



## **LAMAR INSTITUTE OF TECHNOLOGY**

### **Mechanical Ventilation (RSPT 2414)**

#### **CREDIT**

4 semester credit hour (3 hour lecture, 1 hour lab)

#### **MODE OF INSTRUCTION**

FACE TO FACE

#### **PREREQUISITE/CO-REQUISITE:**

MTH 1332, BIOL 2301,2101, 2302, 2102, RSPT 1213, RSPT 1310, RSPT 1240, RSPT 1160, RSPT 1325,

#### **COURSE DESCRIPTION**

The study of mechanical ventilation with emphasis on ventilator classification, methods, principles, and operational characteristics. Includes indications, complications, and physiologic effects/principles of mechanical ventilation. Emphasizes initiation, management, and weaning of ventilatory support.

#### **COURSE OBJECTIVES**

Upon completion of this course, the student will be able to:

1. **Describe mechanical ventilation as related to spontaneous and artificial ventilation with emphasis on ventilator classification, methods, principles, and operational characteristics.**
2. **Identify Indications, complications, and physiologic effects/principles of mechanical ventilation.**
3. **Perform and demonstrate competency for initiation, management, and weaning of ventilatory support;**
4. **Identify and assemble necessary equipment for mechanical ventilation;**
5. **Perform and demonstrate competency in verification of Ventilator operation;**

#### **INSTRUCTOR CONTACT INFORMATION**

Instructor: Stacey Rashall, RRT

Email: [sgrashall@lit.edu](mailto:sgrashall@lit.edu)

Office Phone: 409-247-5143

Office Location: Gateway room 109

Office Hours: SEE STARFISH AND OUSTIDE OFFICE DOOR

## REQUIRED TEXTBOOK AND MATERIALS

### List required texts and materials.

1. *Mechanical Ventilation Physiological and Clinical Applications*  
by Susan P. Pilbeam and Jim Cairo *Eighth Edition*
  - ISBN number 978-0-323-871648
2. *Workbook for Mechanical Ventilation Physiological and Clinical Applications*  
by Susan P. Pilbeam and Jim Cairo
  - ISBN# 978-0-323-871693

Package of #882 scantrons, #2 pencils, and flash drive

### Competencies:

Ventilator set up, Routine Ventilator check, Ventilator parameter change , inline aerogen or mesh nebulizer treatments, Ventilator graphic analysis, capnography, weaning and weaning parameters, non-invasive ventilator set up, non-invasive vent settings, Ventilation via mask, Ventilations via ETT, CPR -airway and ventilation, CPR compressions, and extubation.

**All workbook homework is due on Test day. No late work accepted.**

**2 Lab tests will be given in this semester : 1 written and 1 verbal/ demonstrating competency skills using the mechanical ventilator.**

## COURSE CALENDAR

Week of	Topic	Required Reading	Assignments and Due Dates
1/20-1/23	Review of Oxygenation and Acid Base Balance Ch 1 – Basic Terms and Concepts of Mechanical Ventilation	Pilbeam's Ch 1	Ch 1 Homework Ch 1 Terms Ch 1 Quiz
1/26-1/30	Ch 2- How Ventilators work	Pilbeam's Ch 2	Ch 2 -Homework Ch 2 Quiz
2/2-2/6	Ch 3- How a Breath is Delivered	Pilbeam's Ch3	Ch 3 Homework Ch 3 Quiz
2/9-2/13	<b>Exam #1, Ch.1,2,3</b> Ch 4- Establishing a need for Mechanical Ventilation	Pilbeam's Ch 4	<b>Turn in Homework Ch 1-3 in Workbook</b> Ch 4 Homework Ch 4 Quiz
2/16-2/20	Ch 5 Selecting the Ventilators and the Mode	Pilbeam's Ch 5	Ch 5 Homework Ch 5 Quiz
2/23-2/27	Ch 6 Initial vent settings &	Pilbeam's Ch 6 and 7	Ch 7 HW & Quiz

	Ch. 7- Final Considerations in Ventilator Set up		
3/2-3/6	<b>Exam #2 ch. 4-7</b> Ch 8- Initial Patient Assessment	Pilbeam's Ch 8	<b>Turn in Homework Ch 4-7 in Workbook</b>
3/16-3/20	Ch 8-9 Initial Patient Assessment	Pilbeam's Ch 9	Ch 8 HW & Quiz
3/23-3/27	Ch 9 Ventilator Graphics <b>Exam #3 Ch 8-9</b>	Pilbeam's Ch 9	Ch 9 HW & Quiz <b>Turn in homework Ch8-9</b>
3/30-4/2	<b>Lab Exam 1</b> Ch 10- Assessment of Respiratory Function Ch 11- Hemodynamic monitoring Ch 12 -Methods to Improve Ventilation in Patient Ventilator Management	Pilbeam's Ch 10, 11,12	Ch 10,11, 12 HW & Quiz
4/6-4/10	Ch 13- Improving Oxygenation and Management of ARDS	Pilbeam's Ch 13	Ch 13 HW & Quiz
4/13-4/17	Ch 14- Ventilator Associated Pneumonia Ch 15 Sedatives Analgesics <b>Exam #4 Ch 10,11,12,13,14,15</b>	Pilbeam's Ch 14,15	Ch 14 ,15 HW & Quiz <b>Turn in Homework Ch 8,9,10,11,12,13,14,15</b>
4/20-4/24	Ch 16- Extrapulmonary Effects of Mechanical Ventilation Ch 17- Effects of Positive Pressure Ventilation	Pilbeam's Ch 16,17,18	Ch 16 , 17,18 HW & Quiz
4/27-5/01	Ch 18- Troubleshooting and Problem Solving Ch19- Basic Concepts of NIV Ch 20- Liberation Ch 21- Long term Ventilation Ch 23- Special Techniques used in Vent support	Pilbeam's Ch ,19,20,21,23	Ch 19,20,21,23 HW
5/4-5/7	<b>Exam #5 Ch 16,17,18,19,20, 21,23</b> <b>Turn in Homework 16-23 (-22)</b>	Prepare for Final	<b>Mechanical Ventilator Competency Check offs Remedial 5/11</b>

### DROP POLICY

If you wish to drop a course, you are responsible for initiating and completing the drop process by the specified drop date as listed on the Academic Calendar. If you stop coming to class and fail to drop the course, you will earn an "F" in the course.

### STUDENT EXPECTED TIME REQUIREMENT

For every hour in class (or unit of credit), students should expect to spend at least two to three hours per week studying and completing assignments. For a 3-credit-hour class, students

should prepare to allocate approximately six to nine hours per week outside of class in a 16-week session OR approximately twelve to eighteen hours in an 8-week session. Online/Hybrid students should expect to spend at least as much time in this course as in the traditional, face-to-face class.

## ATTENDANCE POLICY

1. **Attendance.** If you do not attend class you are missing some very valuable information. Tests will include both textbook material and anything mentioned in class/lab. There will be a sign-in and sign-out sheet for each class.
2. Students are to follow the absenteeism policy for each course. If the policy is not followed the student may be cited with a Level I or Level II offense, as defined in the Code of Conduct and Disciplinary Policy.
3. Absences in lab will result in a grade of 0 for that lab day.
4. **Homework Assignments.** Please turn in homework assignments at the start of the next class meeting. NO LATE WORK ACCEPTED.
5. **Absences.** Attendance is expected. According to LIT policy students with approved absences shall be allowed to make up examinations and written assignments without penalty. This privilege does not extend to unapproved absences. Students are allowed **2 absences per semester**, with or without a Dr.'s excuse. Each absence in excess of the 2 allowable absences will result in a 10% reduction per absence, in the student's final class grade. Example: 3 total absences (2 allowed + 1 excessive) = 10% reduction in final class grade, 4 absences = 20% reduction in final class grade, etc. Deductions as a result of excessive absences will be applied to the student's final class grade at the end of the semester. If absences (whether approved or not) seriously interfere with student performance, the instructor may recommend to the Department Chair that the student be dropped from the course.
6. **Make-up Exam.** Students may make-up an exam only if the absence is excused by the instructor. The make-up exam will be taken on the next class day that you return.
7. **Class Roll** will be taken on the first- and fourth-class days. If your name is not on the class roster on the fourth-class day, you will be asked to leave class until this matter is addressed.
8. **No eating, no drinking, turn off beepers, turn off cell phones, no texting, no disruptive behavior, and No children allowed in class.**
9. **During exams, please put all of your belongings including electronic devices, such as cell phones, tablets, computers, smart watches, etc., against a wall in the classroom. If you have an electronic device out, then you will receive a zero on that exam. If you are caught cheating, then this can result in being dismissed from the program.**
10. **Remediation** – Refer to Respiratory Care Student Handbook.
11. **Cell phone Policy**
  - Cell phones must be silenced or turned off during class time.
  - Cell phones will be placed in the appointed cell phone pocket hanger.
  - Attendance will be taken from the cell phone hanger with assigned names.
  - Any cell phone use in class will result in your dismissal from class.

- If cell phones are used during an exam, you will be dismissed from the Respiratory Care Program.
- Computer usage not related to course content is prohibited and will result in your dismissal from the Respiratory Care Program.

## **COURSE EVALUATION**

Final grades will be calculated according to the following criteria:

### **Grade Scale**

90 – 100	A
80 – 89	B
77 – 79	C
68 -76	D
< 68	F

**Final grades will be calculated to the following criteria:**

TEST (4-6 exams)	70%
QUIZ, HOMEWORK (workbook)	10%
LAB TESTS (2-3)	20%

LIT does not use +/- grading scales

## **ACADEMIC DISHONESTY**

Students found to be committing academic dishonesty (cheating, plagiarism, or collusion) may receive disciplinary action. Students need to familiarize themselves with the institution's Academic Dishonesty Policy available in the Student Catalog & Handbook at <http://catalog.lit.edu/content.php?catoid=3&navoid=80#academic-dishonesty>.

## **TECHNICAL REQUIREMENTS**

The latest technical requirements, including hardware, compatible browsers, operating systems, etc. can be online at <https://lit.edu/online-learning/online-learning-minimum-computer-requirements>. A functional broadband internet connection, such as DSL, cable, or WiFi is necessary to maximize the use of online technology and resources.

## **ARTIFICIAL INTELLIGENCE**

Lamar Institute of Technology (LIT) recognizes the recent advances in Artificial Intelligence (AI), such as ChatGPT have changed the landscape of many career disciplines and will impact many students in and out of the classroom. To prepare students for their selected careers, LIT desires to guide students in the ethical use of these technologies and incorporate AI into classroom instruction and assignments appropriately. Appropriate use of these technologies is at the discretion of the instructor. Students are reminded that all submitted work must be their own original work unless otherwise specified. Students should contact their instructor with any questions as to the acceptable use of AI/ChatGPT in their courses

## **DISABILITIES STATEMENT**

The Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. LIT provides reasonable accommodations as defined in the Rehabilitation Act of 1973, Section 504 and the Americans with Disabilities Act of 1990, to students with a diagnosed disability. The Special Populations Office is located in the Eagles' Nest Room 129 and helps foster a supportive and inclusive educational environment by maintaining partnerships with faculty and staff, as well as promoting awareness among all members of the Lamar Institute of Technology community. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409)-951-5708 or email [specialpopulations@lit.edu](mailto:specialpopulations@lit.edu). You may also visit the online resource at Special Populations - Lamar Institute of Technology ([lit.edu](http://lit.edu)).

## **STUDENT CODE OF CONDUCT STATEMENT**

It is the responsibility of all registered Lamar Institute of Technology students to access, read, understand and abide by all published policies, regulations, and procedures listed in the *LIT Catalog and Student Handbook*. The *LIT Catalog and Student Handbook* may be accessed at [www.lit.edu](http://www.lit.edu). Please note that the online version of the *LIT Catalog and Student Handbook* supersedes all other versions of the same document.

## **STARFISH**

LIT utilizes an early alert system called Starfish. Throughout the semester, you may receive emails from Starfish regarding your course grades, attendance, or academic performance. Faculty members record student attendance, raise flags and kudos to express concern or give praise, and you can make an appointment with faculty and staff all through the Starfish home page. You can also login to Blackboard or MyLIT and click on the Starfish link to view academic alerts and detailed information. It is the responsibility of the student to pay attention to these emails and information in Starfish and consider taking the recommended actions. Starfish is used to help you be a successful student at LIT.

## **STUDENT EXPECTED TIME REQUIREMENT**

For every hour in class (or unit of credit), students should expect to spend at least two to three hours per week studying and completing assignments. For a 3-credit-hour class, students should prepare to allocate approximately six to nine hours per week outside of class in a 16-week session OR approximately twelve to eighteen hours in an 8-week session. Online/Hybrid students should expect to spend at least as much time in this course as in the traditional, face-to-face class.

## **Course Outline**

### **A. Review of oxygenation and acid-base status:**

1. Normal values for:
  - a. arterial blood gas measurements
  - b. mixed venous blood gas measurements
  - c. hemoximetry
2. Normal PaO<sub>2</sub> based on age.
3. PaO<sub>2</sub> values at varying altitudes.
4. Determine Oxygenation status:
  - a. P(A-a)O<sub>2</sub> value
  - b. PaO<sub>2</sub>/PAO<sub>2</sub> ratio
  - c. PaO<sub>2</sub>/FIO<sub>2</sub> ratio
  - d. CaO<sub>2</sub>
5. Interpreting an arterial blood gas measurement.
  - a. Calculating a change in pH based on a change in PaCO<sub>2</sub>.
  - b. The bicarbonate
  - c. pH (hydrogen ion content)
  - d. PaCO<sub>2</sub>.
6. A PaCO<sub>2</sub> value estimated based on:
  - a. change in a patient's alveolar ventilation
  - b. CO<sub>2</sub> production.
7. Calculating changes in bicarbonate based on changes on:
  - a. pH
  - b. PaCO<sub>2</sub>.

### **B. Basic terms and Concepts of mechanical ventilation**

1. Graphs of changes in:
  - a. Intrapulmonary pressure
  - b. Spontaneous ventilation
  - c. Positive pressure breath.
2. Converting mm Hg to cm H<sub>2</sub>O.
3. Calculating a time constant.
4. Comparing several time constants and which will receive more volume during inspiration.
5. A figure showing:



- a. abnormal compliance
  - b. airway resistance
  - c. determine which lung unit will fill more quickly or with a greater volume.
- 6. Respiratory mechanics
  - a. Transpulmonary pressure
  - b. transrespiratory pressure
  - c. transairway pressure
  - d. transthoracic pressure
  - e. elastance
  - f. compliance
  - g. resistance.
- 7. Changes in pressure measured on the manometer during inspiration with a mechanical ventilator:
  - a. lung compliance
  - b. peak pressure.
- 8. Formulas for calculating:
  - a. compliance
  - b. resistance.
- 9. Mouth pressure.
- 10. The value for intraalveolar pressure during:
  - a. normal quiet breathing during the phases of:
    - 1. Inspiration
    - 2. Exhalation.
- 11. Airway conditions as related to increased resistance.
- 12. Advantages of negative pressure ventilation.
- 13. Pressure terms and definitions:
  - a. Peak inspiratory pressure
  - b. baseline pressure
  - c. PEEP
  - d. plateau pressure.
- 14. The measurement of plateau pressure.
- 15. The percentage of passive filling (or emptying) for:
  - a. 1 time constant
  - b. 2 time constants
  - c. 3 time constants
  - d. 4, 5 time constants
- 16. Calculating the transairway pressure
  - a. given the peak inspiratory pressure
  - b. given plateau pressure of 20 cm H<sub>2</sub>O
  - c. given flow rate.

### C. How ventilators work.

- 1. The basic types of power sources used for mechanical ventilators.
  - a. electric
  - b. pneumatic
  - c. combined electric and pneumatic

2. Control system
  - a. A closed loop and an open loop system.
  - b. User interface.
3. A ventilator's pneumatic circuits.
  - a. internal
    1. single
    2. double
  - b. external
    1. Main inspiratory line
    2. Adapter
    3. Expiratory line
    4. Expiratory valve
4. Power transmission and conversion system
  - a. drive mechanism
  - b. compressors
  - c. volume displacements designs
  - d. flow control valves

**D. How a breath is delivered.**

1. The equation of motion
  - a. pressure
  - b. flow
  - c. volume
  - d. time
2. Factors controlled and measured by the ventilator during inspiration
  - a. pressure
  - b. volume
  - c. flow
  - d. time
3. Inspiratory Waveform Control:
  - a. pressure controlled
  - b. volume controlled
  - c. Flow, volume, and pressure waveforms at the mouth:
    1. Rectangular
    2. Exponential
    3. Sinusoidal
    4. Ramp
4. Four Phases of a breath
  - a. change from exhalation to inspiration
  - b. inspiration
  - c. change from inspiration to exhalation
  - d. exhalation
5. Trigger variable
  - a. time triggering
  - b. patient triggering
    1. Pressure triggering
    2. Flow triggering
    3. Volume triggering

6. The limit variable
  - a. pressure limiting
  - b. volume limiting
  - c. flow limiting
7. Maximum safety pressure
  - a. pressure limiting
  - b. pressure cycling
8. The cycling mechanism
  - a. volume cycled ventilation
  - b. set volume vs. actual volume
    1. Tubing compressibility
    2. System leaks
  - c. time cycled ventilation
  - d. flow cycled ventilation
  - e. pressure cycled ventilation
  - d. Inflation hold
9. Types of breath:
  - a. mandatory
  - b. spontaneous.
10. Expiratory Phase
  - a. definition of expiration
  - b. baseline pressure
  - c. time-limited exhalation
  - d. continuous gas flow
  - e. Negative end-expiratory pressure (NEEP)
  - f. expiratory hold
  - g. expiratory retard
  - h. continuous positive airway pressure (CPAP) and positive end expiratory pressure (PEEP)

**E. Noninvasive positive pressure ventilation works.**

1. Noninvasive ventilation and the basic noninvasive techniques.
2. The clinical and physiological benefits of noninvasive positive pressure ventilation (NPPV).
3. Criteria NPPV in the acute and chronic care settings.
  - a. selection
  - b. exclusion
4. Ventilators used for noninvasive ventilation.
5. Humidification used during noninvasive ventilation (NPPV).
6. FIO<sub>2</sub> delivered by a portable pressure-targeted ventilator.
7. CO<sub>2</sub> rebreathing during Noninvasive Positive Pressure Ventilation administration from a portable pressure-targeted ventilator.
8. The various types of interfaces used for Noninvasive Positive Pressure Ventilation (NPPV).
  - a. advantages
  - b. disadvantages

9. Initiating Noninvasive Positive Pressure Ventilation NPPV.
10. Indicators of success for patients receiving Noninvasive Positive Pressure Ventilation NPPV.
11. Ventilator changes based on observation of the:
  - a. patient's respiratory rate
  - b. acid- base,
  - c. oxygenation status.
12. Complications of Noninvasive Positive Pressure Ventilation NPPV.
13. Solutions for complications of Noninvasive Positive Pressure Ventilation.
14. Weaning a patient from Noninvasive Positive Pressure Ventilation.

**F. Establish the need for mechanical ventilation.**

1. Acute respiratory failure
  - a. recognize the patient in distress
  - b. define respiratory failure
  - c. recognize hypoxia and hypercapnia
2. Patient history and diagnosis
  - a. central nervous system disorders
  - b. neuromuscular disorders
  - c. increase work of breathing
3. Physiological measurements in acute respiratory failure
  - a. ventilator mechanics
    1. Maximal inspiratory pressure
    2. Vital capacity
    3. Peak expiratory flow rate
    4. Respiratory rate and minute ventilation
  - Failure of oxygenation
4. Criteria for mechanical ventilation
  - A. apnea
  - b. acute respiratory failure
  - c. impending respiratory failure
  - d. refractory hypoxic respiratory failure
    1. Increased work of breathing
    2. Ineffective breathing pattern
5. Alternatives to Invasive Ventilation
  - a. high flow oxygen device
  - b. Non-invasive positive pressure ventilation (NPPV)
6. Intubation without ventilation
  - a. airway obstruction
  - b. protect the airway
  - c. facilitate removal of secretions
7. Ethical considerations
  - a. patient choice
  - b. advance directive
  - c. living will
  - d. DNR status
8. Case scenarios
  - a. drug and alcohol overdose

- b. Guillain-Barre' Syndrome
- c. status asthmaticus
- d. kyphoscoliosis and pneumonia
- e. COPD

**G. Select the ventilator and the mode.**

1. Ventilator and mode selection based on:
  - a. patient's history
  - b. physical assessment
  - c. patient interface
  - d. control variable
  - e. breath type
  - f. mode
2. Methods of therapeutic intervention:
  - a. positive or negative pressure ventilation
  - b. invasive or noninvasive ventilation
  - c. volume or pressure ventilation
  - d. full or partial ventilator support.
3. Mode of Ventilation and breath delivery
  - a. type of breath
  - b. targeted control variable
  - c. timing of breath delivery
4. Factors that affect pressure during volume ventilation
  - a. patient lung characteristics
  - b. inspiratory flow pattern
  - c. volume setting
  - d. positive end-expiratory pressure
  - e. auto-peep
5. Factors that affect volume delivery during pressure ventilation
  - a. pressure setting
  - b. pressure gradient
  - c. patient lung characteristics
  - d. inspiratory time
  - e. patient effort
6. Difference in function for:
  - a. continuous mandatory ventilation
  - b. Assist/Control ventilation
  - c. volume targeted continuous mandatory ventilation
  - d. pressure targeted continuous mandatory ventilation
  - e. synchronized intermittent mandatory ventilation
  - f. spontaneous modes
    1. Spontaneous breathing
    2. Continuous positive airway breathing
    3. Pressure support ventilation
7. Terminology:
  - a. trigger
  - b. cycle
  - c. limit

8. Graphics related to modes of ventilation
  - a. volume-targeted
  - b. continuous mandatory ventilation
  - c. pressure-targeted continuous mandatory ventilation
  - d. volume targeted synchronized intermittent mandatory ventilation
- e. pressure targeted synchronized intermittent mandatory ventilation
- f. pressure support ventilation.
9. Special Modes
  - a. pressure augmentation
  - b. pressure regulated volume control
  - c. volume support
  - d. mandatory minute ventilation
  - e. airway pressure release ventilation
  - f. bilevel positive airway pressure
  - g. proportional assist ventilation.
  - h. close loop ventilation

#### **H. Initial ventilator settings.**

1. Initial ventilator settings for volume ventilation:
  - a. calculating tubing compliance.
  - b. volume loss caused by tubing compliance.
  - c. calculating minute ventilation
  - d. calculating total cycle time
  - e. calculating inspiratory time
  - f. calculating expiratory time,
  - g. calculating flow in L/sec
  - h. calculating tidal volume
  - i. flow waveform
  - j. inspiratory to expiratory ratios given the necessary patient data
  - k. pressure limit
  - l. inflation hold
  - m. inspiratory and expiratory pressure
2. Calculate the desired FIO<sub>2</sub> needed to achieve a desired PaO<sub>2</sub> based on arterial blood gases.
3. Flow patterns
  - a. rate of gas flow
  - b. flow patterns
    1. Constant flow
    2. Ascending ramp
    3. Sine flow
    4. Descending ramp
4. Calculations based on patient's sex, height, and ideal body weight:
  - a. initial minute ventilation
  - b. tidal volume
  - c. rate of volume ventilation
5. Mechanical deadspace considerations
  - a. adding tubing
  - b. large heat moisture exchangers

6. Inspiratory hold and plateau.
7. Settings based on the patient's lung pathology, body temperature, metabolic rate, altitude, and acid- base balance:
  - a. Initial mode
  - b. minute ventilation
  - c. tidal volume
  - d. frequency
  - e. Positive End Expiratory Pressure (PEEP)
8. Peak inspiratory pressure
9. Plateau pressure
10. Selection and initial settings for the various modes of pressure ventilation:
  - a. bi-level positive airway pressure
  - b. pressure support ventilation
  - c. pressure control ventilation
  - d. servo controlled (dual modes) ventilation.
11. Pressure support ventilation from a pressure-time graph.
  - a. Measure pressure plateau from pressure-time and flow-time waveforms during pressure-controlled mechanical ventilation.
12. The mode of ventilation based on:
  - a. trigger
  - b. target
  - c. cycle criteria.
13. Case scenarios for ventilator adjustment
  - a. myocardial infarction
  - b. patient triggering additional breaths
14. Initial settings during pressure ventilation
  - a. setting baseline pressure and end expiratory pressure
  - b. determine tidal volume delivery
15. Initial settings during pressure support ventilation
  - a. Tidal volume
  - b. respiratory rate
  - c. decrease work of breathing associated with breathing through an artificial airway
16. Initial settings for pressure control ventilation
  - a. Pressure set to plateau pressure during volume ventilation
  - b. peak pressure minus five if plateau pressure unavailable
  - c. rate
  - d. inspiratory time
  - e. inspiratory to expiratory time
17. Initial settings for bi-level positive airway pressure ventilation
  - a. nonintubated and intubated patients
  - b. inspiratory positive airway pressure
  - c. expiratory positive airway pressure
  - d. oxygen flow
  - e. observe use of accessory muscles
    1. Inspiratory effort

2. Presence of auto positive end expiratory pressure (auto-PEEP)
18. Dual control pressure ventilation modes with volume targeting
  - a. volume assured pressure support
  - b. pressure regulated volume control
19. Volume support
  - a. spontaneous mode

**I. Final considerations in ventilator setup.**

1. Pros and cons of using the sigh mode.
2. Sigh with the concept of a recruitment maneuver in adult respiratory distress syndrome.
3. Extrinsic positive end- expiratory pressure in patients with airflow obstruction and air trapping who have trouble triggering a breath.
4. Equation for the desired FIO<sub>2</sub> setting.
5. Capabilities of an adult ventilator.
6. Initial ventilator settings from the guidelines to manage different patient problems.
7. Maintain adequate humidification.

**J. Initial assessment of the mechanically ventilated patient.**

1. Operational verification procedure.
2. Recommended times when an oxygen analyzer is used to measure the FIO<sub>2</sub> during mechanical ventilation.
3. Causes of an increase in:
  - a. transairway pressure
  - b. peak pressure
  - c. plateau pressure.
4. Calculate:
  - a. alveolar volume from tidal volume
  - b. dead space values.
5. Pressure-time and flow-time curves obtained during pressure-controlled continuous mandatory ventilation to determine:
  - a. plateau pressure.
6. A system leak from a volume-time curve.
7. Physical examination and radiographical data to determine:
  - a. pneumonia
  - b. pneumothorax
  - c. asthma
  - d. pleural effusion
  - e. emphysema
8. A lung compliance problem or an airway resistance problem is present using:
  - a. ventilator flow sheet
  - b. time
  - c. volume
  - d. peak inspiratory pressure



- e. plateau pressure
- 9. A static pressure-volume curve for static compliance and dynamic compliance to determine changes in:
  - a. compliance
  - b. resistance.
- 10. Alveolar ventilation based on:
  - a. ideal body weight
  - b. tidal volume
  - c. respiratory rate.
- 11. A cuff leak by listening to breath sounds.
- 12. Inappropriate endotracheal tube cuff pressures.
- 13. Inappropriate tube size.
- 14. Flow sheet information on a patient on pressure control ventilation and recommend methods to determine changes in:
  - a. compliance
  - b. airway resistance
- 15. The technique for measuring endotracheal tube cuff pressure using:
  - a. manometer
  - b. syringe
  - c. three-way stopcock
- 16. The two methods of dealing with a cut pilot tube without changing the endotracheal tube.
  - a. needle and stopcock
  - b. syringe
- 17. Non-invasive monitoring of pulse oximetry, VD/VT ratio, capnography, transcutaneous O<sub>2</sub>/CO<sub>2</sub> monitoring.
- 18. Noninvasive monitoring of ECG, hemodynamics, and fluid balance.
- 19. Review Radiograph

#### **K. Ventilator graphics.**

- 1. Ventilator variables from pressure, flow, and volume scalars in the following modes:
  - a. volume controlled continuous mandatory ventilation
  - b. volume controlled synchronized intermittent mandatory ventilation plus pressure support
  - c. ventilation and continuous mandatory ventilation, pressure-controlled
  - d. continuous mandatory ventilation
  - e. pressure controlled synchronized intermittent mandatory ventilation
  - f. pressure support ventilation.
- 2. Ventilator variables and ventilator parameters and their values from the following loops:
  - a. flow- volume
  - b. pressure-volume
- 3. Ventilator scalars and loops with the following:
  - a. changes in compliance

- b. changes in airway resistance
  - c. inappropriate sensitivity setting
  - d. inadequate inspiratory flow
  - e. auto-PEEP
  - f. leaks
  - g. active exhalation during pressure support ventilation
  - h. an inspiratory pressure spike during pressure support ventilation.
- 4. Airway resistance and compliance from information obtained from scalars and loops during ventilation.
- 5. The changes that occur in scalars and loops during volume-targeted and pressure-targeted ventilation when:
  - a. airway resistance increases
  - b. lung compliances decreases.
- 6. A compliance value obtained during pressure control ventilation;
  - a. determine whether the compliance is normal
  - b. determine tidal volume delivery
  - c. ways to adjust the set pressure to gain a desired tidal volume.

**L. Noninvasive assessment of respiratory function**

- 1. Devices used to measure:
  - a. airway pressure
  - b. volume
  - c. flow
- 2. Measuring:
  - a. Static compliance
  - b. dynamic compliance
  - c. airway resistance
  - d. mean airway pressure.
- 3. The effects of changes on measurement of the work of breathing in:
  - a. airway resistance
  - b. and respiratory system compliance
- 4. Pathological conditions that alter lung compliance and airway resistance
  - a. ARDS
  - b. restrictive diseases
- 5. The pressure-time product
  - a. management of mechanically ventilated patients.

**M. Methods to improve ventilation and other techniques in patient-ventilator management.**

- 1. Ventilator adjustments to reduce work of breathing and improve ventilation based on:
  - a. patient diagnosis
  - b. arterial blood gas results
  - c. ventilator parameters.
- 2. Specific size endotracheal tube and patient will need:
  - a. appropriate suction catheter size
  - b. length

- c. amount of suction pressure
- 3. The benefits of:
  - a. closed-suction catheters
  - b. open suction technique.
- 4. Instilling normal saline to loosen secretions before suctioning.
  - a. pros and cons
- 5. Ventilator associated pneumonia protocol
  - a. endotracheal tube that can provide continuous aspiration of subglottic secretions.
  - b. silent aspiration with cuffed endotracheal tube
- 6. Sputum descriptions and physical findings in a patient, and provide a possible cause for the findings.
  - a. mucoid
  - b. mucopurulent
  - c. green
  - d. brown
  - e. rusty
  - f. bloody
  - g. pink-frothy
- 7. Identify presence of change or change in cardiopulmonary abnormalities
- 8. The parameters that is useful in establishing the presence of a respiratory infection.
  - a. fever
  - b. WBC
- 9. Prone positioning in ventilated patients with Adult Respiratory Distress Syndrome.
  - a. Potential problems associated
  - b. Theories about how ventilation-perfusion is improved with
- 10. Protocols for using metered dose inhalers and small volume nebulizers powered by external flowmeters during mechanical ventilation.
  - a. A change in medication based on the patient's response to a beta agonist during mechanical ventilation.
- 11. The equipment needed for the in-house transport of a mechanically ventilated patient.
  - a. Complications associated with the in-house transport of a mechanically ventilated patient.
- 12. Patient-centered mechanical ventilation and how it might be assessed by the respiratory therapist.
- 13. Non-invasive assessment of cardiac monitoring
- 14. Review chest radiograph

**N. Improve oxygenation and the management of ARDS.**

- 1. The desired FIO<sub>2</sub> needed to achieve a desired PaO<sub>2</sub>
  - a. based on current ventilator settings
  - b. blood gases.

2. Determine the gas delivery method, metering, and clinical analyzing devices.
2. The percent shunt,
3. Continuous positive airway pressure (CPAP) and PEEP.
  - a. indications
  - b. contraindications
4. Primary goal of PEEP and the conditions in which high levels of PEEP are used.
  - a. Optimum PEEP level from a PEEP study with:
    - provided arterial blood gasses (ABG's)
  - b. hemodynamic data.
  - c. Increase in peak inspiratory pressure that occurs when PEEP is increased.
  - d. The appropriate way to establish an optimum PEEP level in a patient with acute respiratory distress syndrome (ARDS) using:
    - e.. recruitment-decruitment maneuver
    - f. deflection point
  - g. A patient with a unilateral lung disease receives PEEP/CPAP therapy.
  - h. The effects of PEEP in a patient with an untreated pneumothorax.
  - i. pressure increased
5. Adjustments in PEEP and ventilator settings based on:
  - a. assessment of the patient
  - b. ventilator parameters
  - c. ABG's.
6. Indicators of an optimum PEEP level.
  - a. Static compliance
  - b. hemodynamic data
  - c. ABG (arterial blood gases)
7. Parameters to measure following the administration of PEEP.
  - a. blood pressure
  - b. heart rate
  - c. static compliance
  - d. cardiac output
8. CPAP to mechanical ventilation with PEEP using:
  - a. patient assessment
  - b. ABG's (arterial blood gases)
9. PaO<sub>2</sub>/FIO<sub>2</sub> ratio.
  - a. acute lung injury
  - b. acute respiratory distress syndrome
10. ARDS
  - a. Setting the PEEP level high
  - b. tidal volume setting
  - c. maximum plateau value
11. Weaning criteria from:
  - a. PEEP
  - b. CPAP.
12. Inverse ratio ventilation

- a. conventional volume ventilator.
- 13. Based on the inflection point on the deflation curve for a patient with ARDS.
  - a. PEEP setting
  - b. pressure-volume loop
  - c. pulmonary perfusion

**O. Ventilator-Associated Pneumonia (VAP)**

- 1. Epidemiology
- 2. Pathogenesis of VAP
- 3. Diagnosis of VAP
  - a. Clinical diagnosis
  - b. Bacteriological (Quantitative) diagnosis
- 4. Treatment of VAP
- 5. Strategies to prevent VAP
  - a. Nonpharmacological interventions
  - b. Pharmacological interventions

**P. The effects of Positive Pressure ventilation on the Cardiovascular, cerebral, renal, and other organ systems.**

- 1. Cardiac output and venous return.
- 2. The effects of positive pressure ventilation on:
  - a. gas distribution
  - b. pulmonary blood flow in the lungs.
  - c. increases intracranial pressure.
- 3. Effects of positive pressure ventilation on renal and endocrine function.
- 4. Assessing a patient's nutritional status
- 5. Techniques that can be used to reduce some of the complications associated with mechanical ventilation.

**Q. The effects of positive pressure ventilation on the pulmonary system**

- 1. Barotraumas or extralveolar air based on patient assessment.
- 2. Appropriate action in patients with barotraumas.
- 3. Acute respiratory distress syndrome to establish an optimum PEEP and ventilation strategy.
- 4. Chest wall rigidity can alter transpulmonary pressures and acceptable plateau pressures.
- 5. Types of ventilator induced lung injury caused by opening and closing of alveoli and overdistention of alveoli
- 6. Clinical findings in hyperventilation and hypoventilation.
- 7. Ventilator settings in patients with hyperventilation and hypoventilation.
- 8. Patient with air trapping.
- 9. Strategies to reduce auto-PEEP.

10. Reduce the work of breathing during mechanical ventilation.
11. Reduce the risk of ventilator-associated pneumonia.
12. Responses to an increase in mean airway pressure in ventilated patient.
13. Effects of positive pressure ventilation on pulmonary gas distribution and pulmonary gas distribution and pulmonary perfusion in relation to normal spontaneous breathing.

**R. Perform troubleshooting and problem solving**

1. The steps for protecting a patient when problems occur.
2. Possible causes for each of the following alarm situations:
  - a. low pressure alarm
  - b. high pressure alarm
  - c. low PEEP/CPAP alarms
  - d. apnea alarm
  - e. low or high tidal volume alarm
  - f. low or high minute volume alarm
  - g. low or high respiratory rate alarm
  - h. low FIO<sub>2</sub> alarm
  - i. Low sources gas pressure
  - j. power input alarm
  - k. ventilator inoperative alarm
  - l. technical error message.
3. Troubleshooting using a graphic from a patient-ventilator
  - a. flow-time
  - b. volume-time
4. Description of a patient situation and recommend a solution.
  - a. leak
  - b. obstruction
  - c. ventilator in-operative
5. Patient-ventilator dyssynchrony:
  - a. signs
  - b. symptom
6. Externally powered nebulizer can affect ventilator function.
  - a. increased flow
  - b. increased volume
7. Electrolyte imbalances\
8. Respiratory infection.
  - a. signs
  - b. symptoms
9. Problems associated with devices used for noninvasive positive pressure ventilation.
  - a. nasal mask
  - b. full face mask
  - c. ETT
  - d. trach
10. The presence of auto-PEEP

- a. increased baseline
- 11. Findings from patient assessment for:
  - a. a right main stem intubation
  - b. pneumothorax.
- 12. Problems caused by a heated humidification system during ventilation.
  - a. increased temperature
  - b. decreased temperature
- 13. Assess a patient's response to bronchodilator therapy.
  - a. ventilator flow-volume loop

**S. Determine the discontinuation of and weaning from mechanical ventilation**

- 1. The weaning parameters a
  - a. acceptable values for ventilator discontinuation.
- 2. The three standard modes of weaning in relation to their success in discontinuing ventilation.
  - a. SIMV with pressure support
  - b. Pressure support with PEEP
  - c. CPAP/BIPAP
- 3. Clinical use of closed loop modes of weaning
- 4. Discontinuing a spontaneous breathing trial in a clinical situation.
  - a. respiratory distress
  - b. cardiovascular unstable
- 5. Criteria used to determine whether a patient is ready for extubation.
  - a. tidal volume
  - b. vital capacity
  - c. maximal inspiratory pressure
  - d. maximal expiratory pressure
- 6. Postextubation difficulties from a clinical case description.
- 7. Treatment for postextubation difficulties.
  - a. cool mist
  - b. racemic epinephrine
  - c. re-intubation
- 8. First recommendation for weaning a patient from mechanical ventilation established by the task force formed by the :
  - a. American College of Chest Physicians
  - b. Society of Critical Care Medicine
  - c. American Association for Respiratory Care.
- 9. Irreversible respiratory disorder that requires long term ventilation.
- 10. The parameter used in the primary index of drive to breathe.
- 11. Adjustments in ventilator setting during use of a standard weaning mode based on:
  - a. patient assessment.
- 12. Spontaneous breathing trials
- 13. Sedatives and the respiratory system.
  - a. depression of the respiratory center
- 14. The use of nonphysician protocols as key components of:

- a. efficient and effective patient weaning.
- 15. The types of patients who might benefit from a tracheostomy.
  - a. ventilator dependence
  - b. neuromuscular diseases
  - c. paralysis
- 16. The function of long term care facilities in the management of ventilator-dependent patients.
  - a. weaning
  - b. transition to home or nursing home
- 17. The probable cause of failure to wean.
  - a. weak muscles
  - b. unstable cardiopulmonary system
  - c. poor nutrition
  - d. psychological dependence

**T. Special applications of mechanical ventilation**

- 1. Airway pressure-release ventilation (APRV) compared with other forms of ventilation.
  - a. benefits
  - b. disadvantages
- 2. APRV in patients with:
  - a. acute lung injury/acute
  - b. respiratory distress syndrome.
- 3. Weaning a patient from APRV.
- 4. High frequency oscillatory ventilation settings.
  - a. The chest wiggle factor
- 5. Heliox
  - a. obstruction
  - b. status asthmatics
- 6. Nitric Oxide
  - a. Pulmonary hypertension

**U. Long Term Ventilation**

- 1. Goals of long- term ventilation
- 2. Sites for ventilator –dependent patients
  - a. acute care, intermediate, long-term care sites
- 3. Patient selection
  - a. disease process and clinical stability
  - b. psychosocial factors
  - c. financial considerations
- 4. Preparation for discharge to home
  - a. geographical and home assessment
  - b. family education
  - c. additional preparation
- 5. Follow-up and evaluation
  - a. adequate nutrition
  - b. family issues



6. Equipment selection for home ventilation
  - a. trach tubes
  - b. ventilator selection
7. Complications of long term ventilation
8. Alternatives to Invasive ventilation at home
9. Expiratory muscles AIDS and secretion clearance
  - a. coughing, oscillation ,mechanical insufflation-exsufflation
10. Trach tubes ,Speaking valves and Tracheal buttons
  - a. tube selection and benefit, loss of speech
  - b. speaking tracheostomy tubes, valves and concerns
  - c. trach buttons and decannulation
11. Ancillary equipment and cleaning for home ventilation
  - a. disinfection procedures
  - b. humidifiers