and non-functioning concentrators at the facility. If you have an analyser, test the purity of the output after running device for >5 minutes. When counting functional concentrators, output must be equal to or greater than 82%.

Maximum flow rate capacity	Number Functional	Number Non-functional
Up to 3L/min		
Up to 5L/min		
Up to 8L/min		
Up to 10L/min		
Greater than 10L/min		
If non-functional for any type is >0, please indicate the reason(s) the devices are non-functional.	<input type="checkbox"/> No spare parts <input type="checkbox"/> No funds for maintenance <input type="checkbox"/> No training to use or to repair <input type="checkbox"/> No consumables (cables, sensors) <input type="checkbox"/> Not installed <input type="checkbox"/> No distributor in country <input type="checkbox"/> Other (specify)_____	

SECTION V: OXYGEN CYLINDERS

Instructions: For each cylinder size and connection type, count the number of cylinders available at the facility.

Cylinder size	Pin-index	Bull-nose
“D” (340L)		
“E” (680L)		
“F” (1360L)		
“G” (3400L)		
“J” (6800L)		
What is the average number of oxygen cylinders consumed per week?	Total _____	
What is the total cost of cylinders/week?		

SECTION VI: CYLINDER ASSEMBLY UNITS

Instructions: Count the number of cylinder assembly units at the facility by functionality and connection type. A cylinder assembly unit is a pressure regulator and gauge.

Functional/Non-functional	Pin-index	Bull-nose
Functional		
Non-functional		

SECTION VII: FLOWMETER, THORPE TUBE

Instructions: Count the number of flowmeters at the facility by maximum flow rate and functionality.

Maximum flow rate capacity	Number Functional	Number Non-functional
Up to 2L/min		
Up to 5L/min		
Up to 10L/min		
Up to 15L/min		
Greater than 15L/min		

SECTION VIII: FLOW-SPLITTER

Instructions: Count the number of functional flow-splitters at the facility by number of outlets, maximum flow rate, and functionality.

		Up to 1L/min	Up to 2L/min
Total number of outlets	2		
	3		
	4		

	5		
Other (specify):			

SECTION IX: OXYGEN DELIVERY INTERFACE

Instructions: Count the number of type of oxygen delivery interface, by age category, available at the facility.

Type	Adult	Paediatric	Neonate
Nasal cannula (nasal prongs)			
Nasal catheters			
Oxygen mask			
Venturi mask			

SECTION X: BiPAP & CPAP MACHINES

Instructions: Count the number of BiPAP machines at the facility by size and functionality.

Size	Number Functional	Number Non-functional
Adult		
Paediatric		
Neonatal		

SECTION XI: HIGH-FLOW NASAL CANNULA (HFNC)

Instructions: Count the number of type of high-flow nasal cannula (HFNC) oxygen delivery interface, by age category, available at the facility.

Size	Total number at facility
Adult	
Paediatric	

SECTION XII: RESUSCITATION BAGS AND MASKS

Instructions: Count the number of complete resuscitation bag and mask units at the facility by size.

Size	Total number of complete units at facility
Adult	
Paediatric	
Neonatal	

SECTION XIII: SUCTION DEVICES

Instructions: Count the number of complete suction devices at the facility by type.

Size	Number Functional	Number Non-functional
Manual		
Electric		
Central vacuum		
If non-functional for any type is >0, please indicate the reason(s) the devices are non-functional.	<input type="checkbox"/> No spare parts <input type="checkbox"/> No funds for maintenance <input type="checkbox"/> No training to use or to repair <input type="checkbox"/> No consumables (cables, sensors) <input type="checkbox"/> Not installed <input type="checkbox"/> No distributor in country <input type="checkbox"/> Other (specify) _____	

SECTION XIV: LARYNGOSCOPE**Instructions:** Count the number of laryngoscopes at the facility (regardless of type).

Type	Total number at facility
Macintosh (Curved blade)	
Miller (Straight blade)	

SECTION XIIV: INTUBATION SETS**Instructions:** Count the number of components of intubation sets at the facility by type.

Component	Adult	Paediatric
Endotracheal tube set: Tube Guide (“Stylet”, or “Bougie”)		
Laryngeal mask:		
Colorimetric end tidal CO ₂ detector		

SECTION XVI: AIRWAYS

Component	Single-use	Reusable
Oropharyngeal (Guedel) airway		
Nasopharyngeal airway		

SECTION XVII: PATIENT VENTILATOR**Instructions:** Count the number of functional patient ventilators at the facility by type.

Type	Number Functional	Number Non-functional
Transport, portable		
Intensive care – Adult		
Intensive care – Paediatric		

If non-functional for any type is >0, please indicate the reason(s) the devices are non-functional.	<input type="checkbox"/> No spare parts <input type="checkbox"/> No funds for maintenance <input type="checkbox"/> No training to use or to repair <input type="checkbox"/> No consumables (cables, sensors) <input type="checkbox"/> Not installed <input type="checkbox"/> No distributor in country <input type="checkbox"/> Other (specify) _____
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SECTION XVIII: AUTOCLAVE / STERILIZER**Instructions:** Count the number of autoclave and sterilizer equipment at the facility.

Capacity	Number functional	Number non-functional
40-60 L		
> 90 L		
Other (specify capacity and type if needed (e.g. Ethylene Oxide)):		

SECTION XIX: OXYGEN TERMINAL BEDSIDE WALL UNITS**Instructions:** Count the number of oxygen terminal bedside wall units at the facility in all wards/departments whose pressure is between 345 – 425 kPa (50-60 psi).

Ward/Department	Total number in the ward/department	Number per bed	Fitted with a valve and a pressure and flow regulator
Emergency Room		<input type="checkbox"/> 1 per bed <input type="checkbox"/> 2 per bed	<input type="checkbox"/> Yes <input type="checkbox"/> No
Intensive Care Unit (ICU)		<input type="checkbox"/> 1 per bed <input type="checkbox"/> 2 per bed	<input type="checkbox"/> Yes <input type="checkbox"/> No
Inpatient Department		<input type="checkbox"/> 1 per bed <input type="checkbox"/> 2 per bed	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is there any other units with oxygen wall outlets? (Do not count terminal units in operating theatres (OT) or X-ray/imaging department.)	<input type="checkbox"/> Yes → Specify name of other unit: _____ <input type="checkbox"/> No		
Other unit		<input type="checkbox"/> 1 per bed <input type="checkbox"/> 2 per bed	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are there bedside oxygen wall units with other pressures other than 345-425 kPa (50-60 psi)	<input type="checkbox"/> Yes → <input type="checkbox"/> No	<u>Pressure</u> _____ kPa or psi (circle one)	<u>Total number</u> _____ <input type="checkbox"/> 1 per bed <input type="checkbox"/> 2 per bed

SECTION XX: OXYGEN CYLINDER MANIFOLD

Instructions: Count the number of oxygen cylinder manifolds at the facility by size (e.g. number of cylinders that it can fit) and switching mechanism (e.g. manual or automatic).

Number of cylinders that can fit in the manifold	Manual switch	Automatic switch
2		
3		
4		
5		
6		
7		
8		

SECTION XXI: BULK LIQUID OXYGEN TANK

QUESTION	RESPONSE
Does the facility have a bulk liquid oxygen tank?	<input type="checkbox"/> Yes <input type="checkbox"/> No
What is the tank capacity in M ³ . if other unit, please indicate.	
What is the refill frequency	<input type="checkbox"/> Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Other (Specify: _____)
how much, price per m3?	

SECTION XXII: ON-SITE OXYGEN PLANT (PSA)

QUESTION	RESPONSE CODE
Does this facility have a pressure swing absorption (PSA) oxygen plant?	<input type="checkbox"/> Yes <input type="checkbox"/> No
What is the manufacturer and model of the plant?	
What is the maximum production capacity of this plant? Change units if not familiar	<input type="checkbox"/> ___ ___ ___ m3/hr <input type="checkbox"/> Other (specify): _____
What is the average oxygen consumption per month? Change units if not familiar	<input type="checkbox"/> ___ ___ ___ m3/month <input type="checkbox"/> Other (specify): _____
Is the oxygen plant functional and operational?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is the oxygen plant operating for 24 hours a day?	<input type="checkbox"/> Yes <input type="checkbox"/> No

What is the percent concentration of oxygen being produced by the plant?	Percent concentration..... ____ ____ . ____%		
Is the oxygen plant connected to a back-up source of electricity, such as a fuel generator?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Is the back-up source of electricity dedicated to the oxygen plant?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Is there a surge suppressor for the oxygen plant?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Is there a voltage stabilizer for the oxygen plant?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Does the oxygen plant have a filling ramp or manifold for filling cylinders?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
How many cylinder connections of the following type are on the ramp/manifold?		Quantity	
	<input type="checkbox"/> Bullnose		
	<input type="checkbox"/> Pin-index		
To what pressure do you fill the cylinders? <i>Only fill in unit of use</i>	Bar ____ ____ ____ <i>or</i> kPa ____ ____ ____ <i>or</i> psi ____ ____ ____		
Approximately, how many cylinders did the oxygen plant fill in the last month?	Type	Nominal content/ O2 capacity (L)	Number
	<input type="checkbox"/> "D"	340	
	<input type="checkbox"/> "E"	680	
	<input type="checkbox"/> "F"	1,360	
	<input type="checkbox"/> "G"	3,400	
	<input type="checkbox"/> "J"	6,800	
<input type="checkbox"/> Other	Specify:		
Is there direct piping from the oxygen plant to other wards/departments within this facility?	<input type="checkbox"/> Yes <input type="checkbox"/> No		

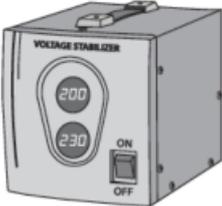
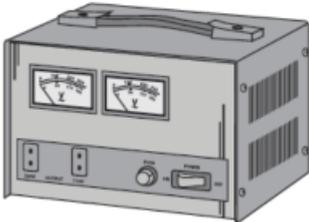
Generator



Voltage Stabilizers

Servo-electronic

Solid-state



“UPS” Uninterrupted Power Supply



OR



Patient monitor



Check to see if ECG module. Facility will have ECG “leads” that look like this:



Pulse oximeters

Self-contained fingertip

Portable handheld

Tabletop



Portable device that has the sensor, analyser and display contained in a single unit.



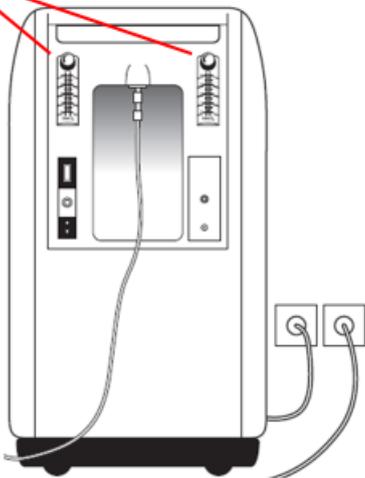
Handheld portable device with display screen and attached sensor probe and cable.



Stationary device for continuous operation/monitoring. Some can be wall- or pole-mounted.

Oxygen Concentrator

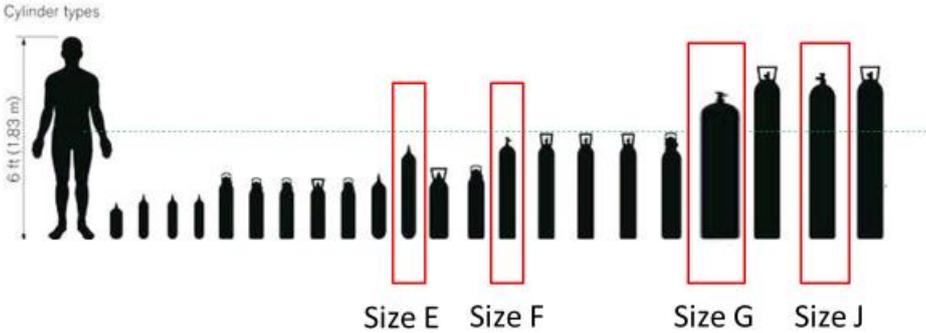
Capacity determined by flowmeter in liters per minute (LPM)



Oxygen Cylinder



Oxygen cylinder sizes (1 of 2)



Oxygen cylinder sizes (2 of 2)

Table 3.2 Cylinder sizes common in health facilities

Cylinder size	D	E	F	G	J
Nominal content/oxygen capacity (L)	340	680	1360	3400	6800
Water capacity (L)	2.3	4.7	9.4	23.6	47.2
Dimensions (height × diameter) (mm)	535 × 102	865 × 102	930 × 140	1320 × 178	1520 × 229
Approximate full weight (kg)	3.9	6.5	17	39	78
Valve outlet connection (and specification)	Pin index (ISO 407)	Pin index (ISO 407)	Bullnose (BS 341)	Bullnose (BS 341)	Pin index side spindle (ISO 407)
Nominal service pressure (kPa/bar/psi)	13 700 kPa (137 bar/1987 psi)	13 700 kPa (137 bar/1987 psi)	13 700 kPa (137 bar/1987 psi)	13 700 kPa (137 bar/1987 psi)	13 700 kPa (137 bar/1987 psi)
Health facility use	Emergency and ambulance transport	Emergency and ambulance transport	Stand-alone	Stand-alone	Manifold connection and stand-alone

Notes: BS – British Standard; ISO – International Organization for Standardization; psi – pounds per square inch absolute.
Source: BOC Healthcare (https://www.bochealthcare.co.uk/en/images/cylinder_data_med309965_2011_tcm409-54065.pdf, accessed 12 June 2019).

Oxygen Cylinder Valve Connection



Pin-index valve



Bullnose valve

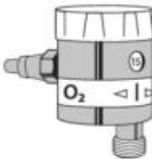
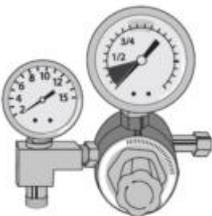
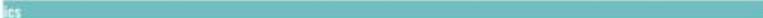
Image source: Essentials of Anaesthetic Equipment – medical gas supply <https://clinicalgate.com/medical-gas-supply/>

Flow meters

Thorpe tube
(rotameter)

Bourdon gauge
(single and multiple stage)

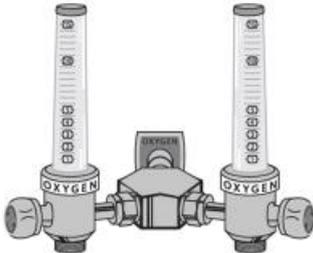
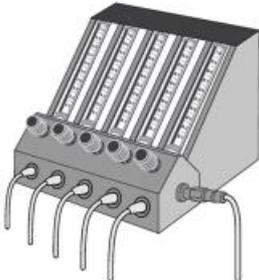
Dial/click
(flow restrictor)



Flow splitters

Flowmeter stand

Dual flowmeter



Oxygen delivery interface

Nasal cannula
(nasal prongs)



Nasal Catheter



Face mask



Venturi Mask



CPAP & BiPAP



Devices to maintain a continuous positive airway pressure (PAP)

- CPAP -> continuous with same pressure for inhalation and exhalation.
- BiPAP -> continuous but with differing pressures for inhalation and exhalation.

High-flow nasal cannula (HFNC)



Suction

Manual



Electric



Airway



Nasopharyngeal airway



Oropharyngeal (Guedel) airway

Mechanical Ventilator



Transportable, portable



Intensive Care

Autoclave / Sterilizer



Terminal wall units



Oxygen distribution manifold

Automatic switch-over
(manual has a switch to turn)



Liquid Oxygen: Bulk Storage Tank



“PSA” Oxygen Plant

