SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

ACADEMIC AFFAIRS

Course Number: RSPC 303 Department: Respiratory Care

Course Title: Intensive Respiratory Care Semester: Spring Year: 1999

Objectives/Competencies

Course Objective	Competencies
1. Basic Terms and Concepts of Mechanical Ventilation: Students will be able to define terms, symbols, mechanisms, the importance in relationships graphs, equations, calculations, normal values and cite abnormal situations.	1. Define the following terms: ventilation, internal and external respiration. 2. Explain the importance of the following in relation to spontaneous ventilation and mechanical ventilation (Pawo, Pa, Paw, Pm, Ppl). 3. Recognize the symbols for, give the equations for, and solve calculations for each of the following: Pawo, Pa, Paw, Pm, Ppl. 4. Describe the normal mechanism by which spontaneous ventilation occurs. 5. Graph the alveolar and intrapleural pressures during spontaneous and positive pressure ventilation. 6. Define compliance and write out equation. 7. Calculate compliance. 8. Define elastance and write out equation. 9. Name the resistance properties that oppose ventilation. 10. Calculate airway resistance. 11. Cite examples in which airway resistance and lung

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2. Basics of Ventilator Graphics: Students will be able to graph, calculate, reproduce graphs, draw, label, identify changes, compare various differences related to basics of ventilator graphics.	compliance are abnormal. 1. Calculate and graph flow, volume, and pressure delivery over time to a lung, given airway resistance and compliance. 2. Reproduce graphs of PIP, Pta, and Pa, given flow and volume graphs. 3. Draw and label components of a normal pressure/volume loop, including inspiratory and expiratory curves, work of breathing, peak inspiratory pressure, and tidal volume. 4. From a pressure/volume graph, identify changes in lung compliance and airway resistance. 5. Draw and label a normal flow/volume loop. 6. Identify the presence of increased airway resistance (obstruction) in a flow/volume loop. 7. Draw pressure, flow, and volume curves over time fro a pressure breath. 8. Compare a volume to a pressure breath in terms of graphic patterns for flow, volume, and pressure over time. 9. Distinguish a change in flow, volume, and pressure curves caused by changes in airway resistance vs. changes in compliance for a volume breath. 10. Explain how changes in lung compliance and airway resistance each affect PIP, Pta, and Pa during volume ventilation. 11. Explain the changes that occur with volume and flow delivery during a pressure breath when lung compliance

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3. Physical Aspects of Mechanical Ventilation: Students will be able to define: power sources, negative and positive pressure, open loop, closed loop, internal and external circuit, drive mechanisms, flow-control valves, four breath types, flow triggering, pressure triggering, inflative hold, peep, pap, and bipap as it relates to physical aspects of mechanical ventilators.	or airway resistance changes. 1. Name the basic types of power sources used for mechanical ventilators. 2. Given a specific power source, name a ventilator that is an example of that power source. 3. Explain the difference between positive and negative pressure ventilators. 4. Recognize an open loop and a closed loop system, given a description of the system. 5. Describe a ventilator internal and external circuit. 6. Label the components of an external circuit (patient circuit) and identify those that are essential for the function of the ventilator. 7. Defend the need for each of the essential parts of a ventilator circuit, that is, why each is essential. 8. List four different examples of types of volume displacement drive mechanisms. 9. Name three different examples of flow-control valves. 10. Compare each of the factors on the left side of the equation of motion with those on the right. 11. Provide four other possible names used to describe pressure ventilation and volume ventilation. 12. Compare the four breath types and their potential waveforms. 13. Relate how a breath that is flow-controlled is similar to a breath that is volume-controlled.

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	14. Given an example of a breath (i.e., patient-triggered, volume-limited, time-cycled), classify the breath as either mandatory, assisted, or spontaneous. 15. Defend the concept that pressure support is actually a spontaneous breath - or, argue why it is not. 16. Explain how flow-triggering is set. 17. Compare the work of breathing required with flow-triggering. 18. From a clinical example of ventilator settings, provide the triggering, limiting, and cycling mechanisms. 19. From clinical information provided about a ventilator, discriminate between a situation of volume loss resulting from tubing compliance and one caused by system leaks. 20. Compare the use of the terms time-cycling, volume-cycling, and flow-cycling as they might be applied to a microprocessor-controlled ventilator in a volume-controlled mode using a set machine rate and flow. 21. Discuss how flow-cycling occurs with pressure support ventilation. 22. Explain how inflation hold affects the I:E ratio. 23. Define the following and explain how they physically affect a breath: expiratory retard, PEEP, CPAP, and BiPAP.
4. Physiological Effects and Complication of Positive Pressure Ventilation: Student will be able to discuss effects, factors, shear stress, positions, auto Peep, oxygen	1. Explain the effects of positive pressure ventilation on cardiac output and venous return to the heart. 2. Discuss the three factors affecting cardiac output during

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therapy, barotrauma, artificial airway as it relates to physiological and complications of PPV.	positive pressure ventilation. 3. Describe how positive pressure ventilation increases intracranial pressure. 4. Summarize the effects of positive pressure ventilation on renal and humoral response in the body. 5. Describe the effects of abnormal arterial blood gases on renal function. 6. Explain the effects of positive pressure ventilation on gas distribution and pulmonary blood flow in the lungs. 7. List the effects of mechanical ventilation on ventilatory status. 8. Explain the concept of shear stress. 9. Compare the prone with the supine position and its effects on oxygenation in patients with ARDS. 10. Recommend positioning in a patient with unilateral lung disease. 11. Define auto-PEEP and list its complications. 12. Name three physiological factors that lead to auto-PEEP. 13. Describe the procedures for measuring auto-PEEP. 14. List three potential methods for reducing auto-PEEP. 15. Discuss on benefit of auto-PEEP. 16. Explain the three primary hazards of oxygen therapy with mechanical ventilation. 17. List and describe four types of barotrauma associated with mechanical ventilation. 18. Summarize the risks of artificial airways during mechanical ventilation.

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5. Types of Ventilators and Modes of Ventilation: Students will be able to define modes of ventilation, TCT, TI, TE, minute ventilation, tidal volume, initial settings, flow wave forms as it relates to mechanical ventilation.	1. Based on a patient's history and assessment, select from the following methods of therapeutic intervention: positive vs. negative pressure ventilation, invasive vs. noninvasive ventilation, volume vs. pressure ventilation, and full vs. partial ventilatory support. 2. Compare the advantages and disadvantages of both volume and pressure ventilation. 3. Explain the differences in function between assist-control (A/C) ventilation, synchronized intermittent mandatory ventilation (SIMV), and spontaneous continuous positive airway pressure (CPAP) ventilation. 4. Use the terms trigger, cycle, and limit to define the following modes, and to draw a graph for pressure/time to show the pressure delivered with each mode: control, assist, A/C, intermittent mandatory, SIMV, pressure control, pressure support, mandatory minute ventilation, airway pressure release ventilation, and bilevel positive airway pressure (BiPAP). 5. Relate each presented mode of ventilation to the type of patient that would most benefit. 6. Calculate total cycle time (TCT), inspiratory time (T1), expiratory time (TE), flow in L/sec, and inspiratory to expiratory (I:E) ratios given the necessary patient data. 7. Calculate initial minute ventilation (VE), total volume (Vr), and rate of volume ventilation (VV) based on patient height and weight.

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	8. Adjust initial VE settings based on body temperature, metabolic rate, altitude, and acid-base balance. 9. Describe the various flow waveforms available in VV. 10. Compare the effects of a constant flow to those of a descending ramp flow. 11. Recommend initial settings for the various modes of pressure ventilation including pressure-supported ventilation (PSV), pressure-controlled ventilation (PCV) pressure-controlled inverse ratio ventilation (PCIRV), airway pressure release ventilation (APRV), and servo-controlled (dual modes) ventilation. 12. Discuss the differences between pressure augmentation (PAug), pressure-regulated volume control (PRVC), and volume-supported (VS) ventilation. 13. Identify inadequate flow on a pressure/time graph. 14. Identify on a pressure/time and flow/time graph when peak inspiratory pressure (PIP) equals alveolar pressure (Palv) during PCV>
6. Establishing the need for mechanical ventilation: Students will be able to define terms, identify objectives, list findings, name categories of disorders, critical values, goals, make recommendations and discuss situations as it relates to establishing the need for ventilation.	1. Define acute respiratory failure and respiratory insufficiency. 2. Identify physiological and clinical objectives of mechanical ventilation. 3. List respiratory, cardiovascular, and neurological findings in mild to moderate hypercapnia and severe hypercapnia. 4. Name three categories of disorders that may lead to respiratory insufficiency or acute respiratory failure.

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	5. State normal values for vital capacity, maximum inspiratory force, peak expiratory pressure, FEV1, peak expiratory flow rate, VD/Vr ratio, P(A-a) O2, and arterial-to-alveolar PO2 ratio. 6. Identify critical values that indicate the need for venulatory support for the following: vital capacity, maximum inspiratory pressure, maximum expiratory pressure, FEV1, peak expiratory flow rate, VD/VT ratio, P(A-a)O2, arterial-to-alveolar PO2 ratio, and PaO2/F1O2 ratio. 7. Name the four standard criteria for instituting mechanical ventilatory support and the four goals of therapy for the mechanically ventilated patient. 8. From clinical data, recommend mechanical ventilation in appropriate patient situations. 9. Discriminate between a patient needing oxygen therapy, bronchodilator therapy, CPAP, and mechanical ventilation. 10. Discuss situations in which mechanical ventilation would not be appropriate even though the patient met criteria for beginning ventilation.
7. Special issues related to ventilator setup: Students will be able to discuss sigh mode, ventilator setup, PEEP, FIO2 setting, ventilator settings for various lung problems as it relates to special issues related to ventilator setup.	1. Compare the effects of elastic recoil and intrathoracic pressures in a normal lung unit with their effects in a lung unit with lower alveolar elastance and increased airway resistance (Raw). 2. Discuss the pros and cons of using the sigh mode during

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	mechanical ventilation. 3. Recommend appropriate sigh volume and rate settings in situations when they are ordered. 4. List the necessary considerations for preparation of final ventilator setup. 5. Explain the concept of using extrinsic positive end-expiratory pressure (PEEPE) in patients with airflow obstruction and air trapping who have trouble triggering a breath during mechanical ventilation. 6. Using the equation for the desired F1O2 setting and given a known PaO2 value, calculate the F1O2 to be employed with a patient. 7. List the essential capabilities of an adult ventilator. 8. Provide initial ventilator settings from the guidelines for patient management for any of the following patient problems: chronic obstructive pulmonary disease (COPD0, neuromuscular disorders, acute asthma attacks, closed head injuries, adult respiratory distress syndrome (ARDS), and acute pulmonary edema.
8. Transport ventilators: Students will be able to describe operation, advantages, disadvantages, characteristics or transport ventilators.	1. Describe the operation of transport ventilators according to the classification system in Chapter 15. 2. Explain the advantages of disadvantages of using a transport ventilator compared with manual ventilation and a self-inflating bag. 3. Describe the desirable characteristics of a transport ventilator used in pre-hospital care.

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	4. Describe the desirable characteristics of a transport ventilator used for in-hospital transport.
9. Noninvasive ventilation: Students will be able to define invasive, noninvasive, equipment used, terminology supplemental oxygen, compare features as it relates to noninvasive ventilation.	1. Compare invasive and noninvasive approaches to positive-pressure ventilation. 2. Describe the use of nasal masks, oronasal masks, nasal pillows, Monarch mask, and mouthpieces for noninvasive ventilation. 3. Define the terminology used to describe noninvasive ventilation. 4. Discuss the issues of carbon dioxide rebreathing during noninvasive ventilation. 5. Describe the technique of supplemental oxygen administration during noninvasive ventilation. 6. Compare the features of critical care ventilators, homecare ventilators, and noninvasive pressure ventilators.
10. High-frequency ventilators: Students will be able to define the differences in ventilation techniques, advantages, disadvantages, complications and theory of gas movement as it relates to high-frequency ventilators.	1. Compare and contrast high-frequency ventilation with conventional ventilation. 2. Describe the differences in high-frequency ventilation techniques. 3. List the potential advantages and disadvantages of high-frequency ventilation. 4. List the complications associated with high-frequency ventilation. 5. Describe the theories of gas movement during high-frequency ventilation.
11. Spontaneous breathing systems: IMV and CPAP: Students	

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will be able to define how IMV and CPAP systems function, pressure triggering and flow, CPAP Rx of sleep apnea.	1. Demonstrate the methods of providing a continuous flow of gas to a mechanical ventilator, allowing intermittent mandatory ventilation to be accomplished. 2. Compare open-circuit and closed -circuit intermittent mandatory ventilation systems. 3. Describe the effects of open- and closed-circuit intermittent mandatory ventilation systems on the work of breathing. 4. Explain the function of a demand valve. 5. Compare pressure triggering and flow triggering. 6. Describe the systems used to provide spontaneous positive end-expiratory pressure (sPEEP) and continuous positive airway pressure (CPAP). 7. Describe the use of CPAP for the treatment of obstructive sleep apnea. 8. Describe the function of auto-adjusting CPAP systems.
12. Expiratory pressure valves: Students will be able to define threshold, flow resistors, orifice, water column, weighted ball and pressure valve devices as it relates to expiratory pressure valves.	1. Compare the characteristic features of threshold resistors and flow resistors. 2. Explain the difference between threshold resistors and flow resistors. 3. Describe the structure and function of water column, weighted ball, electromagnetic valve, and flexed spring threshold devices. 4. Describe the structure and function of adjustable orifice and scissors valve flow resistors.

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13. Extracorporeal life support: Students will be able to define approaches, function of components, anticoagulation as it relates to extracorporeal life support.	5. Explain the effects of end-expiratory pressure valves on the work of breathing. 1. Compare veno-arterial and veno-venous approaches to extracorporeal life support. 2. Describe the function of the following components of the extracorporeal life support circuit: cannulae, drainage and reinfusion tubing, bladder reservoir, blood pump, membrane oxygenator, and heat exchanger. 3. Compare the operation of roller pumps and centrifugal pumps. 4. Describe how the oxygenator provides control of oxygen and carbon dioxide levels. 5. Explain why anticoagulation is important during extracorporeal life support.