

UCSF MEDICAL CENTER
DEPARTMENT OF NURSING
NURSING PROCEDURES MANUAL

OXYGEN AND AEROSOL THERAPY (GENERAL)

PURPOSE

To guide registered nurses (RNs) in the care of patients requiring oxygen and aerosol therapy.

Oxygen (O₂) and/or aerosol therapy requires a provider order. This order must include the oxygen flow rate or oxygen concentration (FiO₂), type of delivery device, frequency, and adjustment parameters. For aerosolized medications refer to [Medication Administration](#) nursing procedure.

RNs and Respiratory Care Practitioners (RCPs) are responsible for initiating, maintaining, and discontinuing oxygen therapy. Patient Care Assistants may assist in maintaining oxygen therapy under direction of RNs and RCPs.

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Related Procedures and Policies:

- Respiratory Care Services Policy/Procedure: Oxygen Therapy
- Respiratory Care Services Policy/Procedure: NPPV & CPAP
- EOC Manual: Medical Gas Cylinders – Safety, Storage & Use
- Nursing General Procedure: [Medication Administration](#)
- Nursing procedure: [High-Flow Nasal Cannula \(Neonatal/Pediatric\)](#)
- Nursing Policy: [Transport Requirements for Acute/Transitional Care Pediatric Patients to Off Unit Procedures](#)
- Nursing Policy: [Transport and Care of Adult Patients for Off Unit Procedures](#)
- Nursing Guidelines: [Guidelines for Safe Administration of Therapies & Medications on Adult Transitional & Acute Care Units](#)
- Nursing Guidelines: [Pediatric Guidelines for Level of Nursing Care \(Therapies & Medications\)](#)

OXYGEN & AEROSOL THERAPY (GENERAL) (continued)

CRITICAL POINTS

- A. Oxygen therapy is ordered as a flow rate with low-flow delivery systems (e.g., nasal cannula 2 L/min), or oxygen concentration for use with high-flow delivery systems (e.g., aerosol face mask 40%).
- B. Bubble humidifiers are recommended for all pediatric patients using a nasal cannula. Humidifiers may be used on adult patients using a nasal cannula at greater than 4 L/min and for comfort.
- C. An oxygen flow meter and self-inflating resuscitation bag must be readily available in patient care areas. Pediatrics must keep a variety of mask sizes with each resuscitation bag.
- D. Collection of water in aerosol tubing will obstruct flow of gas to patient. To prevent water build up, use a water collection bag. Do not empty water collected in aerosol tubing back into nebulizer.
- E. Pediatric patients with increased oxygen requirements must be accompanied by a RN to all off-unit procedures. Refer to Nursing Administrative Policy [Transport Requirements for Acute/Transitional Care Pediatric Patients to Off Unit Procedures](#).

EQUIPMENT / SUPPLIES / change frequency

I. LOW-FLOW OXYGEN EQUIPMENT

- A. Oxygen equipment includes:
 - Oxygen flow meter (green)
 - Humidifier (if needed)
 - Tubing
 - Delivery device (e.g., nasal cannula or mask). **A humidifier should NOT be used with a non-rebreathing mask.**
- B. Oxygen delivery equipment is changed when visibly soiled.

II. PORTABLE OXYGEN TANKS

- A. Transport:
 - Use only transport “E” tanks in a caddy or designated bed holder.
 - Prior to transport RN verifies tank is **full (green zone)**. Refer to [Appendix D](#).
 - Oxygen tank duration (manual calculation and estimation table):

➤ **Tank Duration Manual Calculation**

$$\text{Oxygen "E" Tank Duration (in minutes)} = \frac{\text{Pounds per Square Inch (psi)} \times 0.28}{\text{Flow Rate}}$$

Example: O₂ via Nasal Cannula at 4L/min. The “E” cylinder’s pressure gauge reads 2000 psi

$$\text{Oxygen "E" Tank Duration} = \frac{2000 \times 0.28}{4} = 140 \text{ minutes}$$

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

➤ **Guide for Estimating Minutes of Available Oxygen**

Liters per Minute	Pressure (psi) in E Oxygen Tank							
	500	750	1000	1250	1500	1750	2000	2200
	Approximate Minutes of Operation							
1	140	210	280	350	420	490	560	616
2	70	105	140	175	210	245	280	308
3	46	70	93	116	140	163	186	205
4	35	52	70	87	105	122	140	154
5	28	42	56	70	84	98	112	123
6	23	35	46	58	70	81	93	102
10	14	21	28	35	42	49	56	61
12	11	17	23	29	35	40	46	51
15	09	14	18	23	28	32	37	41

Note: Gray shaded area indicates **less than 30 minutes of oxygen**.

When pressure gauge readings are between the psi readings on the table, use the lower psi reading to determine the appropriate minutes of oxygen available.

B. Storage:

- Oxygen tanks with **700 psi or less are considered “empty”**. Do not use during transport. Return tank to designated storage area.
- Store full and empty portable oxygen tanks in separate designated areas.

HIGH-FLOW OXYGEN EQUIPMENT (AEROSOL THERAPY)

A. Aerosol equipment includes:

- Oxygen flow meter (green)
- Nebulizer unit
- Aerosol tubing
- Water collection bag
- Sterile water for aerosol therapy
- Delivery device (e.g., face tent or trach collar)

B. Aerosol equipment must be changed every 24 hours. Label sterile water bottle with date and time.

Procedure

I. FOR BOTH OXYGEN & AEROSOL THERAPY

- A. Assess pulmonary status and document findings. Include SpO₂ (oxygen saturation) and mode of O₂ delivery.
- B. Instruct patient/family regarding purpose and goal of O₂ therapy and associated hazards.
- C. Observe and educate patient as clinically indicated to prevent accidental disconnection from O₂ supply, removal of device, or obstruction of gas flow.

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

- D. Observe skin areas on ears, face, nares, or neck for irritation or abrasion from delivery device. Use foam ear protectors for irritation around ears.
- E. A provider order is required to discontinue O₂ therapy.
- F. Discard/return used equipment at completion of therapy.

II. OXYGEN THERAPY

- A. Assess appropriateness of prescribed flow rate or oxygen concentration in relation to: clinical condition, prescribed delivery device, and goals of oxygen therapy.
- B. Obtain and set up appropriate equipment listed in [Equipment/Supplies - Section III](#). See [Appendix A: Low-Flow Delivery Systems](#).
- C. Implement oxygen administration at the prescribed flow rate or concentration.
- D. Observe for changes in breathing pattern and sedation level.
- E. When transporting or ambulating patients on oxygen attach a [full](#) "E" cylinder. Or, for an ambulating patient on nasal cannula, tank must have [at least ≥ 1000 psi](#) available.

III. AEROSOL THERAPY

- A. Assess appropriateness of prescribed oxygen concentration (FiO₂), delivery device, and frequency (PRN or continuous) in relation to: clinical condition, prescribed delivery device, and goals of aerosol therapy.
 - A heated nebulizer may be indicated for some patients with thick secretions, or who are breathing through an artificial airway.
- B. Obtain and set up appropriate equipment listed in [Equipment/Supplies - Section III](#). See Appendix B and C: [High-Flow Delivery Systems](#) and [Additional Equipment](#).
- C. Start aerosol therapy at prescribed oxygen concentration.
- D. Set flow rate at a minimum of 10 L/min to create visible mist.
 - When weaning oxygen concentration of the aerosol system, the flow rate should remain at 10 L/min minimum.
 - To increase or decrease oxygen concentration, adjust dial on nebulizer to desired FiO₂ and adjust flowmeter to manufacturer's recommended flow.
- E. Discontinue aerosol if patient experiences wheezing, and/or paroxysms of coughing. Notify provider and consult RCP to reevaluate therapy.
- F. Discard and replace sterile water bottle every 24 hours or when empty.

OXYGEN / AEROSOL THERAPY DOCUMENTATION

- A. Document O₂ therapy, flow rate and/or FiO₂, and delivery device.
- B. [Response to therapy](#): document patient's response to oxygen/aerosol therapy per standard of care or per provider order.

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

References

- AARC Clinical Practice Guideline Oxygen Therapy for Adults in the Acute Care Facility 2002 Revision & Update.
- Barnhart, S.L. & Czervinske, M.P. (1995). *O₂ and aerosol in perinatal and pediatric respiratory care*. Philadelphia: W.B. Saunders.
- Bowden, V.R. & Greenberg, C.S. (2008). *Pediatric Nursing Procedures*. (2nd ed.) Philadelphia: Lippincott Williams & Wilkins.
- Bowman, A. (2008). Oxygen therapy. In Jean Proehl (4th ed.). *Emergency Nursing Procedures* (pp.106-129). Elsevier Health Sciences.
- Eikin, M.A., Perry, A.G., Potter, P.A. (2000). Oxygen administration in nursing interventions and clinical skills (2nd ed.) (pp. 728-738). St. Louis: Mosby.

◆◆◆◆◆PROCEDURE HISTORY◆◆◆◆◆

- Authors: Melissa Ballard, RN; Pearl Jue, RRT; Brian Daniels, RRT
- Originated: 9/94
- Resources: CNSs; RRTs
- Reviewed: 9/95
7/18: Approved by the Patient Care Standards Committee
- Reviewed/revised: 9/97, 10/00, 4/01
- 3/04: Marylou Muwaswes, RN, MS, CNS; Pearl Jue, RRT; Pauline Chin, RN, MS
- 2/07: Marylou Muwaswes, RN, MS, CNS; Rebecca Hancock, RRT; Brian Daniel, RRT; Paige Kelly, RRT
- 5/11: Rebecca Hancock, RRT; Brian Daniel, RRT; Lisa Tsang RN, MN; Melissa Lee RN, MS, CNS
- 12/13: Beth Kennalley, RN, MSN, PNP, CNS; Melissa Lee RN, MS, CNS
- 10/16: Lisa Tsang, RN, MN; Melissa Lee, RN, MS, CNS; Ramona Burke, RRT; James Bisgaard, RRT-NPS
- 7/18: Melissa Lee, RN, MS, CNS; Lisa Tsang, RN, MN; Ramona Burke, RRT; James Bisgaard, RRT-NPS
- 8/19: Melissa Lee, RN, MS, CNS (Appendix A Simple Mask revision)
- 11/20: Melissa Lee, RN, MS, CNS; Lisa Tsang, RN, MN, CNS

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Inquiries to: Institute for Nursing Excellence at ucsf.inex@ucsf.edu

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

APPENDIX A: Low-Flow oxygen DELIVERY SYSTEMS

TYPE DEVICE/SETUP	FLOW RATE	COMMENTS	PRECAUTIONS
Flow Meter	<ul style="list-style-type: none"> Regulates the amount of liters per minute flow. 	<ul style="list-style-type: none"> Tubing may be attached directly, unless a humidifier is required. 	<ul style="list-style-type: none"> Flow meter should be in the off position when attaching to oxygen source
Nasal cannula	<p>Approximate Inhaled FiO₂ (Adult):</p> <ul style="list-style-type: none"> 1 L/min=approx. 24% 2 L/min=approx. 28% 3 L/min=approx. 32% 4 L/min=approx. 36% 5 L/min=approx. 40% 6 L/min=approx. 44% 	<ul style="list-style-type: none"> Irritation of nasal mucosa may occur at flow rates > 4 L/min Bubble humidifiers are recommended for all pediatric patients and on adult patients with flow greater than 4 L/min and/or for comfort The tubing length can be extended with additional tubing and a connector Change when soiled 	<ul style="list-style-type: none"> Assess patency of nares prior to application Delivered oxygen concentration is influenced by tidal volume, respiratory rate, and whether breathing predominantly through mouth or nose Twisting and kinking of tubing can be problematic. Assess tubing periodically for patency
Simple Mask	<ul style="list-style-type: none"> 6-10 L/min 	<ul style="list-style-type: none"> Always use liter flow of at least 6 L/min to prevent rebreathing exhaled CO₂. Must remove to eat/speak. May be uncomfortable and cause skin irritation. 	<ul style="list-style-type: none"> Delivered O₂ concentration is influenced by tidal volume, respiratory rate, and pattern Suffocation possible if O₂ supply is cut off or patient vomits and can't remove mask
Partial Re-breathing Mask	<ul style="list-style-type: none"> 6-10 L/min (enough to prevent complete collapse of reservoir bag) Yields a variable oxygen concentration of 35-60% 	<ul style="list-style-type: none"> Provides intermediate to high oxygen concentration There is no significant rebreathing of CO₂ Not to be used with a humidifier 	<ul style="list-style-type: none"> Remove all valves to create a Partial Rebreathing mask Delivered O₂ concentration is influenced by tidal volume, respiratory rate, and pattern

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

TYPE DEVICE/SETUP	FLOW RATE	COMMENTS	PRECAUTIONS
Non-Rebreathing Mask (NRB)	<ul style="list-style-type: none"> • 6-10 L/min (enough to prevent complete collapse of reservoir bag) • Yields a variable oxygen concentration of 55-70% 	<ul style="list-style-type: none"> • Delivers highest O₂ concentration possible with a low flow device • Must be removed for eating/speaking • NOT to be used with a humidifier • Adults: Use of high FiO₂ via NRB can assist in the absorption of air from the pleural space for pneumothorax. The same concepts can be applied to intervention for pneumocephalus. NRB may be used on acute care for pneumothorax if patient condition stable and if NRB not for ongoing hypoxia. 	<ul style="list-style-type: none"> • Ensure mask has only 1 valve present (remove second valve if needed) • Suffocation possible if O₂ supply is cut off, or patient vomits and cannot remove mask • Delivered O₂ concentration is influenced by tidal volume, respiratory rate, and pattern
Bubble Humidifier	<ul style="list-style-type: none"> • Bubble humidifiers are recommended for all pediatric patients using a nasal cannula • May be used on adult patients using a nasal cannula at greater than 4 L/min and/or for comfort 	<ul style="list-style-type: none"> • Provides humidity when administering oxygen Connects directly to flow meter, oxygen tubing connects to device • Bubble humidifiers are relatively inefficient, but may be helpful for patients complaining of nasal mucosa discomfort 	<ul style="list-style-type: none"> • Do not refill humidifiers • Discard and replace when water reaches the “replace” level • Ensure that the humidifier cap is well secured to the flow meter and bottle (can be confirmed by the presence of bubbling)

APPENDIX B: High-Flow oxygen DELIVERY systems

TYPE DEVICE/SETUP	FLOW RATE	COMMENTS	PRECAUTIONS	ADDITIONAL EQUIPMENT
<ul style="list-style-type: none"> • Aerosol Mask • Face tent • Trach collar 	<ul style="list-style-type: none"> • Turn flow meter to highest point (enough so mist visible during entire inspiratory phase) • Yield 28-95% concentration 	<ul style="list-style-type: none"> • Must be removed for eating and speaking • Can be used in tandem with a second large volume nebulizer • Face tent is less claustrophobic 	<ul style="list-style-type: none"> • Ensure nebulizer is tightly secured to flow meter • Face tent – lower inspired oxygen concentration due to dilution with room air • Delivered O₂ concentration affected by tidal volume, respiratory rate and pattern 	<ul style="list-style-type: none"> • Flow meter • Large volume nebulizer • Aerosol tubing • Water collection Bag

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

TYPE DEVICE/SETUP	FLOW RATE	COMMENTS	PRECAUTIONS	ADDITIONAL EQUIPMENT
Aerosol Mask with Reservoir tubes	<ul style="list-style-type: none"> Turn flow meter to highest point (enough so mist visible during entire inspiratory phase) 	<ul style="list-style-type: none"> Reservoir tubes are used to prevent entrainment of room air Attach 6" reservoir tubes in ports of mask Must be removed for eating and speaking 	<ul style="list-style-type: none"> Suffocation possible if oxygen supply is cut off or patient vomits and cannot remove mask Ensure nebulizer is tightly secured to flow meter Delivered oxygen concentration is influenced by tidal volume, respiratory rate, and pattern 	<ul style="list-style-type: none"> Flow meter Large volume nebulizer Aerosol tubing Water collection bag
High Flow Nasal Cannula (HFNC)	<ul style="list-style-type: none"> HFNC use and max liter flow on the acute and transitional care areas is restricted. Refer to the following references for criteria: Adult: Guidelines for Safe Administration of Therapies & Medications on Adult Transitional & Acute Care Units Pediatric: Pediatric guidelines for level of nursing care (therapies and medications) 	<ul style="list-style-type: none"> Additional references: Respiratory Care Services Policy/Procedure: Oxygen Therapy Section G For Pediatric Transitional Care and Pediatric Cardiac Transitional Care patients see High-Flow Nasal Cannula (Neonatal/Pediatric) Appendix E: Advanced Lung Disease Patients with High Flow Nasal Cannula in the Adult Transitional Care Unit 	<ul style="list-style-type: none"> Respiratory Care Services initiates HFNC and has primary responsibility to adjust settings per provider order Contact respiratory therapist prior to transport to discuss plan for HFNC therapy during off-unit transport If system alarms, call RCP immediately, and do NOT silence the alarms. The circuit can be hot, avoid direct contact with patient to prevent burns 	<ul style="list-style-type: none"> Respiratory Care Services is responsible for equipment set up and maintenance Nursing is responsible for ensuring nasal cannula is in place and positioned correctly
Venturi Mask or Air Entrainment Mask (Not used frequently at UCSF)	<ul style="list-style-type: none"> 24-50% "fixed" oxygen concentration 	<ul style="list-style-type: none"> Provides low to moderate oxygen concentration which is less affected by breathing pattern Do NOT use with humidifier 	<ul style="list-style-type: none"> Always attach aerosol collar to prevent accidental occlusion of entrainment ports by bed linen Suffocation possible if O₂ supply is cut off, or patient vomits and cannot remove mask 	<ul style="list-style-type: none"> Flow meter O₂ tubing

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

TYPE DEVICE/SETUP	FLOW RATE	COMMENTS	PRECAUTIONS	ADDITIONAL EQUIPMENT
		<ul style="list-style-type: none"> • Must be removed for eating and speaking 		
High Flow Nebulizer	<ul style="list-style-type: none"> • Turn flowmeter to highest point (enough so mist visible during entire inspiratory phase) 	<ul style="list-style-type: none"> • Use reservoir tubes to increase O₂ concentration • Must be removed for eating and speaking 	<ul style="list-style-type: none"> • Suffocation possible if O₂ supply is cut off, or patient vomits and cannot remove mask • Ensure nebulizer is tightly secured to flow meter • Delivered oxygen concentration is influenced by tidal volume, respiratory rate, and pattern 	<ul style="list-style-type: none"> • Flow meter • Aerosol tubing • Water collection bag • Mask, face tent, or trach collar
Nebulizer	<ul style="list-style-type: none"> • Provides high flow oxygen delivery while at the same time providing 100% relative humidity to the patient's airway 	<ul style="list-style-type: none"> • O₂ concentration set on nebulizer • Minimum flow 10L/min (so mist visible from delivery device) • To increase relative humidification, use heater 	<ul style="list-style-type: none"> • Aerosol generated may cause bronchospasm • If water collects in tubing, it obstructs the flow of gas to patient and varies the delivered O₂ concentration 	

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OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

APPENDIX C: Additional EQUIPMENT

TYPE OF EQUIPMENT	PURPOSE	COMMENTS	PRECAUTIONS
Water Collection Bag	<ul style="list-style-type: none">• To collect excess water that would normally become trapped in aerosol tubing	<ul style="list-style-type: none">• DO NOT empty water collected in tubing back into nebulizer• Should be used with all heated aerosol and T-piece set-ups and all (heated or cool) trach collars set ups	<ul style="list-style-type: none">• If water collects in tubing, it will obstruct flow of gas to patient and vary the delivered oxygen concentration
Heater	<ul style="list-style-type: none">• Maximum humidity of delivered oxygen to patient		<ul style="list-style-type: none">• As water in nebulizer decreases, the temperature of delivered oxygen increases

OXYGEN & AEROSOL THERAPY (GENERAL) (continued)

APPENDIX D: PORTABLE OXYGEN TANK TRANSPORT SIGN

KNOW YOUR FLOW BEFORE YOU GO!

1) Verify the tank is full (gauge is in the green zone)



2) Check the Oxygen Requirements for the Duration of Transport

Guide for Estimating Minutes of Available Oxygen

Liters per Minute	Pressure (psi) in E Oxygen Tank							
	500	750	1000	1250	1500	1750	2000	2200
	Approximate Minutes of Operation							
1	140	210	280	350	420	490	560	616
2	70	105	140	175	210	245	280	308
3	46	70	93	116	140	163	186	205
4	35	52	70	87	105	122	140	154
5	28	42	56	70	84	98	112	123
6	23	35	46	58	70	81	93	102
10	14	21	28	35	42	49	56	61
12	11	17	23	29	35	40	46	51
15	09	14	18	23	28	32	37	41

Note: Shaded area indicates less than 30 minutes of oxygen. When pressure gauge readings are between the psi readings on the table, use the lower psi reading to determine the appropriate minutes of oxygen available.

References: Oxygen and Aerosol Therapy Nursing Procedure
Based on the 9/13 ICU Comprehensive Unit-based Safety Program (CUSP) tool

02/18

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

APPENDIX E: Advanced Lung Disease Patients with High Flow Nasal

Cannula (HFNC) in the Adult Transitional Care Unit (TCU)

The Advanced Lung Disease (ALD) patient population has high oxygen demands at home due to the progressive nature of their lung disease. Supportive therapies, such as high flow nasal cannula (HFNC) and non-rebreather mask (NRB) recovery after activity, may need to be initiated in the inpatient setting. This appendix is a reference for TCU staff providing care to the ALD population who require high oxygen demands and does not replace clinical decision making by the multidisciplinary team.

NOTE: HFNC therapy is for TCU and critical care areas only.

- A.** Rapid response team and ALD service will huddle for each HFNC patient every morning to discuss clinical status.
- B.** HFNC rate greater than 25L/min requires transfer to ICU.
- C.** Patients are instructed to pre-oxygenate with NRB before activity (e.g., ambulation, PT).
 - This is not a sign of increasing oxygen demand.
- D.** NRB may be used to recover oxygen saturation after activity (e.g., ambulation, working with PT).
 - Patients should recover oxygen saturation to 90% or greater within 30 minutes.
- E.** Escalation:
 - If NRB recovery needed when patient at rest or with minimal activity (e.g., eating, using bathroom):
 - ❖ RN will notify provider, RRT.
 - ❖ HFNC rate to be increased if not at maximum rate of 25L/min.
 - ❖ IF HFNC at maximum rate of 25L/min, discuss transfer to ICU for closer management.
 - If HFO rate rapidly escalating, discuss transfer to ICU for closer management.
 - If recovery time to re-gain oxygen saturation to 90% is greater than 30 minutes:
 - ❖ RN will notify provider, RRT.
 - ❖ Discuss transfer to ICU for closer management.
 - If there is an increase in frequency of desaturation events (greater than 3 times per shift), discuss transfer to ICU for closer management.
- F.** Nursing documentation in EMR:
 - Every desaturation with oxygen saturation
 - If using dual therapies (e.g., HFNC and NRB), add a second O₂ device to document all oxygen systems being used.
 - Oxygen saturation at time of therapy, and after therapy administered, to capture response to therapy.
 - Oxygen flow settings during ambulation.
 - Signs/symptoms of respiratory distress (e.g., labored breathing, use of accessory muscles) under respiratory assessment.
- G.** Room set up:
 - Ensure there is only ONE FULL tank in the room at all times.
 - Patients must call for RN assistance when exchanging O₂ modalities for ambulation, etc.

OXYGEN & AEROSOL THERAPY (GENERAL) *(continued)*

- Patients must call RN on return back to room to remove empty/extra tanks, etc.; and to assist in replacing HFNC.
- Suction setup in room on all HFNC patients.
- Move closer to nurses station when possible.

H. Additional guidelines and procedures:

- [Guidelines for Safe Administration of Therapies & Medications on Adult Acute Care & Transitional Care Units at UCSF Medical Center Campuses](#)
- Respiratory Care Services Policy/Procedure: Oxygen Therapy

APPENDIX E HISTORY:

Author: Michelle Macal, RN, MSN, CNS

Originated: 7/18 Added to procedure. (12/17 Document developed.)

Reviewed: 12/17 Matthew Aldrich, MD, Medical Director, Critical Care Medicine; Brian Daniel, RRT, RCP, Clinical Specialist-RCS; David Gordon, RN, DNP; Rosalee Greenholz, RN, MS, 10ICC Unit Director; Steven Hays, MD, Medical Director, Lung Transplant; Gautham Iyer, RN, NP, Advanced Lung Disease Service; Linda Liu, MD, Medical Director, RCS; Denise Marasigan RCP, RRT-ACCS; Jonathan Pascual, RN, MS, NP; Jensine Russell, RN, DNP, 10 CVT Unit Director

7/18: Approved by the Patient Care Standards Committee

Reviewed/revised: