I. Purpose
This policy will establish standards and procedure for obtaining high quality pulmonary mechanics.

II. Policy
A. Bedside spirometric evaluations or pulmonary mechanic evaluations may consist of forced vital capacity, negative inspiratory force, tidal volume, minute volume ventilation, and respiratory rate values, and when appropriate, maximum volume ventilation, rapid shallow breathing index, or a peak flow expiration values.
B. Criteria for pulmonary mechanics include:
   1. Patient must be able to follow commands to obtain certain ordered values
   2. Patients who may have identified or suspected risks of impending or continuing ventilatory failure
C. Objectives for performing pulmonary mechanics include:
   1. Obtain preop evaluation for patients who may be at cardiopulmonary risk
   2. Obtain values to guide in mechanical ventilation weaning or discontinuation
   3. Obtain values that help identify ventilatory failure
   4. establishing pre- and post- treatment ventilatory values for patients receiving aerosolized bronchodilator drugs, chest physiotherapy or hyperexpansion therapy to aid in assessing therapy effectiveness.
D. A written order is necessary for pulmonary mechanic tests; however, pulmonary mechanics may be obtained without orders on some patients for evaluating the effectiveness of respiratory therapy.
E. At minimum, a forced vital capacity, negative inspiratory force pressure, tidal volume, and respiratory rate will be obtained on mechanically ventilated patients each morning unless a desist order is written.
F. Negative inspiratory force is independent of patient effort. It may be performed on non-alert patients.
G. The intubated patient’s vital signs should be monitored closely during the tests; any dramatic change in the patient’s status should result in temporary termination of the tests.
H. As a standard of care, pre and post bronchodilator, peak expiratory flow rates are routinely evaluated in emergency room patients as part of their evaluation without a written order from the physician.

III. Equipment
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A. Pressure Manometer
B. Volume Spirometer
C. Bacterial Filter
D. Corrugated Tubing
E. 15 mm Adapter, or
F. Mouthpiece, or
G. Soft Seal Face Mask
H. Nose Clips (optional)
I. Peak Expiratory Flow Meter

IV. Procedure for Obtaining Pulmonary Mechanics
A. Collect the appropriate equipment
B. Proceed with minimum delay to patient area
C. Scan the patient chart to determine the order, diagnosis, and pertinent history and physical
D. Locate and identify the patient
E. Identify self and department to the patient
F. Explain prescribed tests to patient
G. Wash hands
H. Apply gloves
I. Aseptically assemble the equipment
J. Instruct the patient on proper technique for each test immediately before testing

1. Forced Vital Capacity
   a. Select the "ON" position on the spirometer
   b. Press the "RESET" button to zero the dial on the spirometer
   c. Connect the spirometer to the patient's artificial airway or place the mask over the patient's mouth and nose in such a way to obtain a seal
   d. Instruct and coach the patient to take a maximum deep breath and exhale as much air as possible
   e. Repeat the vital capacity maneuver a minimum of three reproducible times; note the best value obtained
   f. Return the patient to pretest oxygen device, if appropriate

2. Tidal Volume/Minute Volume
   a. Select the "ON" position on the spirometer
   b. Press the "RESET" button to zero the dial on the spirometer
   c. Connect the spirometer to the patient's artificial airway or place the mask over the patient's mouth and nose in such a way to obtain a seal
   d. Allow patient to breathe normally for one minute while observing for:
      i. the total volume obtained during the minute (minute ventilation)
      ii. the patient's respiratory rate
      iii. Divide the volume obtained by the patient's respiratory rate obtained during the one minute period
   h. Return the patient to pretest oxygen device, if appropriate

3. Negative Inspiratory Force
   a. If the patient has an artificial airway, inflate the endotracheal or tracheostomy tube cuff and provide airway care as needed
   b. Inform the patient that they will not be able to inspire any air during this test
   c. Connect the spirometer to the patient's artificial airway or place the mask over the patient's mouth and nose in such a way to obtain a seal
   d. Observe the patient's breathing pattern
   e. Instruct the patient to breathe in as hard as possible
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f. Occlude the ventilation port at the end of expiration.
g. Keep the port occluded for 10 to 20 seconds, so that the patient is stressed.
h. Make note of the maximum negative pressure generated by the patient.
i. Return the patient to pretest oxygen device, if appropriate

4. Rapid Shallow Breathing Index (optimal value is under 100)
   a. Perform the tidal volume maneuver
   b. Express the tidal volume in liters
   c. Divide the respiratory rate by the tidal volume

5. Peak Expiratory Flow Rate
   a. Gently rest the pointer to the end of the PEF meter nearest the mouthpiece
   b. Instruct the patient to hold the meter lightly; do not obstruct the pointer or the exhalation holes
   c. Instruct patient to take as deep a breath as possible and place the mouthpiece end into the patient’s mouth while forming a tight seal
   d. Instruct the patient to blow into the meter as quickly and as hard as possible
   e. Note the number at the pointer
   f. Repeat the above steps twice, for a total of three times
   g. Record the highest achieved value out of the three values in the patient’s record

K. Coach the patient during each test to obtain the patient’s maximum effort
L. Observe for any signs of respiratory distress, i.e. increased respiratory rate, pulse, bronchospasms, or physical signs of hypoxia
M. Obtain the patient’s best three reproducible values for each test
N. Place the patient’s disposable supplies in a protective package and leave in the room
O. Wash hands
P. Document the patient’s result on the appropriate records, i.e., respiratory record, ventilator flowsheet, physician progress notes. Objectively document if the patient’s effort is less than normal