

MEDICAL OXYGEN GUIDELINES

For district level hospitals



Uttar Pradesh Health System
Strengthening Project



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FOREWORD

The Guidelines on Medical Oxygen, the first of its kind in U.P, lays the foundation for the improvement of equitable access to medical oxygen in health facilities in the state. In deed access to quality assured medical oxygen can mean the difference between life and death for patients. In order to safe guard the quality of oxygen from manufacturer to patient, to ensure its appropriate administration to patient, and even to drastically improve the screening of hypoxaemia patients, an enabling environment is required to streamline efforts to ensure that patients receive oxygen therapy when needed.

This Guidelines provides the foundational principles for engaging stakeholders in oxygen supply, distribution, administration, and equipment maintenance. It also reinforces the commitment of the Government of Uttar Pradesh to systematic and coordinated improvement in providing life-saving commodities, in this case, medical oxygen, to patients.

The successful implementation of the Guidelines on Medical Oxygen will require the sustained involvement and input of all stakeholders. I therefore urge all stakeholders to study the guidelines carefully and identify how they can contribute to achieving its aims and objectives.

V. Hekali Zhimomi
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List of Acronyms

BIPAP	Bilevel Positive Airway Pressure
BIS	Bureau of Indian Standards
CHC	Community Health Centre
CMS	Chief Medical Superintendent
COPD	Chronic Obstructive Pulmonary Diseases
CPAP	Continuous Positive Airway Pressure
EML	List of Essential Medicines
EMLc	List of Essential Medicines for Children (EMLc)
INR	Indian Rupees
LMIC	Low Middle Income Countries
NDMA	National Disaster Management Authority (NDMA)
SIC	Superintendent In Charge
UP	Uttar Pradesh
WHO	World Health Organization
PHC	Primary Health Centre
PPP	Public Private Partnership

Part I

MEDICAL OXYGEN GUIDELINES

1.0 Scope and Justification

Uttar Pradesh (UP) with population of 220 million people, is one of economically backward state of India. The per capita Net State Domestic Product (NSDP), at constant prices in 2013-14, of UP was 19,000 INR as compared to the National average of 40,000 INR. Despite impressive achievements in past few decades, the mortality and morbidity in UP are still disproportionately higher than that of national average. To cater to primary and secondary level of care UP has nearly 20,521 Health Sub-centres, 3,621 Primary Health Centres (PHC), 821 Community Health Centres (CHCs), 557 Urban PHCs and 159 District-Level Hospitals. Apart from these 3758 Ambulances and 150 Advanced Life Support Ambulances were also operational in the State.

All the functions of the human body require oxygen, thus, oxygen deprivation (known as hypoxaemia, a low level of oxygen in the blood) can have severe adverse effects on the cells that perform important biological processes. When severe hypoxaemia is not quickly diagnosed and addressed, it can lead to death. Hypoxaemia is caused in a range of common conditions—including childhood pneumonia, new-born conditions, and

obstetric emergencies. Oxygen therapy is the most commonly used intervention in the treatment of hypoxaemia. Oxygen therapy is also helpful for patients with non-communicable diseases, such as asthma and heart failure, and during pandemic disease outbreaks*. Considering the life-saving properties of Oxygen, World Health Organization (WHO) has included Oxygen in its “Model List of Essential Medicines (EML)” and “List of Essential Medicines for Children (EMLc)”.

Access to Oxygen is more critical for CHCs and district level hospitals, responsible for providing child and maternal care for people belonging to low economic strata of a State. Despite usefulness of Oxygen therapy, a study conducted by Uttar Pradesh Health System Strengthening Project (UPHSSP), found that District hospitals of UP State had poor oxygen supply system. Study also revealed that only 64% District hospitals had centralized medical gas distribution system. Very few hospitals had oxygen concentrators in their NICUs and operation theatres. In view of the above Government of Uttar Pradesh has decided to formulate State Oxygen guidelines.

Key Challenges:

- *Global estimates suggest that one in five sick newborns has hypoxaemia upon admission to a hospital.*
- *Improved oxygen delivery systems could reduce childhood pneumonia– related mortality by at least 35 percent.*
- *For women giving birth in LMIC, obstetric emergencies related to hypoxaemia 15 percent of all pregnant women develop a potentially life threatening complication.*
- *Despite importance of Oxygen therapy only 64% of District level hospitals in UP have centralised Oxygen supply system and very few hospitals had Oxygen Concentrator*

1.1 GOAL

The goal of this guideline for Medical Oxygen is to reduce morbidity and mortality from hypoxaemia by improving access to oxygen systems. Specific objectives include:

* Oxygen is essential: an issue brief by Path

- *Scaling up the accessibility, affordability, availability, and acceptance of pulse oximeters and oxygen therapy in U.P across all tiers of health service delivery;*
- *Encouraging rational use of essential medicines including oxygen to treat all hypoxaemia-related diseases specially in mother and neonates.*

1.2 GUIDELINS AREAS

Based on medical Oxygen requirements at district level hospitals and considering the best industry practices, following key measures are suggested for the State.

1.2.1 ***Production of Oxygen in the State:*** Oxygen is listed in essential drug; still it is produced by only few vendors in India. It results in cost escalations and irrational supply of Oxygen. State should encourage investment in this sector. Vendors may setup Oxygen units at least one in Western, Central and Eastern UP. Surplus capacity of these units can be used to supply Oxygen to other states.

1.2.2 ***Assessment of Oxygen gas Supply system:*** Most of district level hospitals do not have piped medical gas system. Also despite heavy consumption of medical oxygen, many district hospitals in bigger cities have single manifolds. Therefore, there is a need to do assessment of Oxygen supply system so that uninterrupted Oxygen supply may be ensured in all district level hospitals. Such assessment should be done at least every five years or at an interval as decided by health department, so that change in demand and technology can be addressed.

1.2.3 ***Provision of appropriate and adequate technology:*** All district level hospitals be provided with sufficient medical gas and air points, as per need of different patient care areas.

District hospitals provided with potentially life-saving equipment such as Oxygen flow meters (in order to achieve the target saturation range), pulse oximeters, humidifiers and Oxygen concentrators.

- 1.2.4 ***Focus on Oxygen conservation:*** State has high incidences and prevalence of child and maternal disease conditions requiring Oxygen therapy for several days. Therefore, to ensure the access of uninterrupted Oxygen supply within limited resources; District level hospitals should focus on Oxygen conservation through routine titration and other suitable methods.
- 1.2.5 ***Establishing Oxygen demand analysis and procurement system:*** Each district hospital should have a system of assessing/forecasting requirements of Oxygen gas. Such assessment should include monthly or seasonal variations in oxygen consumption. Review should also include the performance of medical gas supplier and such information should be used by the District hospital for procurement of medical gas.
- 1.2.6 ***Oxygen monitoring system:*** Most of District hospitals are ill equipped to monitor uninterrupted oxygen supply in hospital, this results in unwanted casualties in critical care areas. Therefore, there is a need to have effective alarm system based monitoring system to supervise the oxygen supply in different areas of hospital especially in critical care areas so that shortage of oxygen supply can be managed in time.

Use of dedicated Oxygen monitoring dashboard may also be used for monitoring Oxygen gas supply in District hospitals.

Monitoring system should include daily checking and recording of oxygen pressure level in standby cylinders kept in different patient care areas. Similarly, oxygen saturation and delivery system (including flow rate) should be recorded on the patient's monitoring chart.

- 1.2.7 ***Maintenance system for Oxygen gas supply system:*** Maintenance of Oxygen manifold, central pipelines and pressures levels is a specialized job therefore, all District level hospital should have a dedicated trained manpower to maintain the oxygen gas supply systems. Team should have a routine oxygen pressure level

and leakage monitoring schedule based on which problem in gas pipelines may be identified and problems are fixed on time to time.

- 1.2.8 ***Operational guidelines for clinical staff of the hospitals:*** Staff providing oxygen gas should be given an operational manual or guide book. Such guidebook should describe oxygen management in different conditions of patient so that they can effectively handle oxygen gas administration. Staff should also be trained in the use of a range of different oxygen delivery devices.
- 1.2.9 ***Training of staff handling medical gas:*** Staff responsible for supply and maintenance of medical oxygen should be trained about basic equipment care.

Part II

MEDICAL OPERATIONAL GUIDELINES

2.0 INTRODUCTION

Oxygen therapy is required to treat hypoxaemia, a low level of oxygen in the blood. Lack of access to oxygen and pulse oximeters for screening for hypoxaemia can be attributed to numerous conditions that this guidelines sets to address. In particular, the absence of clear regulations and guidelines as well as fragmented supply and distribution systems for oxygen aggravates the oxygen access for patients.

2.1 Medical Oxygen Vs Industrial Oxygen:

Industrial oxygen is used in numerous industries for running manufacturing processes. Manufacturing of oxygen for industrial purposes is also required to meet industrial standards. Oxygen plants used in the generation of oxygen for industrial application must meet the specifications of the industry.

The procedure for generating medical and industrial oxygen is same. However, medical oxygen is generated with high purity and the oxygen system for generation of medical oxygen is fabricated with the highest quality standards. Medical oxygen is distilled in the air separation till it meets medical specifications. Medical grade oxygen is used in ambulances, surgery and intensive care units. For production of medical oxygen, which is also listed as a drug on the WHO list of essential medicines, it is mandatory to have proper drug licenses and comply with standard operating systems. It is also necessary to comply with Indian Pharmacopeia standards for generating medical oxygen.

This Guidelines on Medical Oxygen, seeks to provide guidelines on medical oxygen that for District Level Hospitals, in Uttar Pradesh.

2.2 Aim of The Operational Guidelines:

The Medical Gas operational guidelines has been developed with an aim to guide and support hospital staff who directly or indirectly interface with medical gases within their role of employment to ensure safe and effective procurement, use and management of medical gases; and therefore safeguard patient's life and health.

2.3 Key Priority Areas:

Oxygen therapy is widely used in the management of a number of chronic and acute health conditions such as chronic asthma, cystic fibrosis, pulmonary hypertension, obstructive sleep apnea, heart failure, case of anaphylaxis, major trauma and seizure or hypothermia.

The therapy may be used in a District Level hospital or pre-hospital setting (e.g. in the ambulance) to manage emergency situations or in the home setting to manage long-term health conditions. The mode of delivery and device used for oxygen therapy depends upon several factors including the patient's specific needs and the opinion of the medical professionals involved.

Oxygen shall be administered in operating theatres and also when hypoxaemia is detected in the following:

- **Children and neonates:** Prematurity, birth asphyxia, acute sepsis, shock, severe pneumonia, meningitis, brain injury, coma, anaemia, severe malaria, heart failure, and acute asthma etc.
- **Adults:** Pneumonia, interstitial lung disease, pulmonary sarcoidosis, lower and upper respiratory infections, pneumoconiosis, severe malaria, meningitis, ischaemia etc.

2.4 Staff Responsibilities:

Following staff should be involved in the Oxygen supply and management in the hospital.

- ❖ **Director/SIC/CMS** or his nominee should be responsible for the overall use & procurement of medical gases in the hospital
- ❖ **Senior nursing/Pharmacists/drug store incharge** should be responsible for ordering of medical gases in the hospital.
- ❖ A Medical Gas System Operator, designated employee (preferably trained in Medical Gas Supply System), should be placed on 24X7 basis and S/he should be designated with following duties
 - Maintenance of manifold, Medical Gas Pipelines and Dispensing Outlet
 - Checking the Quality of Oxygen Gas
 - Storage of the gas cylinders
 - Shifting/moving of cylinders within the hospital
 - Replacement of cylinders
- ❖ In a smaller hospital such as PHC, CHC, the role of medical gas operator may be performed by a attendant (Ward boy) specially trained for this purpose.

2.5 Medical Gases Committee:

Each hospital should have a medical gas committee. This committee should be responsible to ensure that risks from medical gases are minimized and it provides

support for handling, storage and maintenance of Oxygen gas in their hospital. In addition the committee will endeavour to improve efficiency and compliance with the set standards. The composition of medical gas committee is given below:

- Chairperson: Director/SIC/CMS
- Members: Senior consultants, Matron (or a nominated Designated Nursing / Medical Officer), Chief Pharmacist / store in charge.

2.6 Common Oxygen Supply System:

Oxygen management not only requires a fool-proof system of delivery and supply of the gas, but also proper procedures in place to ensure that hospitals order appropriate amounts and well in time. It also requires standard apparatus and procedure for maintenance of the medical gas supply system. Medical oxygen is mainly supplied in following ways:

a) Oxygen Cylinders

Oxygen gas can be stored in a portable tank. These are called compressed gas systems. They require continuous refills and are thus most useful where central refilling and transportation infrastructure are reliable and affordable.

b) Oxygen Concentrators (Bed side and portable)

Oxygen concentrators is a device that takes oxygen from the room, concentrates it for therapeutic use, and removes other naturally occurring gases. It is less portable than oxygen cylinder. The benefits of concentrators are that they are less expensive and don't require filling like tanks. However, they require a consistent supply of electricity and routine maintenance.

c) Central Source (Liquid tank & Oxygen generator)

A central oxygen or pipeline, system uses pipes to provide oxygen to various locations within a health facility/hospital. These systems are typically economical in large hospitals that require a high volume of oxygen and can support the costs of the centralized pipeline infrastructure.

Liquid oxygen can be stored in a portable tank and connected to central pipeline. Liquid oxygen is highly concentrated, so more oxygen can be stored in a smaller tank. This is useful in large district hospitals because it will evaporate if it isn't used in a timely manner then it will be wastage.

Hospitals with higher Oxygen consumptions may use Oxygen generator to produce Oxygen inside the hospitals itself. Such a system may have lower per unit cost of Oxygen but would require uninterrupted power supply and highly skilled manpower.

Comparative of the three supply system is given in Annexure 1. To ensure uninterrupted oxygen supply in a hospital, Bulk supply system shall comprise of following three level of oxygen supply system:

- **Primary supply:** The primary source of supply shall be permanently connected and shall be the main source of supply to the medical oxygen supply system. As a minimum, the primary supply should have usable quantity of product to meet expected usage between scheduled product deliveries. Primary supply is usually done by Oxygen Generator or Jumbo Gas Cylinder using manifold system or liquid tank.
- **Secondary supply:** The secondary source of supply shall be permanently connected, automatically supply the pipeline, and capable of providing the total oxygen flow requirement in the event of a primary supply failure. As a minimum, the secondary supply should have usable quantity of product to meet expected usage between a request for product delivery and the delivery of the product.
- **Reserve supply:** The reserve supply is the final source of supply to specific sections of the pipeline, capable of meeting the required demand in the event of failure of the primary and secondary supplies, or failure of the upstream distribution pipe work. As a minimum, the reserve supply should have usable

quantity of product to meet critical patient care between a request for product delivery and the delivery of the product. Under most conditions, compressed gas cylinders are the most appropriate method of providing a reserve source of supply.

2.7 Oxygen Supply System Suitable for District Hospitals:

Looking into the patient load and complexities of care required at district hospitals medical oxygen should be supplied through **centralized pipeline system**. It should be supplemented by **Compressed oxygen gas** cylinders, which also acts as reserve supply.

- ❖ **Centralized pipeline system** comprises a main source of supply (generally with a secondary and tertiary source to ensure continuity of service) connected via a permanent fixed pipeline system to appropriate terminal unit outlets in relevant locations across the site. Plant and system status is monitored continuously by a series of alarms which sound at designated locations to indicate faults or low pressure.
- ❖ Oxygen Generators can be installed at all commissionrate Head Quarters' District Hospitals on Government owned but outsourced operation and maintenance or on PPP mode and Liquid oxygen tank may be installed at hospitals having 300 or more bed strengths.
- ❖ In a hospital, **Jumbo sized cylinders** should be commonly used in manifold room, which are capable of holding 6800 litres of oxygen. In manifold room cylinders should be arranged into two groups a primary and secondary group.
- ❖ Normally, the oxygen gas is used up from the primary group, with gas being expended equally from all cylinders, as they are connected in parallel through a common outlet. Once the levels in the cylinders are sufficiently low, a pressure transducer switches to the secondary manifold; allowing the primary manifold to be replenished.

Summary of Proposed Oxygen Supply System, Sources, Oxygen and Distribution System is given below.:

Facility	Type of Supply	Sources	Distribution System
District Hospitals	Primary supply	Oxygen Gen/Liquid oxygen*	Centralized
CHC	Primary supply	Jumbo size (D Type) cylinder	Centralized
PHC	Primary supply	Small oxygen size(A & B)	Bedside(Direct)
District Hospitals	Secondary supply	Jumbo size (D Type)	Centralized
OT, Emergency, ICU	Primary supply	Oxygen Concentrator	Bedside(Direct)
PHC, CHC& all DH	Reserve	Small oxygen size(A & B)	Bedside(Direct)

*For more than 300 beds having space required by regulatory body

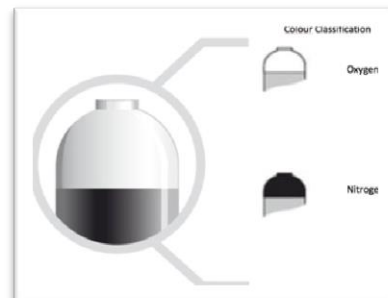
- ❖ Each hospital be provided with one Oxygen concentration analyser (Purity analyser)
- ❖ **Pulse oximeters should be adequately available in all patient care areas** and should always be used to assess patients at the time of admission and to regularly monitor the progress of patients on oxygen therapy.
- ❖ **Multipara monitors should be available for 20% of ICU/NICU/SNCU/PICU/Emergency beds.**
- ❖ **One Flow-meter and regulator should be available for each Oxygen dispensing outlet**
- ❖ **At least One Stretcher with Oxygen Cylinder for each ward for patients' transfer.**
- ❖ **Oxygen Cylinder stand be available for each Ambulance.**
- ❖ **CPAPs be available for each NICU/SNCU/PICU.**
- ❖ **BiPAPs be available for each ICU.**
- ❖ **Venturi mask, regulator, 4way adapter, flow-meter, bubble humidifier be available for each ward.**

2.8 Identification of Medical Gas in Hospitals

Medical gases are used in cylinders and central pipelines. For gas cylinder “gas cylinder Rule 1981”, static and mobile pressure vessels (unfired) rules 1981 and BIS Act 1986 is applicable. To ensure the correct use of medical gas standard colour codes are used globally. This section gives the colour codes of different medical gases.

a) Colour Codes Medical Gas Cylinders

- White shoulder and black body contains medical Oxygen (O₂) and
- Blue shoulder and blue body contains nitrous oxide (NO₂).
- Black shoulder and black body contains nitrogen (N₂).



b) Central Gas Pipeline

Central pipe lines in most of District level hospital require oxygen, air and nitrous oxide. The colour codes as prescribed by BIS are given below:

Gas	Background	First Colour Band	Second Colour Band
Air	Sky Blue	White	Black
Oxygen	Canary Yellow	White	-
Nitrous Oxide	Canary Yellow	French Blue	Signal Red
Vacuum	Sky Blue	Black	-

Colour bands are superimposed on ground colour at the following points:

- *Intersection points and change of direction points in piping ways*
- *Other points such as midway, near valve, junction joints of services appliances, before and after walls and partitions, etc. at the intervals of no more that 10M and adjacent terminal units and*
- *At start and terminating points*

Colour bands shall be arranged in the sequence given above. Marking will also include arrows denoting direction of flow and letters used for marking shall not be less than 6 mm high.

c) Central Gas Outlet

- Green background: for Oxygen
- Blue background: Nitrous Oxide
- Black/grey background: Medical air
- Yellow background: Vacuum



Outlet shall be equipped with a primary and secondary check valve and the secondary check valve shall be rated at minimum pressure of 200 p s i.

2.9 Requirements of Medical gas and Air Points:

All critical care areas of the hospitals such as emergency wards, operation theatre, ICU, NICU, labour room should have uninterrupted 24x7 oxygen supply. As per industry norms the requirement of oxygen supply in Hospitals are as follows:

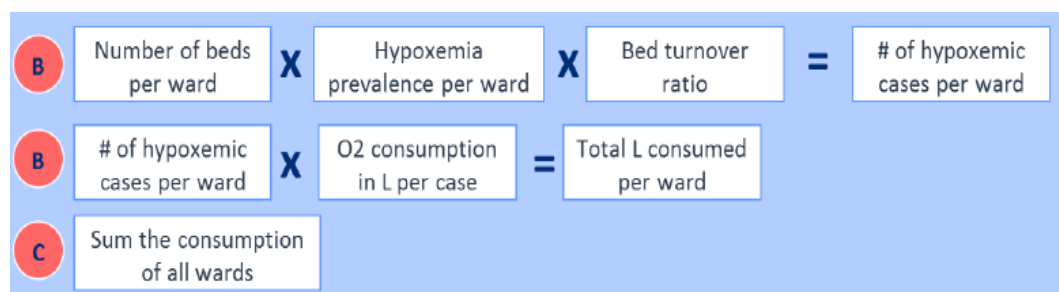
<i>Specialities/Wards</i>	<i>Number of Outlet Points per Bed</i>		
<i>Specialities/Wards</i>	<i>Number of Outlets Points</i>		
	<i>Oxygen</i>	<i>Suction</i>	<i>Air</i>
<i>ICU</i>	2	2	1
<i>PICU/NICU</i>	3	3	3
<i>HDU</i>	2	2	1
<i>Wards</i>	1	1	1
<i>OT</i>	2	2	1
<i>Labour Room</i>	2	2	1
<i>Cardiac ICU</i>	2	2	1

In General wards at least 20 % of the beds should have an Oxygen outlet.

2.10 Estimating Oxygen Requirements

Authorities of District hospitals should routinely assess the Oxygen requirements of their hospital and monitor its consumption. Given below is a simple methods to estimate oxygen uses in District level hospitals.

2.11.1. Formula used to calculate the oxygen requirements at the facility level



Typically, one Type **B** cylinders are used for 3 major surgeries each lasting for an average duration of 2 hours. This information can be used to estimate the Oxygen requirements of a district hospital. Detailed and accurate information can be obtained by analysing data about Oxygen consumption and different types of surgeries (major /minor) performed by a hospital during a defined time period.

Another method to measure the Oxygen requirement is given below.

$$(\text{No. of beds} \times 1.25 + \text{ICU and OT} \times 1.25 + \text{delivery beds} \times 1.25) \times 0.06$$

= is Oxygen required per hours

2.11.2. Formula used to calculate the oxygen requirements in the State:

Information about total oxygen consumption in the State is essential to have better control over its usages and to get better pricing during vendor negotiation.

2.11.3. *Formula to estimate the supply cost of Medical Oxygen*

- A Determine the cost of each of mode of supply and the supply mix for every health facility
- B Derive total CAPEX and OPEX costs from the above

2.11 Conservation of Oxygen Requirements:

District level hospitals should adopt Oxygen conservation strategies to reduce consumption and hence cost saving. Routine titration is one such method of Oxygen conservation recommended by WHO. Titration is the process of adjusting oxygen levels to maintain patient peripheral blood oxygen saturation level (SpO₂) above the recommended target level of 90% at $\leq 2,500$ meters (m) above sea level or 87% at $> 2,500$ m above sea level¹. Other methods of Oxygen conservation include trans-tracheal catheters, reservoir cannulas, and demand oxygen delivery systems.

Medical staff treating the patients need to be properly oriented with the oxygen conservation system they use so that they understand capabilities and limitations of the technology they adopt.

2.12 Monitoring and Evaluation:

Medical gases used in a hospital are life-supporting element that gives direct influence in maintaining the life of a patient. Therefore, at the point use, medical gas must be clean, highly pure and supplied under stable pressure.

Hospital should have detailing of location of expansion joints of medical gas pipeline that may get damaged during a strong shaking. To avoid disruption of services during and post disaster scenario all such locations should be regularly checked through a check-list under routine maintenance program.

¹ World Health Organization. Oxygen therapy for children. Geneva: World Health Organization; 2016. 66 p.

To maintain a stable supply of medical gases, it is necessary to establish a monitoring system which surely traces the flow of invisible gas from the source of supply through piping to the section to use the gas.

2.13.1. Alarm's Requirements

The centralized oxygen supply should be monitored continually by alarms which indicate audibly and visually if any issues develop which could affect the supply. Alarm panels are located in various key areas and also centrally at the 24 hr manned switchboard in Main Reception. The following alarm signals should be available in the hospital:

- Liquid level in any cryogenic vessel below the minimum specified by the management of the healthcare facility in consultation with the gas supplier
- Changeover from primary to secondary supplies
- Secondary or reserve supply below minimum pressure
- Deviation of pipeline pressure by more than ± 20 % from the nominal distribution pressure

2.13 Safety Procedures:

Key security points are given below:

- Oxygen Flow meters should be connected to Medical Gas Pipeline System
- Oxygen Flowmeters must remain turned off at all times except when in use
- Masks must not be left on beds with flow meters left open.
- Nursing staff must be aware of the importance of this as there are two consequences arising from failure to turn off the flow meters when not in use or in case of the followings:
- Fire or Explosion risk; severe burns or damage to equipment
- Wasteful and costly discharge of Oxygen

GUIDELINES OF MEDICAL OXYGEN ADMINISTRATION

3.0 INTRODUCTION

This section describes the clinical guidelines of Oxygen administration at different health care facilities.

3.1 Personnel Who May Administer Oxygen:

Oxygen can be administered by any qualified nurse, paramedics, doctor, in accordance with policy for administration of medicines. Hospital administration will ensure the usage of medical gases by designated personnel.

3.2 Conditions Requiring Oxygen Care in Adults:

Each district level hospitals' oxygen guidelines should ascertain the following key points:

- Oxygen will be primarily be used to treat hypoxaemia, breathlessness or dyspnoea.

- That pulse oximetry is included as part of routine vital signs for all patients.
- That any patient with SpO₂ <90% on pulse oximetry or clinical signs of hypoxaemia should receive oxygen.
- For some conditions—severe anaemia, heart failure, shock, sepsis or brain injury/infection/coma—it is also appropriate to give oxygen when the S_pO₂ is ≤ 94%.
- All critically ill patients should be given oxygen (by paramedics, nurses, or other health professionals) while awaiting medical review and history.
- All patients who require supplementary oxygen therapy should be given oxygen in line with the clinical guidelines on oxygen

Precautions:

Oxygen therapy should be given with caution in patients admitted with Paraquat poisoning, Acid inhalation and Previous Bleomycin use.

Patients with chronic carbon dioxide retention, oxygen administration may cause further increases in carbon dioxide and respiratory acidosis. This may occur in patients with COPD, neuromuscular disorder, morbid obesity or musculoskeletal disorders.

High concentration O₂ (70%-100%) may damage the alveolar membrane when inhaled for greater than 48 hours. This risk can increase after chemotherapy/Bleomycin administration.

3.3 Oxygen Care in Neonates:

More than half of all neonatal deaths globally are due to preterm birth complications, neonatal pneumonia, and neonatal sepsis. Antibiotics with full supportive care for severe neonatal infections—which includes oxygen therapy—could prevent substantial neonatal deaths each year.



Oxygen therapy in newborn infants, particularly when they are born preterm, should reflect the fact that in the first hours of life they have lower normal oxygen saturation than older newborns. Pulse oximetry should be used to monitor SpO₂, which should be maintained $\geq 88\%$ but in pre-term babies no higher than 95% to prevent eye damage.

For preterm infants (< 32 weeks' gestation), bag-and-mask resuscitation with 30% oxygen should be used.

3.4 Oxygen Care in Children Care:

Pneumonia is the leading infectious cause of death in children younger than five years, and causes 15 percent of child deaths around the world. Approximately 13 percent of children with pneumonia develop hypoxaemia. If both pulse oximetry and oxygen therapy are consistently available child deaths could be minimised each year.

- All children living at ≤ 2500 m above sea level should receive oxygen therapy if their oxygen saturation is $\leq 90\%$, as measured by pulse oximetry.
- In children living at high altitude (> 2500 m above sea level), the normal oxygen saturation is lower than those living at sea level, and a level of SpO₂ such as $\leq 87\%$ could be used as a threshold for giving oxygen.
- When children are monitored with pulse oximetry, any child with an SpO₂ $< 90\%$ should receive oxygen.

3.5 Transfer and Transportation of Patients Receiving Oxygen

Special care is needed for patients requiring transportation. As far as possible all sick patients and children with unstable haemodynamic requiring oxygen therapy during transfer/transport are to be accompanied by a Registered Nurse/midwife. Clear instructions must be provided for personnel involved in the transfer of the patient, which must include delivery device and flow rate. Patients who are transferred from one area to another must also be provided with clear documentation of their ongoing oxygen

requirements and documentation of their oxygen saturations. Other important points for patient requiring oxygen during transportation are as follows:

- Staff must ensure that adequate oxygen is administered during transfers and whilst patients are in diagnostic departments.
- Oxygen saturation should be monitored continuously by registered healthcare professionals for seriously ill patients who require escorted transfers.
- Patients who are medically unstable and those requiring oxygen therapy (Reservoir mask, Venturi mask above 35% or Humidified oxygen above 35% or nasal or simple mask above 5l/min) whilst being transferred from one area to another should be accompanied by a competent healthcare provides staff may transfer stable patients on low dose oxygen.

Hospital administration must ensure there are adequate numbers of oxygen cylinders & they are full when they leave the department/or hospital.

If a patient transfers from an area not utilising the target saturation system then their oxygen should be administered as per the transferring areas prescription until the patient is reviewed and transferred over to the target saturation scheme, which should occur as soon as possible.

3.6 Peri-operative and immediately post operatively

The usual procedure for prescribing oxygen therapy in these areas should be adhered to, utilising the target saturation. If a patient is transferred back to the ward on oxygen therapy and is not on the target saturation system, the need for on-going oxygen therapy should be reviewed as soon as possible. If oxygen therapy is to be continued, it should be prescribed using the target saturation scheme unless there is an alternative time-limited instruction which is part of the hospital's/healthcare facilities' Post-Operative care policy for selected patients.

3.7 Follow up of Patient with Oxygen care:

Oxygen administration by any method must be supervised by trained personnel to detect and manage complications appropriately. A nurse should check every 3 hour that the prongs or catheter are in the correct position and not blocked with mucus, that all connections are secure, that the oxygen flow rate is correct, that the airways are not obstructed by mucus and that there is no gastric distension. Prongs or catheters should be removed and cleaned at least twice a day.

All severely ill children must be monitored regularly for vital signs and general condition. As SpO₂ is the most vital clinical sign, pulse oximetry is an invaluable routine monitoring tool.

3.8 Conditions When to Stop Oxygen:

The conditions that requires Oxygen supply to be stopped are:

- At least once each day, children who are clinically stable (have no emergency signs and SpO₂ > 90%) should be disconnected from oxygen for 10–15 min and carefully examined for changes in clinical signs and SpO₂, to assess whether supplemental oxygen is still required.
- Supplemental oxygen may be interrupted in the morning, when there are likely to be adequate staff to observe the child throughout the day. If supplemental oxygen shall not be discontinued in the evening/night because of the presence of few overnight staff.
- The child should be disconnected from the oxygen source and observed carefully to avoid any adverse complications like re-emergence of hypoxaemia. If severe hypoxaemia (SpO₂ < 80%), apnoea or severe respiratory distress occurs, oxygen therapy should be immediately restarted.
- Some children will become hypoxemic very rapidly when they are taken off oxygen; this is a marker of severe disease and a high risk for mortality. Parents and nursing staff should be advised to watch children to determine whether they develop cyanosis or severe respiratory distress.

- Where oxygen supplies are ample, children should receive supplemental oxygen until their SpO₂ on room air is $\geq 90\%$. If the SpO₂ is $\geq 90\%$ after a trial on room air, they should remain off oxygen, and the SpO₂ should be rechecked after 1 h, as late de-saturation can sometimes occur.
- For all children who appear to deteriorate clinically, the SpO₂ should be checked to determine whether they need oxygen. If bed space allows, children should not be discharged until their SpO₂ has been stable at $\geq 90\%$ while breathing room air for at least 24 h, until all danger signs have resolved and appropriate home treatment can be organized. The chest X-ray appearance is not a useful guide to the need for oxygen therapy

3.9 Ordering and Supply of Oxygen Cylinders:

- A minimum number of oxygen cylinders are stored in the oxygen shed. The number of full oxygen cylinders is checked at least once each week by the pharmacy/store team. At the same time, it is checked that all cylinders are undamaged and properly retained, and that the shed is clean and secure. Stock levels can be higher and stock checks must be more frequent when oxygen cylinders are in heavy use.
- The nurse in charge orders more oxygen cylinders when stocks fall below the reorder level.
- A nurse or trained member of the business team must check the delivery on arrival. This includes counting the number of cylinders that have been delivered, confirming that they are all oxygen cylinders and within date, and verifying that they are all in good condition. After checking the delivery, the shed is unlocked so that the delivered cylinders can be put in it and the empty cylinders taken away. The receipt is then delivered to the accounts department, either directly or by placing it in the message book on the ward.
- Emergency orders of oxygen cylinders over the weekend are more expensive. Therefore, staffs are requested to ensure that stock levels are maintained to avoid the need for this.

3.10 Precautions in Handling Oxygen Cylinders:

- All gas cylinders must be handled safely from the perspective of both the handler(s) and the gas. They must be moved slowly and gently, in line with the moving and handling guidance for heavy objects. They must be stored in an upright position at all times and only transported on the custom-built trolleys. When not on a trolley they must be chained upright against a wall in the oxygen shed. Staff must wear shoes with toe protection when handling cylinders, in accordance with the Staff Clothing Policy.
- The cylinders must be kept dry, clean, and free from grease and dusts.
- Each time an oxygen cylinder is required for clinical use by a particular patient, its colour, labelling, general condition and expiry date must always be checked before use, even if it has been used before.
- There must be no smoking or naked flames within the vicinity of oxygen cylinders. Patients must be informed that they and their visitors must not smoke in the vicinity of the oxygen cylinder, in addition to the placement of the sign on the cylinder as described in the section on “The Clinical Use of Oxygen Cylinders”.
- There is a designated shed for the storage of oxygen cylinders. It must be kept clean and orderly, and it must be kept locked at all times when not in use. Domestic staff must clean it once every month.
- No smoking is allowed in the vicinity of the gas storage area or in proximity to any gas cylinder. There are numerous hazard warning signs on the shed itself and there is a “No Smoking” notice outside the gas storage area.



3.11 Equipment and Accessories:

Following equipment should be available at each location of oxygen use.

- A functional and clinically appropriate pulse oximeter must be available at each location that oxygen is used

- Functional oxygen delivery systems and oxygen analysers must be made available
- Oxygen concentrators in critical care areas such as emergency, operation theatre, ICU and NICU.

Note: Other equipment and their uses are given in annexure 7

3.12 Training and Competencies:

Any qualified health professional (medical and nursing) can commence oxygen therapy in an emergency situation.

Healthcare professionals involved in prescribing or administering oxygen should be familiar with clinical guidelines on medical oxygen. Healthcare professionals should receive regular and continuous training in oxygen therapy.



- Training is a requirement for all those expected or required to utilise any application of the medical gas pipeline prior to unsupervised use.
- Training must include fire prevention and fire procedures. Special attention should be given to ensuring staff know how to locate and operate fire call points, are shown where fire extinguishers are situated and are taught which type of fire extinguisher to use. Staff should be shown where medical gas pipeline shut off valves are located, how to operate them, and the implications of shutting off these valves.
- Initial training will consist of a 2 hour long competency based session, which incorporates a theory and practical test. Subsequent to this annual refresher training must be done.
- Training records must be kept for all staff undertaking training, and made accessible to ward managers and medical devices clinical risk manager for central recording.

- Employee dealing with medical gas supply system and equipment technicians should receive regular and continuous training on maintenance of oxygen equipment.

3.13 Five Things to Make Oxygen Use Safer in Hospitals:

Although oxygen is a safe product to administer and handle, during emergencies and under pressure it is potentially dangerous and should be handled carefully. Following are key measures to ensure that Oxygen is administered safely.

1. *Check that the oxygen being given to the patients is prescribed*

Oxygen is a medicine and should always be prescribed. In an emergency, oxygen can be given immediately and documented later.

2. *Measure and record saturation levels*

Oxygen is a treatment for hypoxaemia, not breathlessness. Establish whether the patient is hypoxaemic and, if so, to what extent. Pulse oximetry is an essential tool in assessing the oxygen saturation of the blood and results should be recorded.

3. *Adjust the flow rate, if required, to achieve target saturation.*

The recommended initial target saturation range, unless stated otherwise, is 94-98%. If patients have chronic obstructive pulmonary disease (COPD) or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88-92%.

4. *Don't confuse oxygen and medical compressed air*

Be aware of colour coding of flow meters and make sure they are not obstructed by curtains or other equipment.

5. *Check the content of cylinders and calculate how long they will last*

This is especially important for cylinders on resuscitation trolleys and when transferring a patient.

3.14 Other Important Measures:

- Minimize use of oxygen cylinders on wards (it is more expensive and less safe than piped oxygen for clinical areas with regular use);
- Ensure reliable and adequate supplies of oxygen cylinders in transfer and emergency situations;
- Assess the risks of confusing oxygen and medical compressed air (for instance, covering air outlets when not in use);
- Ensure that oxygen is prescribed, and pulse oximetry is available in all locations where oxygen is used;
- Ensure a multidisciplinary group is responsible for the safe use of oxygen in your hospital; this includes reviewing oxygen related incidents, developing a local oxygen policy and a training programme.

3.15 Reporting Faulty Oxygen Cylinders

Any fault with an oxygen cylinder or attached equipment should be reported to **the medical gas supplier and the Chief Medical Superintendent of the hospital.**

REFERENCES

Below is the list of key references and resources used to support the information included in this guidelines:

1. *Oxygen is essential: a policy and advisory primer by Path*
2. *Oxygen is essential: an issue brief by Path*
3. *World Health Organization. Oxygen therapy for children. Geneva: World Health Organization; 2016. 66 p.*
4. *Oxygen Guidelines by Salisbury NHS Foundation, Salisbury District Hospital, Salisbury, Wiltshire, UK*
5. *Study on Oxygen Consumptions and Delivery System in Uttar Pradesh by UPHSSP, Lucknow; November, 2017.*
6. *Grace Wu at al. A model for oxygen conservation associated with titration during paediatric oxygen therapy, PLOS ONE, V.12(2); 2017, e0171530*
7. *National Medical Oxygen and Pulse Oximetry Scale Up Road Map (2016-2020/21), Government of Ethiopia*

GLOSSARY

Anaemia	A condition in which there is a deficiency of red cells or of haemoglobin in the blood, resulting in pallor and weariness.
Apnoea	Temporary cessation of breathing, especially during sleep.
Asphyxia	A condition arising when the body is deprived of oxygen, causing unconsciousness or death; suffocation.
Hypoxemia	An abnormally low concentration of oxygen in the blood.
Medical Gas	Any gas or mixture of gases intended for administration to patients for anaesthetic, therapeutic, diagnostic or prophylactic purposes
Pneumonia	Lung inflammation caused by bacterial or viral infection, in which the air sacs fill with pus and may become solid.
Procurement	The action of obtaining or procuring something.
Pulse oximeters	An oximeter that measures the proportion of oxygenated haemoglobin in the blood in pulsating vessels, especially the capillaries of the finger or ear.
Resuscitation	The action or process of reviving someone from unconsciousness or apparent death.
Sarcoidosis	A chronic disease of unknown cause characterized by the enlargement of lymph nodes in many parts of the body and the widespread appearance of granulomas derived from the reticuloendothelial system
Shock	An acute medical condition associated with a fall in blood pressure, caused by such events as loss of blood, severe burns, allergic reaction, or sudden emotional stress, and marked by cold, pallid skin, irregular breathing, rapid pulse, and dilated pupils.

APPENDIX

Annexure Number	Description
Annexure 1	Pros and Cons of Different Oxygen Supply Systems
Appendix 2	Critical illnesses requiring high levels of supplemental oxygen
Appendix 3	Serious illnesses requiring moderate levels of supplemental oxygen if the patient is hypoxaemic
Appendix 4	COPD and other conditions requiring controlled or low-dose oxygen therapy
Appendix 5	Conditions for which patients should be monitored closely oxygen therapy is not required unless the patient is hypoxaemic
Appendix 6	Administering acute oxygen therapy
Appendix 7	Equipment used in the delivery of oxygen
Appendix 8	Flow Chart for oxygen administration
Appendix 9	Humidification

Annexure 1: Pros and Cons of Different Oxygen Supply Systems

Model	<i>Cylinders</i>	<i>Concentrators (Bedside & Portable)</i>	<i>Central Source (Liquid tank & O2 generator)</i>
Description	High pressure gas is supplied via portable canisters (typically 7,500L) and delivered to health facilities, which must exchange the empty cylinders	Oxygen enriched gas is supplied by entraining air from the environment and separating the nitrogen via pressure swing absorption (PSA)	Oxygen is provided via a large central source on-site, most often in addition to a manifold or network of copper pipes
Use case(s)	<ul style="list-style-type: none"> Facilities without a reliable power source or in close proximity of a plant Deliver medium-high output flow; well-suited for all 3 application areas 	<ul style="list-style-type: none"> Facilities with a reliable power source (or backup) Deliver low output flow (~ 5L/min); well-suited for disease management but too low for emergencies 	<ul style="list-style-type: none"> Large facilities with reliable infrastructure and skilled technicians Deliver high output flow and pressure; well-suited for all 3 application areas
Main advantages	<ul style="list-style-type: none"> No need for electricity or highly skilled technicians Low capital investment cost 	<ul style="list-style-type: none"> Can ensure continuous supply at low running cost One concentrator can serve up to 4 beds 	<ul style="list-style-type: none"> Can ensure continuous supply at high pressure Most cost effective system for larger facilities
Main disadvantages	<ul style="list-style-type: none"> Supply is highly dependent on supplier availability Cost of transport can lead to budget constraints System is highly sensitive to leakage Canisters are potentially hazardous (explosion risk) Only one bed per cylinder 	<ul style="list-style-type: none"> Requires access to uninterrupted power Service and supply of spare parts should be foreseen Relatively low output often insufficient for emergency care (ICU) 	<ul style="list-style-type: none"> High capital investment Requires access to reliable and sufficient power source Need for skilled technicians and adequate infrastructure System is potentially hazardous
Peripheral equipment necessary	<ul style="list-style-type: none"> Manometer (Regulator, gauge, flowmeter) Humidifier Nasal prongs/catheter_ Cylinder Key 	<ul style="list-style-type: none"> Humidifier Nasal prongs/catheter 	<ul style="list-style-type: none"> Cylinders incl. peripheral equipment

Source: National Medical Oxygen and Pulse Oximetry Scale Up Road Map (2016-2020/21), Government of Ethiopia

Annexure 2: Critical illnesses requiring high levels of supplemental oxygen

- *The initial oxygen therapy is a reservoir mask at 15 l/min*
- *Once stable the oxygen dose and aim for target saturation range of 94-98%*
- *If oximetry is unavailable, continue to use a reservoir mask unit definite treatment is available*
- *Patient with Chronic obstructive pulmonary diseases (COPD) and other risk factors for hypertensions who develop critical illness should have the same initial target saturations as other critically ill patients pending the results of blood gas measurements, after which these patients may need controlled oxygen therapy or supported ventilation if there is severe hypoxaemia and /or hypercapnia with respiratory acidosis.*

Conditions

Additional Comments

Cardia arrest or resuscitation	Use bag-valve mask during active resuscitation Aim for maximum possible oxygen saturation until the patient is stable
Shock, sepsis, major trauma, near-drowning, anaphylaxis, major pulmonary haemorrhage	Also give specific treatment for the underlying conditions
Major head injury	Early intubation and ventilation if comatose
Carbon Monoxide poisoning	Give as much oxygen as possible using a bag-valve mask or reservoir mask. Check carboxy haemoglobin levels and oxyhaemoglobin owing to their similar absorbances. The blood gas PaO ₂ (partial pressure of alveolar oxygen.) will also be normal in these cases (despite the presence of tissue hypoxia)

Source:

<http://www.icid.salisbury.nhs.uk/ClinicalManagement/Respiratory/Documents/8cc986f57c4041e68944595552169215OxygenPolicyAppendix1May2009.pdf> (As accessed on Dec. 15, 2017)

Annexure 3: Serious illnesses requiring moderate levels of supplemental oxygen if the patient is hypoxaemic

- *The initial oxygen therapy is nasal cannulae at 2–6 l/min (preferably) or simple face mask at 5–10 l/min unless stated otherwise.*
- *For patients not at risk of hypercapnic respiratory failure who have saturation, 85%, treatment should be commenced with a reservoir mask at 10–15 l/min.*
- *The recommended initial oxygen saturation target range is 94–98%.*
- *If oximetry is not available, give oxygen as above until oximetry or blood gas results are available.*
- *Change to reservoir mask if the desired saturation range cannot be maintained with nasal cannulae or simple face mask (and ensure that the patient is assessed by senior medical staff).*
- *If these patients have co-existing COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88–92% pending blood gas results but adjust to 94–98% if the PaCO₂ is normal (unless there is a history of previous hypercapnic respiratory failure requiring Non-invasive Ventilation (NIV), Intermittent Positive-Pressure Ventilation (IPPV) and recheck blood gases after 30–60 min.*

Diseases Conditions	Additional Comments
Acute hypoxaemia (cause not yet diagnosed)	Reservoir mask at 10–15 l/min if initial SpO ₂ ,85%, otherwise nasal cannulae or simple face mask Patients requiring reservoir mask therapy need urgent clinical assessment by senior staff
Postoperative breathlessness	Management depends on underlying cause
Acute heart failure	Consider CPAP or NIV in cases of pulmonary oedema
Pulmonary embolism	Most patients with minor pulmonary embolism are not hypoxaemic and do not require oxygen therapy
Pleural effusions	Most patients with pleural effusions are not hypoxaemic. If hypoxaemic, treat by draining the effusion as well as giving oxygen therapy
Pneumothorax	Needs aspiration or drainage if the patient is hypoxaemic. Use a reservoir mask at 10–15 l/min if admitted for observation. Aim at 100% saturation (oxygen accelerates clearance of pneumothorax if drainage is not required)
Deterioration of lung fibrosis or	Reservoir mask at 10–15 l/min if initial SpO ₂ ,85%, otherwise nasal cannulae or simple face mask

Diseases Conditions	Additional Comments
other interstitial lung disease	
Severe anaemia	The main issue is to correct the anaemia. Most anaemic patients do not require oxygen therapy
Sickle cell crisis	Requires oxygen only if hypoxaemic. Low oxygen tension will aggravate sickling

Annexure 4: COPD and other conditions requiring controlled or low-dose oxygen therapy

- *Prior to availability of blood gases, use a 28% Venturi mask at 4 l/min and aim for an oxygen saturation of 88–92% for patients with risk factors for hypercapnia but no prior history of respiratory acidosis.*
- *Adjust target range to 94–98% if the PaCO₂ is normal (unless there is a history of previous NIV or IPPV) and recheck blood gases after 30– 60 min.*
- *Aim at a prespecified saturation range (from alert card) in patients with a history of previous respiratory acidosis. These patients may have their own Venturi mask. In the absence of an oxygen alert card but with a history of previous respiratory failure (use of NIV or IPPV), treatment should be commenced using a 28% oxygen mask at 4 l/min in prehospital care or a 24% Venturi mask at 2–4 l/min in hospital settings with an initial target saturation of 88–92% pending urgent blood gas results.*
- *If the saturation remains below 88% in prehospital care despite a 28% Venturi mask, change to nasal cannulae at 2–6 l/min or a simple mask at 5 l/min with target saturation of 88–92%. All at-risk patients with alert cards, previous NIV or IPPV or with saturation, 88% in the ambulance should be treated as a high priority. Alert the A&E department that the patient requires immediate senior assessment on arrival at the hospital.*
- *If the diagnosis is unknown, patients aged >50 years who are long-term smokers with a history of chronic breathlessness on minor exertion such as walking on level ground and no other known cause of breathlessness should be treated as if having chronic obstructive pulmonary disease (COPD) for the purposes of this guideline. Patients with COPD may also use terms such as chronic bronchitis and emphysema to describe their condition but may sometimes mistakenly use ‘asthma’. FEV₁ should be measured on arrival in hospital if possible and should be measured at least once before discharge from hospital in all cases of suspected COPD.*

- *Patients with a significant likelihood of severe COPD or other illness that may cause hypercapnic respiratory failure should be triaged as very urgent and blood gases should be measured on arrival in hospital.*
- *Blood gases should be rechecked after 30–60 min (or if there is clinical deterioration) even if the initial PaCO₂ measurement was normal.*
- *If the arterial carbon dioxide tension (PaCO₂) is raised but pH is >7.35 ([H⁺] (45 nmol/l), the patient has probably got long-standing hypercapnia; maintain target range of 88–92% for these patients. Blood gases should be repeated at 30–60 min to check for rising PaCO₂ or falling pH.*
- *If the patient is hypercapnic (PaCO₂ .6 kPa or 45 mm Hg) and acidotic (pH ,7.35 or [H⁺] .45 nmol/l) consider non-invasive ventilation, especially if acidosis has persisted for more than 30 min despite appropriate therapy.*

Diseases Conditions

Additional Comments

Acute hypoxaemia (cause not yet diagnosed)	May need lower range if acidotic or if known to be very sensitive to oxygen therapy. Ideally use alert cards to guide treatment based on previous blood gas results. Increase flow by 50% if respiratory rate is .30 (see recommendation 32)
Exacerbation of CF	Admit to regional CF centre if possible; if not, discuss with regional centre or manage according to protocol agreed with regional cystic fibrosis (CF) centre Ideally use alert cards to guide therapy. Increase flow by 50% if respiratory rate is .30 (see recommendation 32)
Chronic neuromuscular disorders	May require ventilatory support. Risk of hypercapnic respiratory failure
Chest wall disorder	For acute neuromuscular disorders and subacute conditions such as Guillain-Barre´ syndrome

CF, cystic fibrosis; COPD, chronic obstructive pulmonary disease; CPAP, continuous positive airway pressure; IPPV, intermittent positive pressure ventilation; NIV, non-invasive ventilation; PaCO₂, arterial carbon dioxide tension; SpO₂, arterial oxygen saturation measured by pulse oximetry.

Annexure 5: Conditions for which patients should be monitored closely but Oxygen therapy is not required unless the patient is hypoxemic

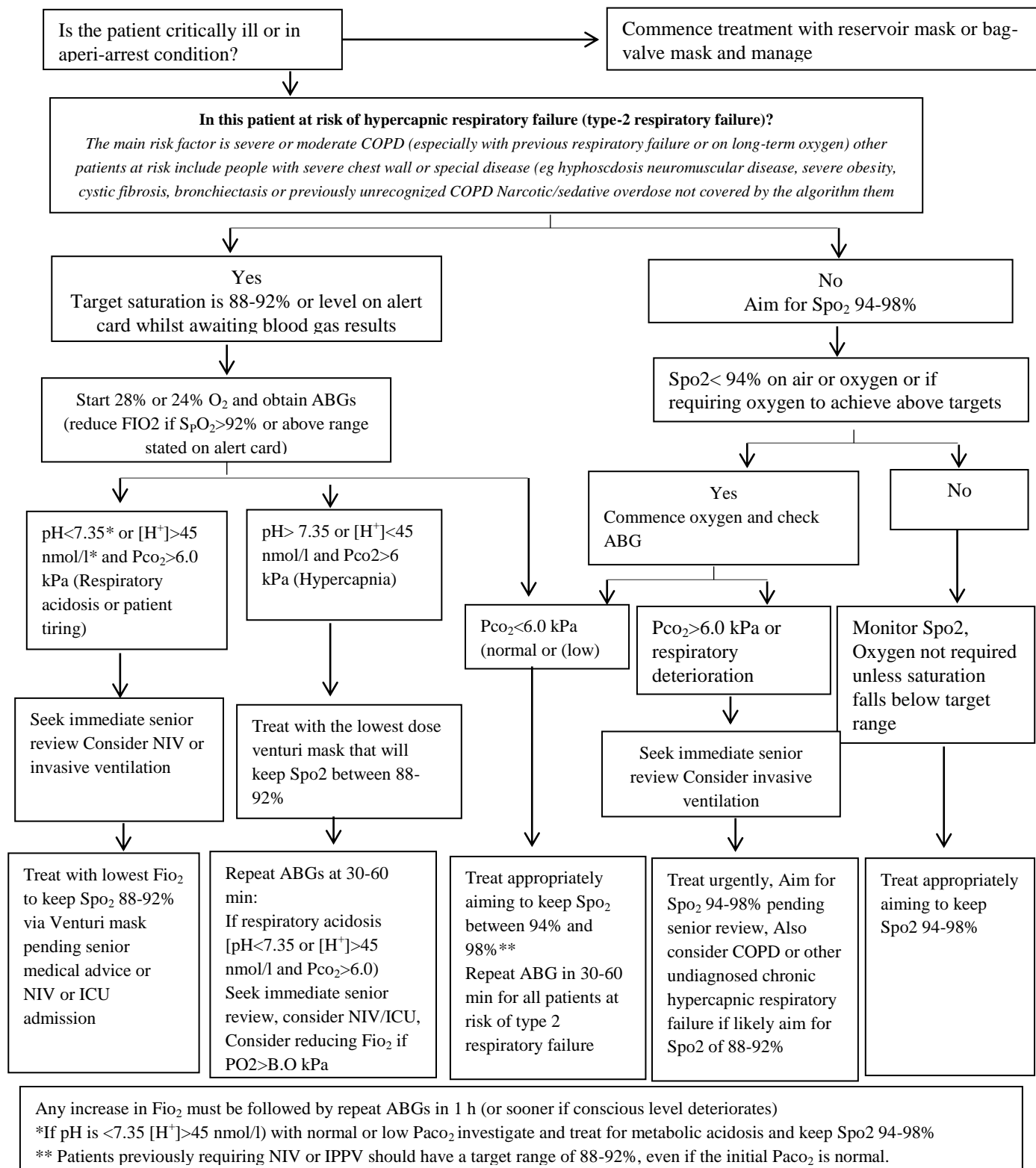
- If hypoxaemic, the initial oxygen therapy is nasal cannulae at 2-6 l/min or simple face mask at 5-10 l/min unless saturation is <85% (use reservoir mask) or if at risk from hypercapnia (see below).
- The recommended initial target saturation range, unless stated otherwise, is 94—98%
- If oximetry is not available, give oxygen as above until oximetry or blood gas results are available
- If patients have COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88-92% pending blood gas results but adjust to 94—98% if the PaCO₂ is normal (unless there is a history of respiratory failure requiring NIV or IPPV) and recheck blood gases after 30-60 min

Disease condition	Additional comments
Myocardial infarction and acute coronary syndromes Stroke	Most patients with acute coronary artery syndromes are not hypoxaemic and the benefits/harms of oxygen therapy are unknown in such cases Most stroke patients are not hypoxaemic. Oxygen therapy may be harmful for non-hypoxaemic patients with mild to moderate strokes.
Pregnancy and obstetric emergencies	Oxygen therapy may be harmful to the fetus if the mother is not hypoxaemic
Hyperventilation or dysfunctional breathing	Exclude organic illness. Patients with pure hyperventilation due to anxiety or panic attacks are unlikely to require oxygen therapy breathing from a paper bag may cause hypoxaemia and is not recommended
Most poisonings and drug overdoses	Hypoxaemia is more likely with respiratory depressant drugs, give antidote if available (eg, naloxone for opiate poisoning) Check blood gases to exclude hypercapnia if a respiratory depressant drug has been taken. Avoid high blood oxygen levels in cases of acid aspiration as there is theoretical evidence that oxygen may be harmful in this condition Monitor all potentially serious cases of poisoning in a level 2 or level

<p>Poisoning with paraquat or bleomycin</p>	<p>3 environment thigh dependency unit or ICU)</p> <p>Patients with paraquat poisoning or bleomycin lung injury may be harmed by supplemental oxygen Avoid oxygen unless the patient is hypoxaemic Target saturation is 88-92%</p> <p>Most do not need oxygen (tachypnoea may be due to acidosis in these patients)</p>
<p>Metabolic and renal disorders</p>	<p>These patients may require ventilatory support and they need careful monitoring which includes spirometry. If the patient's oxygen level falls below the target saturation, they need urgent blood gas measurements and are likely to need ventilatory support</p>
<p>Acute and subacute neurological and muscular conditions producing muscle weakness</p>	

COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; IPPV, intermittent positive pressure ventilation; NIV, non-invasive ventilation; Paco₂, arterial carbon dioxide tension; Spo₂, arterial oxygen saturation measured by pulse oximetry.

ANNEXURE 6: ADMINISTERING ACUTE OXYGEN THERAPY



ANNEXURE 7: EQUIPMENT USED IN THE DELIVERY OF OXYGEN (Choose the appropriate delivery device)

SN	ACTION	RATIONALE
1	Ensure patency of airway	To promote effective oxygenation
2	The type of delivery system used will depend on the needs and comfort of the patient. It is the nurses role to assess the patient and use the prescribed system	To provide accurate oxygen delivery to the patients Most stable patients prefer the patients prefer nasal cannulae to masks.
3	Ensure oxygen is prescribed on prescription chart. In some situations a patient group direction may be in place to allow designated nurses to administer In these cases the doctor must review the patients condition within the stated time and prescribe oxygen accordingly.	To ensure a complete record is maintained and expedite patient treatment. The exception to this action would be during an emergency situation where the resuscitation guideline should be followed.
4	Inform patient and or relative/ carer of the combustibility of oxygen	Oxygen supports combustion therefore there is always a danger of fire when oxygen is being used.
5	Show and explain the oxygen delivery system to the patient. Give the patient the information sheet about oxygen.	To obtain consent and cooperation.
6	Carefully assemble the oxygen delivery system	To ensure oxygen is given as prescribed.
7	Attach oxygen delivery system to	To ensure oxygen supply is ready oxygen source.
8	Attach oxygen delivery system to patient according to manufacturer's instructions.	For oxygen to be administered to patients
9	Turn on oxygen flow in accordance with prescription and manufacturers instruction.	To administer correct % of oxygen
10	Ensure patient has either a drink or a mouthwash within reach.	To prevent drying of the oral mucosa.
11	Clean oxygen mask as required with general purpose detergent and dry thoroughly needed. Discard systems after use.	To minimise risk of infection (Single patient device)

1. Oxygen source (piped or cylinder)
2. Flow meter
3. Saturation monitor
4. Oxygen Delivery system

Device	Descriptions	Purpose
A. Nasal Cannulae	<p>Nasal cannulae consist of pair of tubes about 2cm long, each projecting into the nostril and stemming from a tube which passes over the ears and which is thus selfretaining.</p> <p>Uncontrolled oxygen therapy</p>	<p>Cannulae are preferred to masks by most patients. They have the advantage of not interfering with feeding and are not as inconvenient as masks during coughing and sneezing. It is not advisable to assume what percent oxygen (FI02) the patient is receiving according to the Litres delivered but this is not important if the patient is in the correct target range.</p>

Action

When using nasal cannula: Position the tips of the cannula in the patient's nose so that the tips do not extend more than 1.5cm into the nose.

Place tubing over the ears and under the chin as shown above. Educate patient re prevention of pressure areas on the back of the ear.


Adjust flow rate, usually 2-4 l/min but may vary from 1-6 l/min in some circumstances.

Rationale

Overlong tubing is uncomfortable, which may make the patient reject the procedure. Sore nasal mucosa can result from pressure or friction of tubing that is too long.

To allow optimum comfort for the patient. To prevent pressure sores.

Set the flow rate to achieve the desired target oxygen saturation.

Device	Descriptions	Purpose
<p>B. Fixed performance mask (Venturi mask and valve)</p>  <p>(Venturi Mask)</p>	<p>A mask incorporating a device to enable a fixed concentration of oxygen to be delivered independent of patient factors or fit to the face or flow rate. Oxygen is forced out through a small hole causing a Venturi effect which enables air to mix with oxygen.</p> <p>Controlled oxygen therapy</p>	<p>This is a high performance oxygen mask designed to deliver a specified oxygen concentration regardless of breathing rate or tidal volume.</p> <p>Venturi devices come in different colours for %</p> <p>Blue = 24% White = 28% Yellow = 35% Red = 40% Green = 60%</p>

Action

Rationale

- | | |
|---|--|
| 8. When using Venturi mask, connect the mask to the appropriate Venturi barrel attached firmly into the mask inlet | To ensure that patient receives the correct concentration of oxygen |
| 9. Fasten oxygen tubing securely. | Correctly secured tubing is comfortable and prevents displacement of mask/cannulae. |
| 10. Assess the patient's condition and functioning of equipment at regular intervals according to care plan | To ensure patient's safety and that oxygen is being administered as prescribed. |
| 11. Adjust flow rate. The minimum flow rate is indicated on the mask or packet. The flow should be doubled if the patient has a respiratory rate above 30 per minute. | Higher flows are required for patients with rapid respiration and high inspiratory flow rates. This does not affect the concentration of oxygen but allows the gas flow rate to match the patient's breathing pattern. |

C) **Simple face mask (variable flow)**

DEVICE



Simple face mask
Variable Percentage
(Delivers unpredictable concentrations that vary with flow rate)

Nasal cannulae should be used for most patients who require medium dose oxygen but a simple face mask may be used due to patient preference or if the nose is blocked

DESCRIPTION

Mask has a soft plastic face piece, vent holes are provided to allow air to escape.
Maximum 50%-60% at 15ltrs/minute flow.

Uncontrolled Oxygen therapy

PURPOSE

This is a variable performance device. The oxygen concentration delivered will be influenced by:

a. the oxygen flow rate(litres per minute) used, leakage between the mask and face;

b. the patient's tidal volume and breathing rate.

NOT to be used for CO₂ retaining patients.

ACTION

RATIONALE

(If using simple face mask) Gently place mask over the patient's face, position the strap behind the head or the loops over the ears then carefully pull both ends through the front of the mask until secure.

Ensure a comfortable fit and delivery of prescribed oxygen is maintained.

Check that strap is not across ears and if necessary insert padding between the strap and head.

To prevent irritation.

Adjust the oxygen flow rate. Must never be below 5L/min

Flows below 5L/m do not give enough oxygen

D) Reservoir mask (non re-breathe mask)

DEVICE

Reservoir Mask (Non-rebreathe Mask)



DESCRIPTION

Mask has a soft plastic face piece with flap-valve exhalation ports which may be removed for emergency air-intake. There is also a one-way valve between the face mask and reservoir bag.

PURPOSE

In non re-breathing systems the oxygen may be stored in the reservoir bag during exhalation by means of a one-way valve. High concentrations of oxygen 80-90% can be achieved at relatively low flow rates.

Uncontrolled oxygen therapy

NOT to be used for CO2 retaining patients except in life-threatening emergencies such as cardiac arrest or major trauma.

ACTION

1. (Non Rebreathe Reservoir Mask)

Ensure the reservoir bag is inflated before placing mask on patient, this can be maintained by using 10-15 litres of oxygen per min.

2. Adjust the oxygen flow to the prescribed rate.

RATIONALE

To ensure the optimal flow of oxygen to the patient.

Inadequate flow rates may result in administration of inadequate oxygen concentration to the patient.

In disposable reservoir, oxygen flows directly into the mask during inspiration and into the reservoir bag during exhalation. All exhaled air is vented through a port in the mask and a one-way valve between the bag and mask, which prevents re-breathing.

E) Tracheostomy mask for patients with tracheostomy or laryngectomy

DEVICE



DESCRIPTION

Mask designed for "neck breathing patients". Fits comfortably over tracheostomy or tracheotomy. Exhalation port on front of mask.

PURPOSE

This is a variable performance device for patients with tracheostomy or tracheotomy. The oxygen concentration delivered will be influenced by:
a. the oxygen flow rate (litres per minute) used.
b. the patient's tidal volume and breathing rate.

Tracheostomy mask

Variable Percentage (Delivers unpredictable concentrations that vary with flow rate)

Uncontrolled Oxygen therapy

Use cautiously at low flow rates in CO2 retaining patients as there may be no alternative.

ACTION

Gently place mask over the patient's airway, position the strap behind the head then carefully pull both ends through the front of the mask until secure.

RATIONALE

Ensure a comfortable fit and delivery of prescribed oxygen is maintained.

Adjust the oxygen flow rate to achieve the desired target saturation range. Start at 4 l/min and adjust the flow up or down as necessary to achieve the desired oxygen saturation range.

To ensure that the correct amount of oxygen is given to keep the patient in the target range.

F) Oxygen Flow Meter

DEVICE



Oxygen flow meter
Delivers oxygen to the patient.

DESCRIPTION

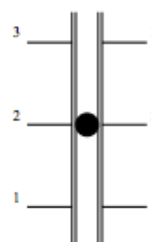
Device to allow the patient to receive an accurate flow of oxygen, usually between 2 and 15 litres per minute.

May be wall-mounted or on a cylinder.

Take Special care if your hospital uses a twin oxygen outlets or if there are air outlets which may be mistaken for oxygen outlets

PURPOSE

To ensure that the patient receives the correct amount of oxygen.



Correct Setting for 2 l/min

ACTION

Attach the oxygen tubing to the nozzle on the flow meter.

Turn the finger-valve to obtain the desired flow rate. The CENTRE of the ball shows the correct flow rate. The diagrams shows the correct setting to deliver 2 l/min.

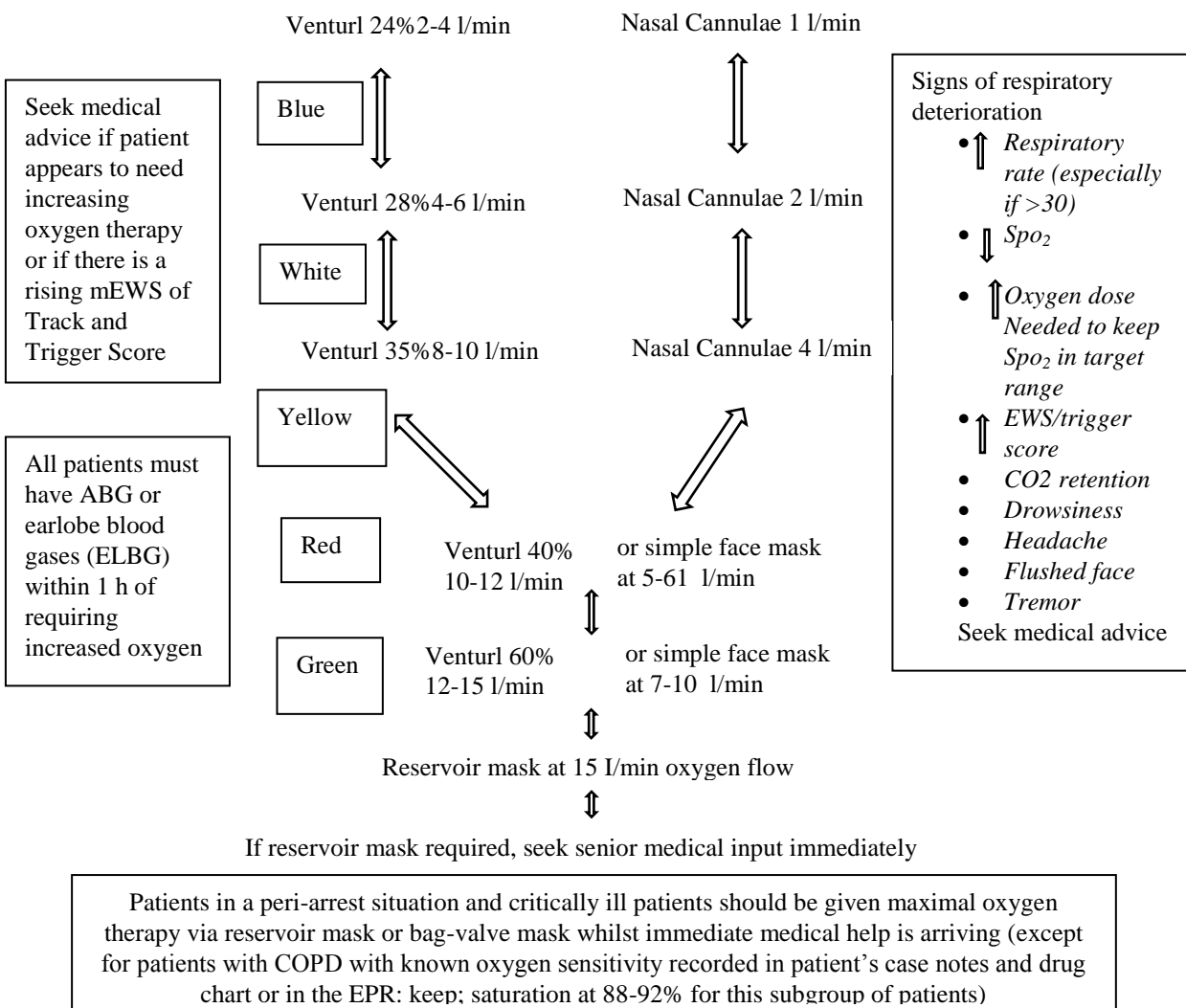
RATIONALE

To ensure that the patient receives the correct amount of oxygen.

ANNEXURE 8 : FLOW CHART FOR OXYGEN ADMINISTRATION

- See patient's drug chart and annexure 1-6 for starting dose and target saturation
- Chose the most suitable delivery system and flow rate
- Titrate oxygen up or down to maintain the target oxygen saturation

The figure below shows available options for stepping dosage up or down. The chart does not imply any equivalence of dose between Venturi masks and nasal cannulae. Allow at least 5 minutes at each dose before adjusting further upwards or downwards (except with major as sudden fall in saturation) Once your patient has adequate and stable saturation on minimal oxygen dose, consider discontinuation of oxygen therapy.



Flow chart for oxygen administration on general wards in hospitals. ABG, arterial blood gas; EPR, electronic patient record; EWS, Early Warning Score; SpO₂, arterial oxygen saturation measured by pulse oximetry

Note: For Venturi mask, the higher flow rate is required if the respiratory rate is >30

ANNEXURE 9: HUMIDIFICATION



Humidified oxygen is helpful to improve patient comfort and tolerance of therapy and to maintain optimal mucocilliary clearance in the airways. Humidification may be required for some patient groups, especially "neck-breathing patients" and those who have difficulty in clearing airway secretions or mucus. This should only be used if specifically requested by the doctor or physiotherapist in the following circumstances. It is indicated in the following situations.

1. If the flow rate exceeds 4 litres per minute for several days
2. Tracheotomy or tracheostomy patients (neck-breathing patients)
3. Cystic Fibrosis patients
4. Bronchiectasis patients
5. Patients with a chest infection retaining secretions. Can be given by warm or cold humidifier systems (*warm humidifier systems are mainly used in critical care areas*)