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The efficiency of bag-valve mask ventilations by medical first responders and basic emergency medical technicians

John Vincent Commander

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THE EFFICIENCY OF BAG-VALVE MASK VENTILATIONS BY
MEDICAL FIRST RESPONDERS AND BASIC EMERGENCY
MEDICAL TECHNICIANS

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Career and Technical Education

by
John Vincent Commander
September 2003
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Approved by:

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ABSTRACT

Bag-valve mask (BVM) ventilation maintains a patient's oxygenation and ventilation until a more definitive artificial airway can be established. In the prehospital setting of a traffic collision or medical aid scene this is performed by an Emergency Medical Technician or medical first responder. Few studies have looked at the effectiveness of Bag-valve mask (BVM) or the complication rate of ventilating an unprotected airway.

The purpose and goal of this study was to educate both medical first responders and basic emergency medical technician’s through positive attribution feedback loop; the important objectives of bag-valve mask (BVM) ventilation: (1) manual airway protection; and (2) adequate tidal volume.
ACKNOWLEDGMENTS

I would like to thank the following individuals who have contributed greatly to the success of this Project:
Professor Joseph A. Scarcella, Ph.D. for his dedication to the students of the Career and Technical Education Department at California State University, San Bernardino. Dr. Scarella spent more numerous hours than any other person I know of reading theses, responding to questions, answering emails and phone calls, updating various Internet sites and providing valuable guidance and encouragement. As my advisor he has played an active role in both my research, the expansion of my knowledge, and my overall education but most of all helping me to get back on track and remain “focused” in my research. He has been a true mentor during my long trek to achieve the Masters Degree; for this, I am deeply grateful and appreciative.

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To Timothy Thelander, whom I owe my deepest and profound heart felt gratitude, for getting me through the paper chase, computer quagmires and keeping me on track and knowing what was best for me in order to be successful in completion of this project.
DEDICATION

This project is dedicated to Daved van Stralen M.D., Pediatric Intensivist, at Loma Linda University Medical Center and Children’s Hospital and Medical Director for the San Bernardino County Fire Department. He is a visionary in pre-hospital and pediatric care management in southern California, an internationally known leader in pre-hospital emergency medicine and pediatric care; a man whose academic accomplishments are surpassed only by his leadership, kindness and compassion, and most of all a good friend. Since 1995 he has been an exemplary role model providing others and me with encouragement, motivation, inspiration, and insight all for the benefit of humankind.

I can only hope that this research project on the efficiency of bag-valve mask ventilation’s by medical first responders and basic emergency medical technicians will complement the years and timeless hours Dr. van Stralen has dedicated to prehospital care in the Inland Empire area.

To my Late loving mother, Jesusita S. Commander for without her love and continued support this mile stone in my life could never have been achieved.
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CHAPTER ONE

BACKGROUND

Introduction

The contents of Chapter One presents an overview of the project. The contexts of the problem are discussed followed by the purpose, significance of the project, and assumptions. Next, the limitations and delimitations that apply to the project are reviewed. Finally, definitions of terms are presented.

Context of the Problem

The primary goal of Emergency Medical Service (EMS) is the reduction of potentially preventable death and disability. This is achieved through early reversal of tissue hypoxia. The quickest and easiest way to disrupt oxygen-reaching tissues is through the loss of the airway. This is the basis for intervention of the familiar mnemonic called Airway, Breathing, Circulation, (ABC’s). It is also the reason airway and breathing come first. The quickest and easiest way to reverse tissue hypoxia is through manual control of the airway with bag-valve-mask ventilation. Loss of airway is thus a major and preventable contribution to highway death or Medical emergency.
Emergency Medical Services Systems (EMSS) label manual control of the airway and bag-valve-mask ventilation as Basic Life Support (BLS). The unintended consequence of this is the consideration by Emergency Medical Service (EMS) caregivers that manual airway control and bag-mask ventilation is simple and easy. It then becomes a task for the medical first responder or Emergency Medical Technician (EMT) with the least experience. This commonly leads to inadequate airway control, which allows ventilated air to enter the stomach and displace gastric contents into the esophagus. The gastric contents, or emesis, obstructs the airway and aspirate into the lungs. This is a problem has been observed in prehospital resuscitations.

There are other causes of airway obstruction besides ventilation-induced emesis. Emesis may already be present when the Emergency Medical Technician (EMT) or medical first responder arrives. Blood from injuries to the airway may pool and obstruct the tracheal opening or may have pre-existing physical anomalies, The inability of the patient to clear secretions may lead to aspiration of these secretions and obstruction of the airway.

An incompletely acquired or unprotected airway decreases the effectiveness of ventilation and gas
exchange. Oxygen levels in the blood decrease while carbon dioxide level increase. This seriously disturbs oxygen delivery to the tissues leading to organ malfunction. Organ malfunctions further disables the patient, accelerating deterioration. This will prompt the Advance Life Support (ALS) providers to accelerate their interventions, which include endotracheal intubation or percutaneous tracheotomy. Both procedures have their risk for complications, particularly if hurried. Endotracheal intubation changes from an emergency procedure in a critically injured patient to a crisis procedure in a dying patient.

Good manual airway control with bag-mask ventilation can stabilize the patient and reduce the apprehension of the Advance Life Support (ALS) team. This increases the safety of endotracheal intubation. It is this Initial Life Support (ILS) that makes the patient stable for a more controllable intubation.

The long-term consequence of tissue hypoxia that occurs from the improperly controlled airway is severe. It begins a cascade of events that leads to the development of end organ damage appearing in the intensive care unit hours to days later. Length of stay in the hospital
increases, days on mechanical ventilator increase, and risk of mortality increases.

From personal observations, the profession identified this as a problem when comparing hospital-based resuscitation with prehospital resuscitation. In the hospital, the senior respiratory care practitioner or an anesthesiologist performs manual acquisition and protection of the airway. In the prehospital setting, this is often performed by less experienced field personnel like a medical first responder or Emergency Medical Technician (EMT). Contributing to this problem is the lack of sufficient personnel on scene who have the proper knowledge of manual airway control.

Adverse weather conditions and various environmental situations also contribute to difficulty in manual airway protection. Even experienced paramedics do not receive instruction in manual airway protection in extreme desert heat, cold winter rains, High altitudes, or hostile snow conditions.

Purpose of the Project

The purpose of the project was to identify better techniques of manual airway control, as well as identify impediments due to weather and personnel shortages. Review
of methods currently used in the field and solicit improvement in techniques from the front line medical first responders and basic emergency medical technicians.

Significance of the Project

Through this project study will identify best practices for prehospital airway management. These best practices will include patient and airway characteristics, available personnel on scene, and the influence of environment. The goal is to identify patient and scene characteristics that contribute to emesis during bag-valve mask ventilation. This data will show that either current standards or techniques are obsolete or correct in aiding or maintaining patient airway management, which can be benefited by all levels of prehospital care.

Assumptions

The following assumptions were made regarding the project:

1. It was assumed that a guideline or airway technique recommendation was needed to be developed in order to address airway management concerns at the basic response level.

2. It was assumed that once these techniques or guideline recommendation become established,
they might be utilized throughout the department, shared locally and or nationwide.

Limitations and Delimitations

During the development of the project, a number of limitations and delimitations were noted. These limitations and delimitations are presented in the next section.

Limitations

The following limitations apply to the project:

1. The scope of this project study is limited to the resources available to the San Bernardino County Fire Department.

2. Utilizing only Basic Life Support (BLS) personnel during course of project.

Delimitations

The following delimitations apply to the project:

1. The project study is designed specifically for Basic Emergency Medical Technicians and medical first responders only.

2. The project study only addresses airway techniques that will improve airway management.
Definition of Terms

The following terms are defined as they apply to this project. They were derived from American Academy of Orthopaedic Surgeons [AAOS] Emergency Care and Transportation of the Sick and Injured (2002). Figure pictures denoted on certain key elements of project shown are from the American Heart Association Guidelines for Cardiopulmonary Resuscitation Emergency Cardiovascular Care (Circulation, 2000).

- Advanced Life Support (ALS) - Advance lifesaving procedures, such as cardiac monitoring, administrations of IV fluids and medications, and use of advanced airway adjuncts.

- Basic Life Support (BLS) - Noninvasive emergency lifesaving care that is used to treat airway obstruction, respiratory arrest, or cardiac arrest.

- Bag-valve-masks (BVM) - This is a combination of facemask and self-inflating resuscitation bag. It also should have an oxygen reservoir and tubing. It is used in conjunction with positioning, NPA, OPA, and endotracheal tubes to provide oxygenation and ventilation to the apneic or hypoventilating patient.
• **Cricoid Pressure** - A technique that is used with intubation or two person BVM ventilation in which pressure is applied on either side of the cricoid cartilage to prevent gastric distention and allow better visualization of vocal cords; also called the Sellick maneuver.

• **Emergency Medical Service (EMS)** - A multidisciplinary system that represents the combined efforts of several professionals and agencies to provide prehospital emergency care to the sick and injured.

• **Emergency Medical Technician - Basic (EMT-B)** - An EMT who has training in basic emergency care skills including automated external defibrillation, use of definitive airway adjuncts and assisting patients with certain medications.
• **Endotracheal Tubes (ETTs)** - Used to establish a definitive airway, ETTs are inserted through the nose or mouth into the trachea. The open tip should lie distal to the vocal cords and proximal to the bifurcation of the main stem bronchi and carina.

• **Esophageal Gastric Tube Airway (EGTA)** - This is similar to the EOA but has an opening in the esophageal tube for inserting an orogastric tube for stomach decompression.

• **Esophageal Obturator Airway (EOA)** - This device consists of a facemask that snaps onto a cuffed tube with a closed end that is inserted blindly into the oropharynx with the head in a neutral position. It is designed to enter and occlude the esophagus, preventing regurgitation. A bag attached to the mask provides ventilation. This device has fallen out of favor over the past 10 years with the increasing acceptance of EMS intubation, the development of superior devices, such as the PTL Airway and Combitube, and the risk of unrecognized tracheal obturation by the basic personnel for whom it was designed originally.
- **Esophageal Tracheal Combitube (ETC)** - A double-lumen tube and balloon cuffs. The blue lumen is the primary ventilation port, and the clear lumen is the ventilation port if the tube is placed in the trachea.

![Figure 2. Esophageal Tracheal Combitube](image)

- **First Responder** - The first trained individual, such as police officer, fire fighter, or other rescuer to arrive at the scene of an emergency to provide initial medical assistance.

- **Head Tilt Chin Lift Maneuver** - A combination of two movements to open the airway by tilting the forehead back and lifting the chin; used for non-trauma patients.
Figure 3. Head Tilt Chin Lift Maneuver

- **Jaw-Thrust Maneuver** - Technique used to open the airway by placing the fingers behind the angle of the jaw and bringing the jaw forward; used when a patient may have a cervical spine or head injury.

Figure 4. Jaw-Thrust Maneuver

- **Laryngoscope** - Consisting of a handle containing batteries and interchangeable blades of various shapes and sizes containing a bulb or fiberoptic
light, the laryngoscope is used to lift the tongue, mandible, and epiglottis and visualize the glottic opening, both for removing foreign bodies and inserting endotracheal tubes.

![Laryngoscope](image)

**Figure 5. Laryngoscope**

- **Nasopharyngeal Airway (NPA)** - This is a rubber tube inserted into the nare and extending into the oropharynx; it is designed to create an airway between the tongue and palate. It may be used in a semiconscious patient. It also may be used to supplement positioning in maintaining an open airway.
Figure 6. Nasopharyngeal Airways

- **Oropharyngeal Airway (OPA)** - This is a plastic or rubber device inserted in the oropharynx to create an airway between the tongue and the palate. This device should not be used on a patient with an intact gag reflex.

Figure 7. Oropharyngeal Airways

- **Pharynogotracheal Lumen Airway (PTL)** - These devices are designed for blind insertion. Regardless of whether the tube is inserted into the esophagus or trachea, the operator determines placement by
examination and auscultation. He/she inflates the proper cuff and accesses the proper ventilation port according to tube placement. If the trachea is intubated, the tube cuff is inflated and the tracheal tube accessed. If the esophagus is intubated, the tube cuff and the large oropharyngeal cuff are inflated, and the oropharyngeal port ventilated through holes in the upper end of the tube and occluding the esophagus. These devices are in limited use; depending on local protocol, EMT-Bs and EMT-Ps have been trained in their use.

- **Pocket mask** - This plastic and rubber mask is designed to protect the rescuer during rescue breathing. It may have a one-way valve to isolate patient secretions and an oxygen port to supplement the rescuer’s exhaled oxygen. Primarily first responders use it when a bag valve mask is not available.

- **Suction Devices** - These are used to remove secretions from the oropharynx, nasopharynx or endotracheal tube. Many types of suction units are used in EMS, including portable hand-powered and battery-powered units as well as wall-mounted units.
Ventilation - Exchange of air between the lungs and the air of the environment, either spontaneously by the patient or with assistance from an EMT-B or first responder.

Organization of the Thesis

The thesis portion of the project was divided into four chapters. Chapter One provides an introduction to the context of the problem, purpose of the project, significance of the project, limitations and delimitations and definitions of terms. Chapter Two consists of a review of relevant literature. Chapter Three documents the steps used in developing the project. Chapter Four presents conclusions and recommendations drawn from the development of the project. Finally, the Appendix consists of the project: Appendix A consists of Department Of Transportation First Responder National Standard Curriculum - Respiratory Module (1997); Appendix B consists of Department Of Transportation Emergency Medical Technician - Basic, National Standard Curriculum - Respiratory Module (1997); Appendix C consists of California Code of Regulations Title 22. Division 9. First Aid Standards for Public Safety Personnel (1999); Appendix D consists of California Code of Regulations, Title 22.
Division 9. Chapter 2. Emergency Medical Technician - I (2001); Appendix E consists of Bag-Valve Mask (BVM) Ventilation survey; Appendix F consists of Bag-Valve Mask Data Collection Card; Appendix G consists of Bag-Valve Mask Ventilation Scene; Appendix H consists of Bag-Valve Mask Ventilation Patient data. The references follow the last appendix.
CHAPTER TWO
REVIEW OF THE LITERATURE

Introduction

Chapter Two consists of a discussion of the relevant literature. Specifically, Review of current prehospital training curriculum both Nationally and California specific. Review of current prehospital training text materials and present literature as it pertains to airway management for medical first responders and EMT’s.

National Standard Curriculum

In this first portion the National Standard Curriculum of Training for both medical first responders and EMT-Basics was reviewed. Things that were considered are their level of instruction, education and skills as it pertains to airway management or control.

The National Highway Traffic Safety Administration has assumed responsibility for the development of training that are responsive to the standards established by the Highway Safety Act of 1966 (amended). Since these training courses are designed to provide national guidelines for training, it is NHTSA’s intention that they be of the highest quality and maintained in a current and up-to-date status from the point of view of both technical content.
and instructional strategy. To this end, NHSTA supported current projects, which involved revision of the Emergency Medical Service: First Responder Training Course and the Emergency Medical Technician-Basic. Both of which are cornerstones of prehospital training.


The First Responder is an integral part of the Emergency medical services system. The term "first responder" has been applied to the first individual who arrives at the scene regardless of the individuals' type of credential. It is the goal the First Responder: National Standard Curriculum to provide student with the core knowledge, skills and attitudes to function in the capacity of a first responder. The first responder uses limited amount equipment to perform initial assessment and intervention and is trained to assist other EMS providers. (p. x)

Within the In United States Department of Transportation (U.S. DOT), National Highway Traffic Safety Administration (NHTSA) EMT-Basic: National Standard Curriculum (1994) states:

The EMT-Basic curriculum is a core curriculum of minimum required information, to be presented within a 110-hour training program. It is recognized that there is additional specific education that will be required of EMT-Basics who operate in the field, i.e. ambulance driver training, heavy and light rescue, basic extrication, special needs, and so on. It is
also recognized that this information might differ from locality to locality, and that each training program, or system should identify and provide special training requirements. This curriculum is intended to prepare a medically competent EMT-Basic to operate in the field. (p. v)

In reviewing both National Standard Curriculum for First Responders and Emergency Medical Technician - Basic. They are extremely similar in nature far as initial indoctrination to basic airway management.

The first responder program curriculum in Module 2 under the heading of "Airway" addresses airway anatomy and physiology, how to maintain an open airway, pulmonary resuscitation, and variations for infant and children, as well as patients with laryngectomies. The use of airways, suction equipment, and barrier devices are discussed. Management of foreign body airway obstruction is also addressed as well. The program provides supervised practice for students to develop the psychomotor skills of airway care. The usage’s of airways, suction equipment, and barrier devices and later have them perform skills evaluation and cognitive written examinations on the subject matter. There is no instruction on advanced airways or management addressed at this level.

The Emergency Medical Technician - Basic Program. Under Module 2, section listed as "Airway". Teaches airway
anatomy and physiology, how to maintain an open airway, pulmonary resuscitation, variations for infant and children and patients with laryngectomies. The use of airways devices, suction equipment, oxygen equipment and delivery systems, and resuscitation devices. The program provides supervised practice for students to develop the psychomotor skills of airway care and uses of equipment to accomplish this task and later have them perform skills evaluation and cognitive written examinations on the subject matter.

Module - 8, under “Advanced Airway” section, which is considered by the D.O.T. as an elective. Some states may not allow BLS personnel to perform these skills as basic scope practices but rather as “optional skills” or “undefined scope of practice skills”.

Overall the this program instructs students on how to maintain an airway by means of orotracheal intubation which includes review of basic airway skills, nasogastic tube insertion for decompression of the stomach of an infant or child patient, and orotracheal intubation of adult, infants and children. It provides the opportunity to practice and demonstrate skills in supervised practice sessions and be tested through “on-hands” testing and written evaluation tool.
California Standard Curriculum

In this second part data is reviewed of current medical training standards for both first responders and Emergency Medical Technicians (EMT's). These standards are equivalents to the National Standards on a local level.

Emergency Medical Service Training Manuscript Review

In this third part a review of various EMS training manuals and text that are placed out on the market for first responders and EMT-Basic’s. The subject matter covered is similar to that of the DOT national curriculum. In some cases either meeting or exceeding the standards required for each level. All twenty-one textbooks that were reviewed during this literature research included the following subject matter:

1. Anatomy, Physiology and Pathophysiology: adult and pediatric

2. Airway control:
   - Manual methods such as crossed finger technique, tongue jaw lift, modified jaw thrust, Head-tilt, chin-lift maneuver, jaw thrust maneuver, sellicks maneuver
   - Mechanical means such as artificial airways adjuncts both basic and advanced. Examples
of basic airways are oropharyngeal (OPA’), nasopharyngeal (NPA’s). Example of advanced are endotracheal Intubation (ET’s), Esophageal-tracheal combiTube (ETC), Pharynogotracheal Lumen (PTL) airway, percutaneous Transtracheal catheter ventilation (PTV),

3. Airway Obstruction recognition: unresponsive and responsive. Mechanical and anatomical

4. Breathing Assessment: Look, Listen, feel, auscultation, Notation of lung sounds such as wheezing, crackles, rales. Use of Accessory muscles.

5. Adequate breathing: rates, rhythm, quality, and depth. Tidal volumes, minute ventilation, hypoventilation, hyperoxygenation, hyperventalion. Agonal respirations

6. Forms of breathing: Mouth to mouth, mouth to nose, mouth to stoma, mouth to mouth and nose

7. Suctioning: orally, Tracheally, nasally and through stoma’s and or tracheostomy tubes with various devices

8. Ventilatory Devices: Bag-valve Mask (BVM)

9. Barrier devices: face shields, pocket masks
10. Oxygen Therapy and treatment


12. Manually Triggered (oxygen Powered) devices: examples like elder valve, demand valve, flow-restricted oxygen-powered ventilation device (FROPVD)

13. Adjunct tools to guide airway management: Pulse Oximetry, end-tidal CO2 detector

14. Ventilation techniques: cricoid pressure, ventilation’s of the surgical airway

Contemporaneous Literature Review

In this fourth part, relevant literature on the subject matter was reviewed.

Ventilation is the mechanical process whereby air is taken into and out of the lungs. Situations in which patients might require ventilatory support range from apnea to patients experiencing depressed respiratory function. If the patient’s rate of breathing decreases significantly it can lead to hypercarbia, hypoxia, a lowered ph level and a decreased in respiratory minute volume. This can result in cardiac or respiratory arrest
if it isn't corrected. Expired air ventilation has been the accepted as the technique of choice since the late 1950's. It has been shown to be an effective practice for both professionals and laypersons including young children over 5 years of age. Ventilation using the expired air of the rescuer can be applied to mouth or nose of the adult victim and mouth-to-nose ventilation of the infant. Mouth-to-Mouth ventilation and Mouth-to-Nose ventilation can provide effective ventilatory support to a patient. A Major advantage of these methods of ventilation is that no equipment is required to effectively offer ventilatory support to the patient. However, the disadvantage of these methods of ventilatory support are that both methods only offer a limited oxygen supply due to the fact that oxygen expired from the rescuer will only contain 17 percent oxygen. Mouth-to-mask Ventilation or Pocket Mask Ventilation. A clear plastic, molded facemask similar to that used in anesthesia maybe used to provide mouth to mask ventilation. A unidirectional valve diverts the patient’s expired air away from the rescuer and traps any macroscopic particles emerging from the patient. This valve improves the aesthetics and reduces risk of cross infection or contamination. The mouth to mask method is a two handed technique which produces a better seal than
that obtained during single person bag-valve-mask ventilation. As with mouth-to-mouth ventilation it is possible to generate high tidal volumes, high airway pressures and increases the risk of gastric inflation.

Bag-valve Ventilation or Bag-valve-mask (BVM) is a self-inflating bag can be connected to a facemask, a tracheal tube, a laryngeal mask, or a combitube. The bag consists of a transparent facemask, one-way valve, oblong self-inflating silicone or rubber bag, and oxygen reservoir. It comes available in infant, child and adult sizes. Depending on make or model of BVM they may or may not have a pop-off release valve. A Pop off release valve allows excess pressure of air being forced into the mask from the bag to be released under certain centimeter of water pressure with allows air to escape. Thereby reducing potential volume Higgins and Yared (1993) and Todres (1993). In most cases the pop off valve should be disabled. Failure to do so could result in inadequate artificial ventilation. The oxygen inlet and reservoir allow for high concentration of inspired oxygen (80% to 100%). The BVM device should be used in conjunction with high-flow oxygen. These devices have a one-way or non-rebreather valve to maintain high concentrations of inspired oxygen.
The volume of most adult BVM is approximately 1600 milliliters (mL). Despite what appears to be large volume for ventilation, the BVM provides less volume than the mouth-to-mask ventilation, if an airtight seal is not obtained between the mask and the face. An airtight seal is difficult to maintain unless a second rescuer squeezes the bag to deliver ventilations. Because of the difficulty of maintaining an airtight seal while squeezing the bag, a single rescuer may wish to perform mouth to mask ventilation instead of using the BVM alone as delineated by Circulation. (2000).

When used by one person, a considerable degree of skill is required to maintain a patent airway and airtight seal with one hand, while squeezing the bag with the other. This is only likely to be achieved by someone who regularly uses a BVM device. Too much air leakage will result in hypoventilation, while excessive tidal volumes may result in gastric insufflation and increase risk of regurgitation. If ventilation has to continue with a BVM, then a two-person technique is preferable; one person holds the facemask in place using both hands and an assistant squeezes the bag. In this way a better seal is achieved, the jaw thrust maneuver is more easily maintained and the patient’s lungs can be ventilated more
effectively. It has been noted by the 2000 Guidelines on Cardiac Care (2001) that when two rescuers are available the BVM can be very effective device.

Airway compromise quickly leads to shock and death if not corrected. The most common cause of obstructed airway in an unconscious person is the tongue. Other causes of airway obstruction include respiratory secretions, gastric contents and foreign bodies. In trauma patients, blood and teeth can obstruct the airway. Any of these materials may be aspirated into the lower airway, inhibiting air movement and gas exchange. When a patient has an obstructed airway, the alveolar / capillary exchange cannot function properly. Until the airway obstruction is corrected the patient will continue to deteriorate; therefore, other inter-ventilations by rescuers are meaningless unless the airways is controlled.

BVM ventilation maintains the patient's oxygenation and ventilation until a more definitive artificial airway can be established. In the prehospital setting of a traffic collision or medical aid scene this is performed by an Emergency Medical Technicians or medical first responders. Few studies have looked at the effectiveness of BVM or the complication rate of ventilating an unprotected airway.
Todres (1993) studied the effectiveness of mask ventilation performed by 112 physicians with clinical responsibilities at a tertiary referral teaching hospital in Ireland. Participants’ physicians were asked to perform mask ventilation for three minutes on a Resaca Anne using a facemask and a two-liter self-inflating bag. The tidal volumes generated were quantified using a Laerdal skill meter computer. The effectiveness of mask ventilation was greater for anesthetists than for non-anesthetist. Physicians who had attended one or more resuscitation course where no more effective at mask ventilation than their colleagues who had not undertaken such courses. It is likely that first responders to in hospital cardiac arrests are commonly unable to perform adequate mask ventilation.

Whereas in research by Elling and Politis (1983) Three hundred and twenty Emergency Medical Technicians (238 males and 82 females) were tested for the ability to ventilate a pre-calibrated Laerdal Recording Resusci-Anne using both a BVM and pocket mask ventilator. The majority of participants were members of volunteer ambulance services, while the remaining rescuers came from both private ambulance services and municipal police and fire departments. Approximately 67.4% were certified as EMT’s
for more than three years, and 22.7% for more than one year but less than three, while the remaining 11% were certified less than one year. 76.5% had never used the pocket mask previously. Having been given time to read the package instructions, all participants were asked to ventilate the mannequin using the Laerdal pocket mask while the tester recorded the first six ventilation attempts. Each rescuer was then given a choice from among five different brands of BVM’s and was asked to pick the one he/she felt most comfortable using. Only one brand of mask that would definitely attain a seal if correct technique was applied was used with all the BVM’s. The participants then again ventilated the mannequin with the first six ventilation attempts recorded. More than 50% of the EMT’s were not capable of ventilating to the minimum standard (800 ml tidal volume) using a BVM. The mean tidal volume for all BVM’s was 641ml, well below the minimum standard. The study demonstrates that the pocket mask method is far superior to the BVM method; mean tidal volume for the pocket mask being 999 ml. The authors further recommend that if these experimental results are confirmed by clinical findings, future educational courses should teach the BVM as a four-hand/two-person skill, with
one rescuer squeezing the bag with both hands and the second rescuer maintaining hyperextension.

Jesudian, Harrison, Keennan, and Mauill (1985) report noted that the BVM is used in most hospitals to initiate cardiopulmonary resuscitation; the authors express some doubt that the BVM can deliver a tidal volume sufficient for resuscitation. His study used ten senior medical students who had recently completed the American Heart Association Advance Cardiac Life Support course. Each participant was asked to deliver at least 1,000 ml tidal volumes for 5 consecutive breaths 1) using a BVM directly connected to an endotracheal tube, 2) in the usual single rescuer manner in the unintubated patient, and 3) where two rescuers used the BVM; one using both hands to hold the mask and maintain the airway, while the other used both hands to squeeze the bag. This study suggests that the BVM used by a single rescuer with minimal training fails to deliver adequate tidal volumes for resuscitation. When two rescuers use the BVM, tidal volumes are more than recommended and are comparable to those seen with endotracheal intubation. Two explanations are offered: First, two hands can more effectively seal the mask to the face so that less delivered tidal volume is lost. Second, two-handed compression of the BVM increases delivered...
tidal volume. The authors conclude that two person BVM ventilation should be considered for initial resuscitation in cardio-pulmonary arrest, and adequacy of ventilatory efforts should be evaluated frequently during cardiopulmonary resuscitation.

Efficacy of cricoid pressure in preventing gastric inflation during Bag-Mask Ventilation in pediatric patients a study done by Salem, Wong, Mani, and Sellick (1974) had ten patients between the ages of 3 months and 5 years, undergoing elective surgical procedures were studied under anesthesia and muscle paralysis. In most patients, bag-mask ventilation for a two-minute period, without cricoid pressure, resulted in appreciable accumulation of gases in the stomach. The investigation indicates that the simple maneuver of gentle cricoid pressure using the middle or little finger of the hand holding the mask is effective in reducing gastric distension during bag-mask ventilation without interfering with its adequacy. Exhaled volumes were greater during Intermittent Positive Pressure Ventilation with cricoid pressure because gases were prevented from entering the esophagus and escaping into the stomach. The authors conclude that use of cricoid pressure during Intermittent Positive Pressure Ventilation should not be regarded as a
substitute for tracheal intubation, but rather as an alternative in certain situations. It is useful when bag-mask ventilation is carried out for short periods or until tracheal intubation is accomplished.

Pearson (1967) Evaluation of the elder demand valve resuscitator for use by First Aid Personnel begin by noting that mechanical resuscitators have often been too complicated to be consistently reliable in the hands of first aid personnel. A tight mask fit is difficult to achieve and a diversity of control knobs gives rise to confusion and ineffective resuscitation. Ten full-time personnel of the ambulance service at Baltimore County Fire Bureau were evaluated, comparing values for mouth-to-mouth, BVM and Elder valve ventilation. The values using mouth-to-mouth did not differ significantly from those obtained with the Elder valve. The same values with the BVM were significantly less than those obtained by the other two methods. The authors concluded that the advantages of the Elder valve over previously available equipment include simplicity, delivery of 100% oxygen, ability to use two hands to maintain a mask fit, high flow rate allowing adequate ventilation in spite of mask leaks, and avoidance of personal contact with the victim.
Disadvantages are the lack of ready availability and dependence on compressed oxygen as a power source.

Dworkin (1987) provided insight on mouth-to-mask rescue breathing and compared those of personal resuscitation masks saying When used correctly, mouth-to-mask rescue breathing provides the same tidal volume as mouth-to-mouth rescue breathing, and is easier to use and provides larger tidal volumes than the BVM technique, since both hands of the rescuer can be used to maintain airway patency and a secure mask fit. In addition, their recommendations included the following:

A well-fitting mask is an effective, simple adjunct for use in artificial ventilation (rescue breathing) by appropriately trained personnel. The mask should have the following characteristics: transparent material, capability of fitting tightly on the face, and availability in one average size for adults... (p. 4)

Hess (1990) performed a study, which evaluated the effects of hand size, use of disposable medical gloves, and number of hands used (one versus two) on the volumes delivered by five adult disposable resuscitators. Persons familiar with BVM ventilation were recruited to participate in the study, eight persons with small hands, and eight with medium hand and eight with large hands. Ventilation was delivered to a Vent-Aid training test lung
(TTL), and volumes were measured. In random order each participant ventured the TTL with all combination of one hand / two hands, gloves / no gloves, and with various types of bag-valve-mask devices. The participants were instructed to ventilate the TTL as they would ventilate a patient. The outcome from the study was the use of gloves did not significantly affect volume delivery. Delivered volumes did increase significantly as hand size increased and as number of hands used to squeeze the bag increased, and observed differences in volume delivery between brands of resuscitators maybe clinically important in some cases. The study emphasizes the importance of squeezing the resuscitator with two hands during bag-valve-mask ventilation.

Wheatley (1997) performed a studying in comparison of three methods of BVM ventilation in which the resuscitator compresses the self-inflating bag between their open palm and the side of their body was compared with conventional single and two-person resuscitator BVM ventilation. Fifteen nurses each ventilated three patients for four minutes following induction of general anesthesia, using one method per patient in random order. Tidal volume and peak mask pressures were higher with two-resuscitator technique than with either form of single resuscitator
ventilation; there were no significant differences between the two methods of single resuscitator ventilation.

In Mc Cabe's (1993) study of comparison of tidal volumes delivered by one verses two handed compressions of manual resuscitation bag and assess the effects of subject characteristics on those tidal volumes. 108 healthcare providers were assigned randomly to one of two procedures: one followed by two-handed compression or two followed by one-handed compression. A one liter resuscitation bag, lung performance analyzer were used to measure tidal volume. There was a significant difference in tidal volume delivered by one-handed verses two-handed compressions. Hand size, grip strength, height and weight were correlated with tidal volumes generated by one handed and two-handed procedures. It final conclusions were tidal volumes delivered by healthcare providers using one verses two hands significantly greater than those delivered by one hand. Strength grip was the best predictor of volume delivered and was more strongly correlated with volumes delivered by one rather than two hands.

Thomas, Dang, Hyatt, and Trinh (1992) evaluated a method of BVM ventilation in which the resuscitator compresses the self-inflating bag between the open palm and body was compared with both standard single and two
resuscitator BVM ventilation. Eighteen subjects ventilated a modified recording manikin using each method in random order. The tidal volume (VT) was greater with open palm than standard single resuscitator ventilation.

In Kanter’s study (1987) performance of BVM ventilation was evaluated on infant resuscitation mannequin to resolve uncertainty regarding the proficiency of pediatric resuscitation personnel in this technique and to determine whether the type resuscitation bag used would affect performance. Overall performance using a self-inflating resuscitation bag was generally adequate. Forty-six of fifty operators achieved an adequate minute ventilation and forty eight of fifty operators achieved a mean tidal volume exceeding that of the mask plus simulated physiologic dead space. A wide variation with tendency to hyperventilate and use excessive pressure indicates the need for improved standard training methods. Technical difficulties with an anesthesia bag impaired performance, suggesting that only self-inflatable bags should be used for mask-bag ventilation during pediatric resuscitation unless the staff’ proficiency with anesthesia bags is clearly demonstrated.

Littlewood and Durbin (2001) presented Evidenced-Based airway management (EBM) and define levels
and quality of experimental support that has been published using EBM principles for various recommendations in these general areas relating to artificial airways. He also pointed out that there is wealth of experimental material published addressing intermediate outcomes, but noted in his research the examination of material related to ultimate patient outcome from the systematic use of techniques and equipment. Though a specific device or technique may be useful and effective in a skilled individual’s hands under carefully controlled clinical conditions, its use by the wider population of caregivers and in routine (uncontrolled) clinical settings is the focus of his report.

Schwartz, Matthay, and Cohen (1995) reviewed 297 emergency tracheal intubations outside the operating room. Pulmonary aspiration was observed in four cent of intubations.

The authors did not note those aspirations may have developed before airway manipulation. This could be either secondary to acute physiological deterioration or from BVM ventilation.

Thibodeau, Verdile, and Bartfiled (1997) found a three and half- percent aspiration incidence (3 of 87 patients) from urgent intubations in the emergency
department. They defined aspiration as witnessed aspiration or positive sputum cultures. They did not differentiate between aspiration from the illness, BVM ventilation or from airway manipulation.

Gausche-Hill et al. (2000) found that thirty one percent of children receiving bag-valve mask (BVM) experienced gastric distention, 147 vomiting, and 147 aspirations. In tracheally intubated children, fewer children (seven percent) had gastric distention while percentages for vomiting was (fourteen percent) and aspiration (fifteen percent) was similar to Bag-valve mask (BVM) ventilation. Whether their number reflects effects of BVM before air manipulation, during airway manipulation, or during transport cannot be discerned.

Aspiration can occur from oral secretions or pharyngeal fluids. This will generally come from incomplete airway protection during BVM ventilation.

BVM ventilation can distend the stomach when the airway is incompletely open and the esophagus incompletely closed. This gastric distention can lead to regurgitation and consequent aspiration of gastric contents.

Apart from aspiration, out-of-hospital BVM ventilation may be inadequate because of incomplete ventilating volume. Gausche-Hills (2000) study of
bag-valve mask and tracheally intubated children found seventeen percent of the children receiving BVM and eighteen percent of the tracheally intubated children did not have good chest rise.

One study by Eckstein, Chan, Schneir, and Palmer (2000) evaluated the effectiveness of BVM ventilations in the prehospital setting. The study had no operational definition of effective BVM ventilation, nor did it state whether EMT’s, first responders or paramedics provided the ventilation. Normally at the scene of a traffic accident or medical aide the EMT or first responder generally provides BVM ventilation.

Signs of aspiration pneumonitis, acute lung injury, acute respiratory distress syndrome, liver and renal failure will measure the downstream effects of effective Bag-valve-mask (BVM) in the first week of hospitalization. The feedback loop will be communication of results on an Intranet website.

Summary

A general but brief history of the BVM practices and history was present. Accurate assessment and management of the airway is critical to the survival of an ill or injured patient. It is sometimes technically difficult to
assist respiration efficiently with a BVM or pocket mask; nevertheless, the ability to establish and maintain an open airway in a patient, and the ability to ensure adequate ventilation and oxygenation of the patient, are therefore essential skill for all emergency health care providers to master. Especially, the first responder and EMT's, in most cases they are our first line of defense for the prevention of human death.

Other techniques for ventilation have been identified throughout the literature for airway management for medical first responders and EMT's such as oral and nasopharyngeal airways, two person mask ventilation, esophageal - tracheal combitube, laryngeal mask airway and endotracheal intubation.

While BVM device has gained widespread acceptance in all care settings, the BVM can also be characterized as cumbersome and difficult to use. The frequent problem with BVM device is the inability to provide adequate ventilatory volumes to a patient who is not endotracheally intubated. This most commonly results from the difficulty of providing a leak proof seal to the face while maintaining an open airway. It also occurs when the bag is not squeezed sufficiently enough to force an adequate amount of air into the patient’s lungs.
The following points are offered as a review of effective ventilation techniques.

1. Chin of the patient should be held forward in a sniffing position provided that there no neck or head injuries associated.

2. The mask used for assisted ventilation should be the appropriate size for each patient and the face should be pulled into the mask.

3. Positioning for ventilation will be slightly different for each type of patient. Therefore, the head should be moved into various positions by flexion, extension, and lateral rotation until the best airway is obtained.

4. If necessary use both hands to hold the mandible forward and hold mask on the face, a second person can squeeze BVM.

5. If head is malposition, gastric distension will occur when BVM is squeezed. To correct this reposition the head or use the sellick maneuver when ventilating.

Finally, the need for reevaluation of the current standards addressing basic airway management needs to be done in order to ensure positive outcome for both patient and responders alike.
CHAPTER THREE

METHODOLOGY

Introduction

Chapter Three documents the steps used in developing the project. Specifically, through target population served, existing system, project study objectives, Method of Procedures through identified four phases of the project. Phase - I: Start Up; Phase - II: Program Development; Phase - III: Implementation; Phase - IV: data gathering and analysis. And project method of evaluation.

Population Served

This project was developed for the San Bernardino County Fire County Fire Department in conjunction with Loma Linda University Medical Center and the Inland Counties Emergency Medical Agency for further development of EMS research in prehospital care in airway management.

The San Bernardino County Fire Department provides fire and emergency services to the largest geographic land mass per capita. San Bernardino County has a population of approximately 1.7 million people living in an area of 19,319 square miles. The county includes urban, suburban, rural, mountain, wilderness and desert areas. Inyo, Mono, Kern, Los Angeles, Orange, and Riverside counties as well
as the Arizona and Nevada state lines, surrounds the county.

**Existing System**

According to DOT standards (1997) the First Responder program initial training in airway management is six hours (see Appendix A & Appendix C). Those who receive training with automated external defibrillation receive an additional hour of airway and bag-valve mask ventilation training. Whereas, In the DOT (1994) EMT curriculum the EMT Basic receives bag-valve mask ventilation training in their initial EMT program, which is approximately seven-hours in length (see Appendix B & Appendix D). For annual continuing education’s, EMT’s and first responders receive one hour of airway and bag-valve mask review. For re-certification every two or three years depending on which organization is utilize to accredit or certify personnel. The EMT and first responder is required to obtain 24 hours of continuing education with two of those hours addressing airway and bag-valve mask ventilation.

**Objectives**

1. Can a positive attribution educational program improve BVM ventilation?
   a. increase risk awareness regarding ineffective BVM ventilation;
b. increase motivation and abilities regarding BVM ventilation;
c. increase awareness of the difficult airway and methods to overcome the difficulty.

2. Can effective BVM Ventilation improve patient outcome?
   a. decreased incidence of aspiration pneumonitis, acute lung injury, acute liver failure, or acute kidney failure;
   b. decreased time on mechanical ventilation;
   c. decreased intensive care unit and hospital length of stay.

Procedure

1. Survey at beginning and end of study period (six months) of Emergency Medical Service (EMS) caregivers demographics and attitude, motivation and perceived ability regarding BVM ventilation and hospital outcome (Appendix E).

2. Identify patient receiving BVM ventilation in pre-hospital setting. Incident commander
will provide data on collection cards (Appendix F) to those who gave BVM ventilation. Cards will be sent to principle investigator. Incident commander will record scene data (Appendix G) from patient care record report(s).

3. Archival patient data will be collected (Appendix H) by associate at respective hospital after appropriate consent is obtained.

Alternate procedures

Continue in present approach

Deception

None

Proposed System

Project Goals

1. To develop and implement a continuous quality improvement program that solicits contributions by EMT's and first responders by June 30, 2002

2. To increase effectiveness of mask ventilation as measured by chest expansion and absence of emesis by June 30, 2002.
Project Objectives

1. To develop an EMS coalition from existing EMS training coordinators within the four divisions of the San Bernardino County Fire Department who have an interest in improving effectiveness of first responder bag-mask ventilation by September 1, 2001.

2. To develop an information form for personnel who administer bag-mask ventilation. The form will ask for patient and environmental characteristics, obstructing problems, and techniques to overcome those obstacles by November 1, 2001.

3. To educate EMS first responders within the San Bernardino County Fire Department in more effective methods for bag-mask ventilation, specifically to reduce emesis, as identified by the EMS coalition, by September 1, 2002.

4. To evaluate, if effective bag-mask ventilation (chest expansion without emesis) has an effect on displayed highway deaths in the hospital or the length of stay in the intensive care unit, days on
mechanical ventilator, incidence of adult respiratory distress syndrome, or multiple organ failure by September 30, 2002.

5. To survey attitudes of EMS first responders toward the effectiveness of their efforts at bag-mask ventilation and whether they believe it is possible to prevent emesis during such ventilation by December 31, 2002.

6. To identify effective means, as contributed by EMT’s and first responders to reduce emesis during bag-mask ventilation by September 30, 2002.

7. To identify effective means contributed by EMT’s and first responder’s, to achieve chest expansion during bag-mask ventilation by September 30, 2002.

8. To analyze the change in incidence of emesis during bag-mask ventilation by September 30, 2002.

9. To analyze the change in frequency that the chest expands during bag-mask ventilation by September 30, 2002.
10. Place found data on to Fire Department Website page to share data results by December 31, 2002.

Method of Procedure

**Phase I: Start up**

Develop a coalition of EMS educators and training personnel from the four divisions that the Department has. The coalition will meet monthly to review it’s contributions from its first responders, then develop training and educational materials for dissemination by quarterly newsletter or Departmental Intranet.

Data Collection of the incident where bag-mask ventilation was performed, the frequency that chest expansion occurred and the frequency that emesis occurred during bag-mask ventilation. Analysis will be made by the coalition and disseminated to field providers.

**Phase II: Program Development**

Collect incident reports of medical aides or accidents involving bag-mask ventilation. Regular, monthly, meetings of the Coalition.

The Coalition will:
Identify characteristics of patient that have or do not have emesis.

Identify techniques used by EMS first responders to prevent or mitigate emesis due to patient characteristics.

Identify scene characteristics of patients who or do not have emesis;

Evaluate methods used by EMS first responders to mitigate or prevent emesis due to scene characteristics; and

Make available through the feedback processes of printed material (newsletter or report) the coalition's findings.

With this material, the coalition will:

- Develop material for an exhibit booth for use at community activities and national EMS Conferences;

- Develop an educational newsletter for EMS first responders.

Phase III: Implementation

The program will be implementation and kick-off will be coordinated and conducted.

The EMS Training Division will:
• Conduct regularly scheduled meetings of the coalition; and
• Collect and evaluate data and contributions from EMS first responders.

Phase IV: Data Gathering and Analysis

Statistical data relating to the project and goals will be collected, analyzed, and incorporated in Quarterly reports. These reports will compare actual project accomplishments with planned accomplishments. They will include information concerning changes made by the project director in planning and guiding the project efforts. The following are some of the methods to be used in constant monitoring and evaluation of the project:

A. Written Reports

Information will be collected to provide ongoing evaluation of the project's goals and objectives. Project activities of organizing the task force. This information will provide an ongoing evaluation to measure project goals to objective.
Phase V

Begin the final report for submission to Department Medical Director.

Method of Evaluation

Using the data complied in Phase IV, the project manager will evaluate: (1) How well the stated project goals and objectives were accomplished; (2) If all the activities outline in the Method of Procedure were performed in accordance with the project agreement; and (3) was the project cost effective?

Summary

The steps used to develop this project were outlined. Its primary focus was on medical first responders and EMT’s to help further research in prehospital care in airway management. Its geographic zone was limited to a small portion of San Bernardino County. Through the formation of a prehospital educators coalition there contributions will serve to identify best practices for prehospital airway management. These best practices will include airway characteristics, available personnel on scene, and influences of environment. The overall goal of this project is to identify patient and scene
characteristics that contribute to emesis during BVM ventilation. The prehospital coalition will conduct meetings and discussion of findings sent to the coalition by the BLS providers. Successful and unsuccessful techniques will be identified and disseminated to field providers. All information obtain will be transmitted as positive attributions to field providers. Feedback of these findings from field providers will drive this project. Field providers surveyed will be any and all who perform BVM ventilation and who are willing to participant in the project.
CHAPTER FOUR
CONCLUSIONS AND RECOMMENDATIONS

Introduction

Included in Chapter Four was a presentation of the conclusions gleamed as a result of completing the project. Further, the recommendations extracted from the project are presented. Lastly, the Chapter concludes with a summary.

Conclusions

The conclusions extracted from the project follows.

1. In research for this project, the conclusion was made that since no set standard guidelines were available to basic responders in regards to airway management, that exploration of present standards are needed to be address to see which are truly the best in order to protect and maintain patency of a persons airway.

2. The question of airway management in a field setting will always be with us. Simply put, without appropriate airway control, everything else we do will mean very little. Despite decades of experience and improvement in airway
hardware, the basic rules of airway management can still be summed up in three trite phrases:

a. Air should go in and out,
b. Blue is Bad... Oxygen is good,
c. Noisy Breathing is Obstructed Breathing.

3. The ability of EMS personnel to do assessment based airway approach and make clinical judgments as to the best tool to manage airways, rather than any single piece of airway hardware.

4. Proper basic airway management skill acquisition is easy and is best retained for much longer period when said training is “hands-on” rather than restricted to instruction by lecture, video or training manual. Hands-on training is also meant to cover diagnosis and treatment of potential problems, especially the risk of aspiration.

5. Without the ability to control the airway adequately, all other interventions are futile. EMS personnel can make its greatest contribution to minimizing morbidity and mortality in its ability to rapidly establish and maintain airway patency. For this reason, continuing research, training, and standardization of advanced airway
techniques, such as transillumination light wands, laryngeal mask airways, retrograde intubation, and rapid sequence intubation (RSI) should be the next priority in prehospital airway management.

Recommendations

The recommendations resulting from the project follows.

1. Barrier devices such as pocket masks or Bag-valve-masks, when utilized should have airtight seal upon the patients face with appropriate head tilt to manage, open and maintain airway. Such techniques to be mastered are the cephalic, lateral and C-E clamp techniques as recommended in the Guideline 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care by International Consensus on Science (ICOS).

2. Bag-valve-mask ventilation technique is an essential skill that requires considerable practice to master. Techniques to be essentially mastered are: bag squeezing and facemask sealing
utilizing single and two handed person techniques.

3. To reduce the risk of gastric inflation during mouth-to-mouth, mouth-to-mask or bag-valve-mask ventilations, deliver slow breathes at the lowest tidal volume that will still make chest visibly rise with each ventilation along with utilization of cricoid pressure as appropriate.

4. Selection of appropriate facemask based on patient size verses age categories.

5. Patients positioning of head, neck and torso are critical key elements to good airway management.

6. Alternative airway devices (i.e., endotracheal, laryngeal mask and the esophageal-tracheal combitube) may be better than bag-valve-mask ventilation when used by trained first responders or Emergency Medical Technicians.

Summary

Chapter Four reviewed the conclusions extracted from the project. Lastly, the recommendations derived from the project were presented.
APPENDIX A

DEPARTMENT OF TRANSPORTATION FIRST RESPONDER

CURRICULUM MODULE - 2 (RESPIRATORY)
OBJECTIVES LEGEND

C = Cognitive  P = Psychomotor  A = Affective
1 = Knowledge level  2 = Application level  3 = Problem-solving level

COGNITIVE OBJECTIVES
At the completion of this lesson, the First Responder student will be able to:

2-1.18 Name and label the major structures of the respiratory system on a diagram. (C-1)
2-1.19 List the signs of inadequate breathing. (C-1)
2-1.20 Describe the steps in the head-tilt chin-lift. (C-1)
2-1.21 Relate mechanism of injury to opening the airway. (C-3)
2-1.22 Describe the steps in the jaw thrust. (C-1)
2-1.23 State the importance of having a suction unit ready for immediate use when providing emergency medical care. (C-1)
2-1.24 Describe the techniques of suctioning. (C-1)
2-1.25 Describe how to ventilate a patient with a resuscitation mask or barrier device. (C-1)
2-1.26 Describe how ventilating an infant or child is different from an adult. (C-1)
2-1.27 List the steps in providing mouth-to-mouth and mouth-to-stoma ventilation. (C-1)
2-1.28 Describe how to measure and insert an oropharyngeal (oral) airway. (C-1)
2-1.29 Describe how to measure and insert a nasopharyngeal (nasal) airway. (C-1)
2-1.30 Describe how to clear a foreign body airway obstruction in a responsive adult. (C-1)
2-1.31 Describe how to clear a foreign body airway obstruction in a responsive child with complete obstruction or partial airway obstruction and poor air exchange. (C-1)
2-1.32 Describe how to clear a foreign body airway obstruction in a responsive infant with complete obstruction or partial airway obstruction and poor air exchange. (C-1)
2-1.33 Describe how to clear a foreign body airway obstruction in an unresponsive adult. (C-1)
2-1.34 Describe how to clear a foreign body airway obstruction in an unresponsive child. (C-1)
2-1.35 Describe how to clear a foreign body airway obstruction in an unresponsive infant. (C-1)
AFFECTIVE OBJECTIVES
At the completion of this lesson, the First Responder student will be able to:

2-1.36 Explain why basic life support ventilation and airway protective skills take priority over most other basic life support skills. (A-3)
2-1.37 Demonstrate a caring attitude towards patients with airway problems who request emergency medical services. (A-3)
2-1.38 Place the interests of the patient with airway problems as the foremost consideration when making any and all patient care decisions. (A-3)
2-1.39 Communicate with empathy to patients with airway problems, as well as with family members and friends of the patient. (A-3)

PSYCHOMOTOR OBJECTIVES
At the completion of this lesson, the First Responder student will be able to:

2-1.40 Demonstrate the steps in the head-tilt chin-lift. (P-1,2)
2-1.41 Demonstrate the steps in the jaw thrust. (P-1,2)
2-1.42 Demonstrate the techniques of suctioning. (P-1,2)
2-1.43 Demonstrate the steps in mouth-to-mouth ventilation with body substance isolation (barrier shields). (P-1,2)
2-1.44 Demonstrate how to use a resuscitation mask to ventilate a patient. (P-1,2)
2-1.45 Demonstrate how to ventilate a patient with a stoma. (P-1,2)
2-1.46 Demonstrate how to measure and insert an oropharyngeal (oral) airway. (P-1,2)
2-1.47 Demonstrate how to measure and insert a nasopharyngeal (nasal) airway. (P-1,2)
2-1.48 Demonstrate how to ventilate infant and child patients. (P-1, 2)
2-1.49 Demonstrate how to clear a foreign body airway obstruction in a responsive adult. (C-1)
2-1.50 Demonstrate how to clear a foreign body airway obstruction in a responsive child. (C-1)
2-1.51 Demonstrate how to clear a foreign body airway obstruction in a responsive infant. (C-1)
2-1.52 Demonstrate how to clear a foreign body airway obstruction in an unresponsive adult. (C-1)
2-1.53 Demonstrate how to clear a foreign body airway obstruction in an unresponsive child. (C-1)
2-1.54 Demonstrate how to clear a foreign body airway obstruction in an unresponsive infant. (C-1)
The following is the core curriculum subject matter that is required to be taught within the program.

1. The Respiratory system
   A. Function
      0. Deliver oxygen to the body
      1. Remove carbon dioxide from the body
   B. Components/anatomy
      1. Nose and mouth
      2. Pharynx
         a. Oropharynx
         b. Nasopharynx
      3. Epiglottis - a leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing.
      4. Windpipe (trachea)
      5. Voice box (larynx)
      6. Lungs
      7. Diaphragm
   C. Physiology
      1. Diaphragm moves down, chest moves out, drawing air into the lungs (inhalation)
      2. Exchange of oxygen and carbon dioxide in the lungs
      3. Diaphragm moves up causing air to exit the lungs (exhalation)
   D. Infant and child anatomy and physiology considerations
      1. All structures are smaller and more easily obstructed than in adults.
      2. Infants and children’s tongues take up proportionally more space in the mouth than adults.
      3. The trachea is more flexible in infants and children.
      4. The primary cause of cardiac arrest in infants and children is an uncorrected respiratory problem.

I. Opening the Airway
   A. One of the most important actions that the first responder can perform is opening the airway of an unresponsive patient.
      1. An unresponsive patient looses muscle tone, and the soft tissue and base of the tongue may occlude the airway.
      2. The tongue is the most common cause of airway obstruction in an unresponsive patient.
      3. Since the tongue is attached to the lower jaw, forward displacement of the jaw will lift the tongue away from the back of the throat.
   B. Head-tilt chin-lift
      1. The method of choice for opening the airway in uninjured patients
2. Research has indicated that the head-tilt chin-lift consistently provides the optimal airway.

3. Used for uninjured, unresponsive patients

4. Technique
   a. Place your hand that is closer to the patient’s head on his/her forehead; apply firm backward pressure to tilt the head back.
   b. Place the fingers of your hand that is closer to the patient’s feet on the bony part of his/her chin.
   c. Lift the chin forward and support the jaw, helping to tilt the head back.

5. Precautions
   a. Finger must not press deeply into the soft tissues of the chin as this may lead to airway obstruction.
   b. The thumb should not be used for lifting the chin.
   c. The mouth must not be closed.

C. Jaw thrust without head tilt
   1. This technique is an alternative method of opening the airway.
   2. Effective but fatiguing and technically difficult
   3. This is the safest approach to opening the airway in the patient with a suspected spinal injury.

4. Indications
   a. Used for trauma patients
   b. Used for unresponsive patients

5. Technique
   a. Grasp the angles of the patient’s lower jaw.
   b. Lift with both hands displacing the mandible forward.
   c. If the lips close, open the lower lip with your gloved thumb.

II. Inspect the Airway
A. An unresponsive patient may have fluid or solids in the airway that may compromise the airway.
B. Responsive patients who cannot protect their airway should also have their airways inspected.
C. Indications
   1. All unresponsive patients
   2. Responsive patients who may not be able to protect their own airways.

D. Technique
   1. Open the patient’s mouth with a gloved hand.
   2. Look inside the airway.
      a. Clear (patent)
      b. Blocked
(1) Fluid
(2) Solids
(3) Teeth, including dentures

III. Airway Adjuncts
A. Oropharyngeal (oral) airways
   1. Oropharyngeal (OP) airways may be used to assist in maintaining an open airway in an unresponsive patient without a gag reflex.
   2. Patients with a gag reflex may vomit when this airway is placed.
   3. Technique
      a. Select the proper size: Measure from the corner of the patient’s lips to the tip of the earlobe or angle of jaw.
      b. Open the patient’s mouth.
      c. Insert the airway upside down, with the tip facing toward the roof of the patient’s mouth.
      d. Advance the airway gently until resistance is encountered.
      e. Turn the airway 180 degrees so that it comes to rest with the flange on the patient’s teeth.
   4. Alternate technique - For use with infants and children
      a. Select the proper size: Measure from the corner of the patient’s lips to the bottom of the earlobe or angle of jaw.
      b. Open the patient’s mouth.
      c. Use a tongue blade to press tongue down and away.
      d. Insert airway in upright (anatomic) position.

B. Nasopharyngeal (nasal) airways
   1. Nasopharyngeal (NP) airways are less likely to stimulate vomiting.
   2. May be used on patients who are responsive but need assistance keeping the tongue from obstructing the airway.
   3. Even though the tube is lubricated, this is a painful stimulus.
   4. Technique
      a. Select the proper size: Measure from the tip of the nose to the tip of the patient’s ear.
      b. Also consider diameter of airway in the nostril. NP airways should not be so large that it causes blanching of the nostril.
      c. Lubricate the airway with a water-soluble lubricant.
      d. Insert it posteriorly. Bevel should be toward the base of the nostril or toward the septum.
      e. If the airway cannot be inserted into one nostril, try the other nostril.
IV. Clearing the Compromised Airway and Maintaining the Open Airway

A. There are three ways that First Responders can clear or maintain an airway.

B. These techniques are not sequential; the situation will dictate which technique is most appropriate.

C. There are three methods of clearing the airway.

1. The Recovery Position
   a. The first step in maintaining an open airway
   b. Uses gravity to keep the airway clear.
   c. The airway is likely to remain open in this position.
   d. Unrecognized airway obstructions are less likely to occur.
   e. Monitor the patient until additional EMS resources arrive and assume care.
   f. Allows fluids to drain from the mouth and not into the airway.
   g. Used in unresponsive, uninjured patient, breathing adequately
   h. Technique
      (1) Raise the patient’s left arm above his/her head and cross the patient’s right leg over the left.
      (2) Support the face and grasp the patient’s right shoulder.
      (3) Roll the patient toward you onto his or her left side.
      (4) Place the patient’s right hand under the side of his/her face.
      (5) The patient’s head, torso, and shoulders should move simultaneously without twisting.
      (6) The head should be in as close to a midline position as possible.

2. Finger sweeps
   a. Uses your fingers to remove solid objects from the airway.
   b. Use body substance isolation.
   c. If foreign material or vomit is visible in the mouth, it should be removed.
   d. Do this quickly.
   e. Blind finger sweeps should not be performed in infants or children.
   f. Technique
      (1) If uninjured, roll the patient to their side
Liquids or semi-liquids should be wiped out with the index and middle fingers covered with a cloth.

Solid objects should be removed with a hooked index finger.

3. Suctioning
   a. Uses negative pressure to keep the airway clear.
   b. A patient needs to be suctioned immediately when a gurgling sound is heard during breathing or ventilation.
   c. Suction is only indicated if the recovery position and finger sweeps are ineffective in draining the airway or trauma is suspected and the patient cannot be placed in the recovery position.
   d. Purpose is to remove blood, other liquids, and food particles from the airway.
   e. Most suction units are inadequate for removing solid objects like teeth, foreign bodies, and food
   f. Portable suction equipment is available and may be manually or electrically operated.
   g. Principles
      (1) Observe body substance isolation.
      (2) A hard or rigid "tonsil sucker" or "tonsil tip" is preferred to suction the mouth of an unresponsive patient.
      (3) The tip of the suction catheter should not be inserted deeper than the base of the tongue.
      (4) Because air and oxygen are removed during suction, it is recommended that you suction for no more than 15 seconds.
         (a) Decrease the time in infants and children.
         (b) Infants 5 seconds
         (c) Children 10 seconds
      (5) Watch for decreased heart rate in infants.
      (6) If a decrease in heart rate is noted, stop suctioning and provide ventilation

V. Determining Presence of Breathing
   A. Immediately after opening the airway, check for breathing
   B. As you determine the presence of breathing, look at the effort or work of breathing.
      1. Breathing should be effortless.
      2. Observe the chest for adequate rise and fall.
      3. Look for accessory muscle use.
   C. Techniques
1. Responsive patients
   a. Ask: “Can you speak?”, “Are you choking?”
   b. The ability to talk or make vocal sounds indicates that air is moving past the vocal cords

2. Unresponsive patients
   a. Maintain an open airway
   b. Place your ear close to the patient’s mouth and nose
   c. Assess for three to five seconds.
      (1) Look for the rise and fall of the chest
      (2) Listen for air escaping during exhalation
      (3) Feel for air coming from the mouth and nose
   d. The first responder may observe the rise and fall of the chest even if an airway obstruction is present, but will not hear or feel air movement
   e. Some reflex gasping (agonal respirations) may be present just after cardiac arrest. This should not be confused for breathing.

D. Inadequate breathing is characterized by the following:
   1. Rate
      a. Less than 8 in adults
      b. Less than 10 in children
      c. Less than 20 in infants
   2. Inadequate chest wall motion
   3. Cyanosis
   4. Mental status changes
   5. Increased effort
   6. Gasping
   7. Grunting
   8. Slow heart rate associated with slow respirations

VI. Ventilation
   A. Once the airway has been assured, and breathing is assessed, breathing for the patient may be necessary.
   B. If the patient is not breathing they only have the oxygen in their lungs and their bloodstream remaining.
   C. In order to prevent death, the First Responder must ventilate the patient.
   D. There are many techniques for ventilation—the first responder must be competent in the following three techniques of ventilation

VII. Techniques of Ventilation
   A. The techniques of ventilation in order of preference are
      1. Mouth to mask
      2. Mouth to barrier device
      3. Mouth to mouth
   B. Mouth to mask ventilation
1. Most effective First Responder technique
2. Most masks have a one-way valve to divert the patient’s exhalations.
3. Masks should be transparent so that vomiting can be recognized.
4. Mouth to mask ventilation is very effective since you use two hands to seal around the mask.
5. Technique
   a. Place the mask around the patient’s mouth and nose using the bridge of the nose as a guide for correct position. Mask position is critical since the wrong size mask will leak.
   b. Seal the mask by placing the heel and thumb of each hand along the border of the mask and compressing firmly around the margin.
   c. Place your index fingers on the portion of the mask that covers the chin.
   d. Place your other fingers along the bony margin of the jaw and lift the jaw while performing a head tilt.
   e. Give one slow (12-2 second) breath of sufficient volume to make the chest rise (usually 800-1200 ml in the average adult).
   f. Too great a volume of air and too fast an inspiratory time are likely to allow air to enter the stomach.
   g. Adequate ventilation is determined by:
      (1) Observing the chest rise and fall
      (2) Hearing and feeling the air escape during exhalation
   h. Continue at the proper rate
      (1) 10-12 breaths per minute for adults with 1-1/2 -2 second ventilation time
      (2) 20 breaths per minute for children and infants with 1 – 1-1/2 second inspiratory time.
      (3) 40 breaths per minute for newborns with 1 to 1-1/2 second inspiratory time.
   i. If the ventilation cannot be delivered, consider the possibility of an airway obstruction.

C. Mouth-to-barrier device
1. A barrier device should be used if available.
2. Some rescuers may prefer to use a barrier device during ventilation.
3. Barrier devices have no exhalation valve and air often leaks around the shield.
4. Barrier devices should have low resistance to delivered ventilation.

5. Technique
   a. the chest rise and fall
      (1) Hearing and feeling the air escape during exhalation
   b. Continue at the proper rate
      (1) 12 breaths per minute for adults
      (2) 20 breaths per minute for children and infants
      (3) 40 breaths per minute for newborns
   c. If the ventilation is necessary, position the device over the patient’s mouth and nose ensuring an adequate seal.
   d. Keep the airway open by the head tilt-chin lift or jaw thrust maneuver.
   e. Give one slow (1-1/2-2 second) breath of sufficient volume to make the chest rise (usually 800-1200 ml in the average adult).
   f. Too great a volume of air and too fast an inspiratory time are likely to allow air to enter the stomach.
   g. Adequate ventilation is determined by:
      (1) Observing the chest rise and fall
      (2) Hearing and feeling the air escape during exhalation
   h. Continue at the proper rate
      (1) 10-12 breaths per minute for adults, with 1-1/2-2 second inspiratory time.
      (2) 20 breaths per minute for children and infants, with 1-1/2 second inspiratory time.
      (3) 40 breaths per minute for newborns, with 1 to 1-1/2 second inspiratory time.
   i. If the ventilation cannot be delivered, consider the possibility of an airway obstruction

D. Mouth to mouth
1. The First Responder must be aware of the risks of performing mouth-to-mouth ventilation.
2. Quick, effective method of delivering oxygen to the non-breathing patient
3. Ventilating a patient with your exhaled breath while making mouth to mouth contact
4. The rescuer’s exhaled air contains enough oxygen to support life.
5. Barrier devices and facemasks with one-way valves are available for use during ventilation.
6. First Responders should always use these devices rather than the mouth-to-mouth technique.

7. Mouth to mask/barrier device does not replace training in mouth to mouth ventilation's

8. The decision to perform mouth-to-mouth ventilation by First Responders is a personal choice. Whenever possible, a barrier device or mouth to mask should be used.

9. Technique
   a. Keep the airway open by the head tilt-chin lift or jaw thrust maneuver.
   b. Gently squeeze the patient’s nostrils closed with the thumb and index finger of your hand on the patient’s forehead.
   c. When ventilating an infants, cover the infants mouth and nose.
   d. Take a deep breath and seal your lips to the patient’s mouth, creating an airtight seal.
   e. Give one slow (1-1/2 - 2 second) breath of sufficient volume to make the chest rise.
      (1) Too great a volume of air and too fast an inspiratory time are likely to allow air to enter the stomach.
      (2) Adequate ventilation is determined by:
         (a) Observing ventilation cannot be delivered, consider the possibility of an airway obstruction

VIII. Foreign Body Airway Obstructions (FBAO) in the Adult
A. Can be the cause of cardiac arrest
   1. Choking/food
   2. Bleeding into the airway
   3. Vomit
B. Can be the result of cardiac arrest
   1. Vomiting
   2. Dentures
   3. Trauma
   4. Tongue
C. Types of airway obstructions
   1. Partial
      a. Good air exchange
         (1) Patient remains responsive
         (2) May be able to speak
         (3) Can cough forcefully
         (4) May be wheezing between coughs
      b. Poor air exchange
(1) Weak ineffective cough
(2) High-pitched noise on inhalation
(3) Increased respiratory difficulty
(4) Possibly cyanotic

2. Complete
   a. No air can be exchanged.
   b. Patient will be unable to speak, breathe, or cough.
   c. Patient may clutch the neck with thumb and fingers—the universal distress signal.
   d. Death will follow rapidly if prompt action is not taken.

D. Management of the Obstructed Airway
   Note: Refer to the American Heart Association Guidelines for the Management of Foreign Body Airway Obstruction.
   1. Partial with good air exchange
   2. Partial with poor air exchange or complete airway obstructions

IX. Foreign Body Airway Obstructions in infants and Children
A. More than 90% of childhood deaths from FBAO are in children below the age of 5.
B. 65% of the patients are infants.
C. FBAO in children is caused by
   1. Toys
   2. Balloons
   3. Small objects
   4. Food (hot dogs, round candies, nuts, and grapes)

D. Should be suspected in infants and children who demonstrate a sudden onset of respiratory distress associated with coughing, gagging, stridor, or wheezing.

E. Airway obstructions may be caused by infection.
F. The First Responder should only attempt to clear a complete or partial airway obstruction with poor air exchange

G. Blind finger sweeps are not done in infants or children.

H. Management of foreign body airway obstructions in infants
   Note: Refer to current American Heart Association Guidelines for Foreign Body Airway Obstruction.

I. Management of foreign body airway obstructions in children
   Note: Refer to current American Heart Association Guidelines for Foreign Body Airway Obstruction.

X. Special Considerations
A. Patients with stomas
   1. Persons who have undergone a laryngectomy (surgical removal of the voice box) have a permanent opening (stoma) that connects the trachea to the front of the neck.
2. When such person requires rescue breathing, mouth to stoma ventilation’s are required.

3. Technique
   a. Make an airtight seal around the stoma. Use a barrier device, if possible.
   b. Deliver ventilation slowly, allowing the chest to rise.
   c. After delivering the ventilation, allow time for adequate exhalation.

4. Some patients have partial laryngectomies. If, upon ventilating stoma, air escapes from the mouth or nose, close the mouth and pinch the nostrils.

B. Infant and child patients
   1. Place an infant’s head in neutral position, but extend a little past neutral if the patient is a child.
   2. Avoid excessive hyperextension of the head.
   3. An oral airway may be considered when other procedures fail to provide a clear airway.
   4. Gastric distension is more common in children.
   5. Gastric distension may significantly impair ventilation attempts in children.

C. Dental appliances
   1. Dentures - ordinarily dentures should be left in place.
   2. Partial dentures (plates) may become dislodged during an emergency. Leave in place, but be prepared to remove it if it becomes dislodged.
APPENDIX B

DEPARTMENT OF TRANSPORTATION EMERGENCY MEDICAL

TECHNICIAN - BASIC MODULE - 2 (RESPIRATORY)
The EMT Basic Curriculum contains the following but not limited to:

**COGNITIVE OBJECTIVES**
At the completion of this lesson, the EMT-Basic student will be able to:

2-1.1 Name and label the major structures of the respiratory system on a diagram. (C-1)
2-1.2 List the signs of adequate breathing. (C-1)
2-1.3 List the signs of inadequate breathing. (C-1)
2-1.4 Describe the steps in performing the head-tilt chin-lift. (C-1)
2-1.5 Relate mechanism of injury to opening the airway. (C-3)
2-1.6 Describe the steps in performing the jaw thrust. (C-1)
2-1.7 State the importance of having a suction unit ready for immediate use when providing emergency care. (C-1)
2-1.8 Describe the techniques of suctioning. (C-1)
2-1.9 Describe how to artificially ventilate a patient with a pocket mask. (C-1)
2-1.10 Describe the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask while using the jaw thrust. (C-1)
2-1.11 List the parts of a bag-valve-mask system. (C-1)
2-1.12 Describe the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers. (C-1)
2-1.13 Describe the signs of adequate artificial ventilation using the bag-valve-mask. (C-1)
2-1.14 Describe the signs of inadequate artificial ventilation using the bag-valve-mask. (C-1)
2-1.15 Describe the steps in artificially ventilating a patient with a flow restricted, oxygen-powered ventilation device. (C-1)
2-1.16 List the steps in performing the actions taken when providing mouth-to-mouth and mouth-to-stoma artificial ventilation. (C-1)
2-1.17 Describe how to measure and insert an oropharyngeal (oral) airway. (C-1)
2-1.18 Describe how to measure and insert a nasopharyngeal (nasal) airway. (C-1)
2-1.19 Define the components of an oxygen delivery system. (C-1)
2-1.20 Identify a non-rebreather face mask and state the oxygen flow requirements needed for its use. (C-1)
2-1.21 Describe the indications for using a nasal cannula versus a non-rebreather facemask. (C-1)
2-1.22 Identify a nasal cannula and state the flow requirements needed for its use. (C-1)

**AFFECTIVE OBJECTIVES**
At the completion of this lesson, the EMT-Basic student will be able to:

2-1.23 Explain the rationale for basic life support artificial ventilation and airway protective skills taking priority over most other basic life support skills. (A-3)
2-1.24 Explain the rationale for providing adequate oxygenation through high-inspired oxygen concentrations to patients who, in the past, may have received low concentrations. (A-3)

**PSYCHOMOTOR OBJECTIVES**
At the completion of this lesson, the EMT-Basic student will be able to:
2-1.25 Demonstrate the steps in performing the head-tilt chin-lift. (P-1, 2)
2-1.26 Demonstrate the steps in performing the jaw thrust. (P-1, 2)
2-1.27 Demonstrate the techniques of suctioning. (P-1, 2)
2-1.28 Demonstrate the steps in providing mouth-to-mouth artificial ventilation with body substance isolation (barrier shields). (P-1, 2)
2-1.29 Demonstrate how to use a pocket mask to artificially ventilate a patient. (P-1, 2)
2-1.30 Demonstrate the assembly of a bag-valve-mask unit. (P-1, 2)
2-1.31 Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers. (P-1, 2)
2-1.32 Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask while using the jaw thrust. (P-1, 2)
2-1.33 Demonstrate artificial ventilation of a patient with a flow restricted, oxygen-powered ventilation device. (P-1, 2)
2-1.34 Demonstrate how to artificially ventilate a patient with a stoma. (P-1, 2)
2-1.35 Demonstrate how to insert an oropharyngeal (oral) airway. (P-1, 2)
2-1.36 Demonstrate how to insert a nasopharyngeal (nasal) airway. (P-1, 2)
2-1.37 Demonstrate the correct operation of oxygen tanks and regulators. (P-1, 2)
2-1.38 Demonstrate the use of a non-rebreather facemask and state the oxygen flow requirements needed for its use. (P-1, 2)
2-1.39 Demonstrate the use of a nasal cannula and state the flow requirements needed for its use. (P-1, 2)
2-1.40 Demonstrate how to artificially ventilate the infant and child patient. (P-1, 2)
2-1.41 Demonstrate oxygen administration for the infant and child patient. (P-1, 2)

The following is the core curriculum subject matter that is required to be taught within the program.

**Anatomy and Physiology**

I. Anatomy review
   A. Respiratory
      1. Nose and mouth
      2. Pharynx
         a. Oropharynx
         b. Nasopharynx
      3. Epiglottis - a leaf-shaped structure that prevents food and liquid from entering the trachea during swallowing.
4. Trachea (windpipe)
5. Cricoid cartilage - firm cartilage ring forming the lower portion of the larynx.
6. Larynx (voice box)
7. Bronchi - two major branches of the trachea to the lungs. Bronchus subdivides into smaller air passages ending at the alveoli.
8. Lungs
9. Diaphragm
   a. Inhalation (active)
      (1) Diaphragm and intercostal muscles contract, increasing the size of the thoracic cavity.
          (a) Diaphragm moves slightly downward, flares lower portion of rib cage.
          (b) Ribs move upward/outward.
      (2) Air flows into the lungs.
   b. Exhalation
      (1) Diaphragm and intercostal muscles relax, decreasing the size of the thoracic cavity.
          (a) Diaphragm moves upward.
          (b) Ribs move downward/inward.
      (2) Air flows out of the lungs.
10. Respiratory physiology
    a. Alveolar/capillary exchange
       (1) Oxygen-rich air enters the alveoli during each inspiration.
       (2) Oxygen-poor blood in the capillaries passes into the alveoli.
       (3) Oxygen enters the capillaries as carbon dioxide enters the alveoli.
    b. Capillary/cellular exchange
       (1) Cells give up carbon dioxide to the capillaries.
       (2) Capillaries give up oxygen to the cells.
    c. Adequate breathing
       (1) Normal Rates
          (a) Adult - 12-20/minute
          (b) Child - 15-30/minute
          (c) Infant - 25-50/minute
       (2) Rhythm
          (a) Regular
          (b) Irregular
       (3) Quality
          (a) Breath sounds - present and equal
(b) Chest expansion - adequate and equal
(c) Minimum effort of breathing - use of accessory muscles - predominantly in infants and children
(4) Depth (tidal volume) - adequate
d. Inadequate breathing
(1) Rate - outside of normal ranges.
(2) Rhythm - irregular
(3) Quality
   (a) Breath sounds - diminished or absent
   (b) Chest expansion - unequal or inadequate
   (c) Increased effort of breathing - use of accessory muscles - predominantly in infants and children
(4) Depth (tidal volume) - inadequate/shallow
(5) The skin may be pale or cyanotic (blue) and cool and clammy.
(6) There may be retractions above the clavicles, between the ribs and below the rib cage, especially in children.
(7) Nasal flaring may be present, especially in children.
(8) In infants, there may be “seesaw” breathing where the abdomen and chest move in opposite directions.
(9) Agonal respirations (occasional gasping breaths) may be seen just before death.

11. Infant and child anatomy considerations
a. Mouth and nose - in general: All structures are smaller and more easily obstructed than in adults.
b. Pharynx - infants’ and children’s tongues take up proportionally more space in the mouth than adults.
c. Trachea (windpipe)
   (1) Infants and children have narrower tracheas that are obstructed more easily by swelling.
   (2) The trachea is softer and more flexible in infants and children.
d. Cricoid cartilage - like other cartilage in the infant and child, the cricoid cartilage is less developed and less rigid.
e. Diaphragm - chest wall is softer, infants and children tend to depend more heavily on the diaphragm for breathing.
B. Adequate and inadequate artificial ventilation

1. An EMT-Basic is artificially ventilating a patient adequately when:
   a. The chest rises and falls with each artificial ventilation.
   b. The rate is sufficient, approximately 12 per minute for adults and 20 times per minute for children and infants.
   c. Heart rate returns to normal with successful artificial ventilation.

2. Artificial ventilation is inadequate when:
   a. The chest does not rise and fall with artificial ventilation.
   b. The rate is too slow or too fast.
   c. Heart rate does not return to normal with artificial ventilation.

II. Opening the Airway

A. Head-tilt chin-lift when no neck injury suspected - review technique learned in BLS course.
B. Jaw thrust when EMT-Basic suspects spinal injury - review technique learned in BLS course.
C. Assess need for suctioning.

III. Techniques of Suctioning

A. Body substance isolation
B. Purpose
   1. Remove blood, other liquids and food particles from the airway.
   2. Some suction units are inadequate for removing solid objects like teeth, foreign bodies and food.
   3. A patient needs to be suctioned immediately when a gurgling sound is heard with artificial ventilation.
C. Types of units
   1. Suction devices
      a. Mounted
      b. Portable
         (1) Electrical
         (2) Hand operated
   2. Suction catheters
      a. Hard or rigid ("tonsil sucker," "tonsil tip")
         (1) Used to suction the mouth and oropharynx of an unresponsive patient.
         (2) Should be inserted only as far as you can see.
         (3) Use rigid catheter for infants and children, but take caution not to touch back of airway.
      b. Soft (French)
(1) Useful for suctioning the nasopharynx and in other situations where a rigid catheter cannot be used.

(2) Should be measured so that it is inserted only as far as the base of the tongue.

D. Techniques of use

1. Suction device should be inspected on a regular basis before it is needed. A properly functioning unit with a gauge should generate 300-mmHg vacuum. A battery-operated unit should have a charged battery.

2. Turn on the suction unit.

3. Attach a catheter.
   a. Use rigid catheter when suctioning mouth of an infant or child.
   b. Often will need to suction nasal passages; should use a bulb suction or French catheter with low to medium suction.

4. Insert the catheter into the oral cavity without suction, if possible. Insert only to the base of the tongue.

5. Apply suction. Move the catheter tip side to side.

6. Suction for no more than 15 seconds at a time.
   a. In infants and children, shorter suction time should be used.
   b. If the patient has secretions or emesis that cannot be removed quickly and easily by suctioning, the patient should be log rolled and the oropharynx should be cleared.
   c. If patient produces frothy secretions as rapidly as suctioning can remove, suction for 15 seconds, artificially ventilate for two minutes, then suction for 15 seconds, and continue in that manner. Consult medical direction for this situation.

7. If necessary, rinse the catheter and tubing with water to prevent obstruction of the tubing from dried material.

IV. Techniques of Artificial Ventilation

A. In order of preference, the methods for ventilating a patient by the EMT-Basic are as follows:

1. Mouth-to-mask
2. Two-person bag-valve-mask
3. Flow restricted, oxygen-powered ventilation device
4. One-person bag-valve-mask

B. Body substance isolation

C. Mouth-to-mouth - review technique learned in BLS course.
D. Mouth-to-mask
1. Review technique learned in BLS course.
2. The mask should be connected to high flow oxygen = 15 liters per minute.

E. Bag-valve-mask
1. The bag-valve-mask consists of a self-inflating bag, one-way valve, facemask, oxygen reservoir. It needs to be connected to oxygen to perform most effectively.
2. Bag-valve-mask issues
   a. Volume of approximately 1,600 milliliters
   b. Provides less volume than mouth-to-mask
   c. Single EMT-Basic may have difficulty maintaining an airtight seal.
   d. Two EMT-Basics using the device will be more effective.
   e. Position self at top of patient’s head for optimal performance.
   f. Adjunctive airways (oral or nasal) may be necessary in conjunction with bag-valve-mask.
   g. The bag-valve-mask should have:
      (1) A self-refilling bag that is easily cleaned and sterilized.
      (2) A non-jam valve that allows a maximum oxygen inlet flow of 15/lpm.
      (3) No pop-off valve, or the pop-off valve must be disabled. Failure to do so may result in inadequate artificial ventilations.
      (4) Standardized 15/22 mm fittings.
      (5) An oxygen inlet and reservoir to allow for high concentration of oxygen.
      (6) A true valve for non-rebreather.
      (7) Should perform in all environmental conditions and temperature extremes.
      (8) Available in infant, child and adult sizes.

3. Use when no trauma is suspected.
   a. After opening airway, select correct mask size (adult, infant or child).
   b. Position thumbs over top half of mask; index and middle fingers over bottom half.
   c. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.
d. Use ring and little fingers to bring jaw up to mask.

e. Connect bag to mask if not already done.

f. Have assistant squeeze bag with two hands until chest rises.

g. If alone, form a “C” around the ventilation port with thumb and index finger; use middle, ring and little fingers under jaw to maintain chin lift and complete the seal.

h. Repeat a minimum of every 5 seconds for adults and every 3 seconds for children and infants.

i. If chest does not rise and fall, re-evaluate.
   (1) If chest does not rise, reposition head.
   (2) If air is escaping from under the mask, reposition fingers and mask.
   (3) Check for obstruction.
   (4) If chest still does not rise and fall, use alternative method of artificial ventilation, e.g., pocket mask, manually triggered device.

j. If necessary, consider use of adjuncts.
   (1) Oral airway
   (2) Nasal airway

4. Use with suspected trauma
a. After opening airway, select correct mask size (adult, infant or child).

b. Immobilize head and neck, e.g., have an assistant hold head manually or use your knees to prevent movement.

c. Position thumbs over top half of mask; index and middle fingers over bottom half.

d. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin. If mask has large round cuff surrounding a ventilation port, center port over mouth.

e. Use ring and little fingers to bring jaw up to mask without tilting head or neck.

f. Connect bag to mask if not already done.

g. Have assistant squeeze bag with two hands until chest rises.

h. Repeat every 5 seconds for adults and every 3 seconds for children and infants, continuing to hold jaw up without moving head or neck.

i. If chest does not rise, re-evaluate.
   (1) If abdomen rises, reposition jaw.
If air is escaping from under the mask, reposition fingers and mask.

Check for obstruction.

If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.

If necessary, consider use of adjuncts.

Oral airway

Nasal airway

Flow restricted, oxygen-powered ventilation devices

Flow restricted, oxygen-powered ventilation devices (for use in adults only) should provide

A peak flow rate of 100% oxygen at up to 40 LPM.

An inspiratory pressure relief valve that opens at approximately 60 centimeters water and vents any remaining volume to the atmosphere or ceases gas flow.

An audible alarm that sounds whenever the relief valve pressure is exceeded.

Satisfactory operation under ordinary environmental conditions and extremes of temperature.

A trigger positioned so that both hands of the EMT-Basic can remain on the mask to hold it in position.

Use when no neck injury is suspected

After opening airway, insert correct size oral or nasal airway and attach adult mask.

Position thumbs over top half of mask, index and middle fingers over bottom half.

Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.

Use ring and little fingers to bring jaw up to mask.

Connect flow restricted, oxygen-powered ventilation device to mask if not already done.

Trigger the flow restricted, oxygen-powered ventilation device until chest rises.

Repeat every 5 seconds.

If necessary, consider use of adjuncts.

If chest does not rise, re-evaluate.

If abdomen rises, reposition head.

If air is escaping from under the mask, reposition fingers and mask.

If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.

Check for obstruction.
3. Use when there is suspected neck injury.
   a. After opening airway, attach adult mask.
   b. Immobilize head and neck, e.g., have an assistant hold head manually or use your knees to prevent movement.
   c. Position thumbs over top half of mask, index and middle fingers over bottom half.
   d. Place apex of mask over bridge of nose, then lower mask over mouth and upper chin.
   e. Use ring and little fingers to bring jaw up to mask without tilting head or neck.
   f. Connect flow restricted, oxygen-powered ventilation device to mask, if not already done.
   g. Trigger the flow restricted, oxygen-powered ventilation device until chest rises.
   h. Repeat every 5 seconds.
   i. If necessary, consider use of adjuncts.
   j. If chest does not rise and fall, re-evaluate.
      (1) If chest does not rise and fall, reposition jaw.
      (2) If air is escaping from under the mask, reposition fingers and mask.
      (3) If chest still does not rise, use alternative method of artificial ventilation, e.g., pocket mask.
      (4) Check for obstruction.

G. Bag to stoma or tracheostomy tube
   1. Definition of tracheostomy - an artificial permanent opening in the trachea.
   2. If unable to artificially ventilate, try suction, then artificial ventilation through mouth and nose; sealing stoma may improve ability to artificially ventilate from above or may clear obstruction.
   3. Need to seal the mouth and nose when air is escaping when artificially ventilating at the stoma.

H. Bag-valve-mask to stoma - use infant and child mask to make seal.
   Technique otherwise very similar to artificially ventilating through mouth. Head and neck do not need to be positioned.

V. Airway Adjuncts
   A. Oropharyngeal (oral) airways
      1. Oropharyngeal airways may be used to assist in maintaining an open airway on unresponsive patients without a gag reflex. Patients with a gag reflex will vomit.
      2. Select the proper size: Measure from the corner of the patient’s lips to the bottom of the earlobe or angle of jaw.
      3. Open the patient’s mouth.
4. In adults, to avoid obstructing the airway with the tongue, insert the airway upside down, with the tip facing toward the roof of the patient’s mouth.

5. Advance the airway gently until resistance is encountered. Turn the airway 180 degrees so that it comes to rest with the flange on the patient’s teeth.

6. Another method of inserting an oral airway is to insert it right side up, using a tongue depressor to press the tongue down and forward to avoid obstructing the airway. This is the preferred method for airway insertion in an infant or child.

B. Nasopharyngeal (nasal) airways
1. Nasopharyngeal airways are less likely to stimulate vomiting and may be used on patients who are responsive but need assistance keeping the tongue from obstructing the airway. Even though the tube is lubricated, this is a painful stimulus.

2. Select the proper size: Measure from the tip of the nose to the tip of the patient’s ear. Also consider diameter of airway in the nostril.

3. Lubricate the airway with a water-soluble lubricant.

4. Insert it posteriorly. Bevel should be toward the base of the nostril or toward the septum.

5. If the airway cannot be inserted into one nostril, try the other nostril.

VI. Oxygen
A. Oxygen cylinders
1. Different sizes
   a. D cylinder has 350 liters
   b. E cylinder has 625 liters
   c. M cylinder has 3,000 liters
   d. G cylinder has 5,300 liters
   e. H cylinder has 6,900 liters

2. Need to handle carefully since their contents are under pressure.

3. Tanks should be positioned to prevent falling and blows to the valve-gauge assembly and secured during transport.

B. Pressure regulators

2. Dry oxygen not harmful in short term; humidifier needed only for patient on oxygen for a long time. Not generally needed for prehospital care.

C. Operating procedures
1. Remove protective seal.

2. Quickly open, then shut, the valve.
3. Attach regulator-flow meter to tank.
4. Attach oxygen device to flow meter.
5. Open flow meter to desired setting.
6. Apply oxygen device to patient.
7. When complete, remove device from patient, then turn off valve and remove all pressure from the regulator.

D. Equipment for oxygen delivery
1. Non-rebreather
   a. Preferred method of giving oxygen to prehospital patients.
   b. Up to 90% oxygen can be delivered.
   c. Non-rebreather bag must be full before mask is placed on patient.
   d. Flow rate should be adjusted so that when patient inhales, bag does not collapse (15 LPM).
   e. Patients, who are cyanotic, cool, clammy or short of breath need oxygen. Concerns about the dangers of giving too much oxygen to patients with history of chronic obstructive pulmonary disease and infants and children have not been shown to be valid in the prehospital setting. Patients with chronic obstructive pulmonary disease and infants and children who require oxygen should receive high concentration oxygen.
   f. Masks come in different sizes for adult, children and infants. Be sure to select the correct size mask.

2. Nasal cannula - rarely the best method of delivering adequate oxygen to the prehospital patient. Should be used only when patients will not tolerate a non-rebreather mask, despite coaching from the EMT-Basic.

VII. Special Considerations
A. Patients with laryngectomies (stomas)
   1. A breathing tube may be present. If it is obstructed, suction it.
   2. Some patients have partial laryngectomies. If, upon artificially ventilating stoma, air escapes from the mouth or nose, close the mouth and pinch the nostrils.

B. Infant and child patients
   1. Place head in correct neutral position for the infant and extend a little past neutral for a child.
   2. Avoid excessive hyperextension of the head.
   3. Avoid excessive bag pressure - use only enough to make chest rise.
4. Ventilate with bag-valve-mask until adequate chest rise occurs. Do not use pop-off valve, must be disabled (placed in closed position) in order to adequately ventilate child or infant.

5. Gastric distention is more common in children.

6. An oral or nasal airway may be considered when other procedures fail to provide a clear airway.

C. Facial injuries
1. Because the blood supply to the face is so rich, blunt injuries to the face frequently result in severe swelling.
2. For the same reason, bleeding into the airway from facial injuries can be a challenge to manage.

D. Obstructions
1. Review the foreign body airway obstruction (FBAO) procedures that the students learned in their BLS training.
2. When foreign body airway obstruction persists, EMT-Basics should perform three cycles of the FBAO procedure, then transport, continuing the FBAO procedure en route.

E. Dental appliances
1. Dentures - ordinarily dentures should be left in place.
2. Partial dentures (plates) may become dislodged during an emergency. Leave in place, but be prepared to remove it if it becomes dislodged.

Procedural (How)
1. Show diagrams of the airway and respiratory system of adults, children and infants.
2. Show examples of inadequate breathing.
3. Demonstrate the head-tilt chin-lift method of opening the airway.
4. Demonstrate the jaw thrust method of opening the airway.
5. Demonstrate mouth-to-mouth artificial ventilation of a patient.
6. Demonstrate artificial ventilation of a patient with a pocket mask with oxygen.
7. Demonstrate assembly of a bag-valve-mask.
8. Use a bag-valve-mask to demonstrate artificial ventilation of a non-neck injured patient with and without assistance.
9. Use a bag-valve-mask to demonstrate artificial ventilation of a suspected spinal injured patient with and without assistance.
10. Demonstrate artificial ventilation of a non-neck injured patient with a flow restricted, oxygen-powered ventilation device.
11. Demonstrate artificial ventilation of a neck-injured patient with a flow restricted, oxygen-powered ventilation device.
12. Demonstrate insertion of an oropharyngeal (oral) airway.
13. Demonstrate insertion of a nasopharyngeal (nasal) airway.
14. Demonstrate how to check a suction unit.
15. Demonstrate the techniques of suctioning.
17. Demonstrate use of a non-rebreather mask.
18. Demonstrate correct operation of oxygen tanks and regulators.
19. Demonstrate artificial ventilation of a patient with a stoma.
20. Demonstrate artificial ventilation of an infant or child patient.
APPENDIX C

CALIFORNIA CODE OF REGULATIONS, TITLE 22.
DIVISION 9 CHAPTER 1.5 STANDARDS FOR
PUBLIC SAFETY PERSONNEL SECTIONS
100018 AND 100019
Article 3. Training Standards

§ 100018. Scope of Course.
(a) The initial course of instruction shall at a minimum consist of not less than fifteen (15) hours in first aid and six (6) hours in cardiopulmonary resuscitation.
(b) The course of instruction shall include, but need not be limited to, the following scope of course which shall prepare personnel specified in Section 100016 of this Chapter to recognize the injury or illness of the individual and render assistance:
   (1) Emergency action principles, which describe the basic problems of decision making in first aid;
   (2) First aid for medical emergencies, including sudden illnesses;
   (3) Cardiac and respiratory emergencies, including cardiac and/or respiratory failures in victims of all ages;
   (4) First aid for traumatic injuries including wounds, and life threatening bleeding
   (5) First aid for specific injuries, including care for specific injuries to different parts
   (6) Bandaging, including materials and guidelines used in bandaging;
   (7) First aid for environmental emergencies including burns, heat and chemical burns, electrical emergencies and exposure to radiation, or climatic changes;
   (8) First aid for injuries to bones, muscles, and joints;
   (9) Emergency rescue and transfer;
   (10) First aid for obstetrical emergencies.

Note: Authority cited: Section 1797.107, Health and Safety Code. Reference: Sections 1797.182 9 and 1797.183, Health and Safety Code; and Section 13518, Penal Code. 1011

§ 100019. Required Topics.
The content of the training course shall include at least the following topics and shall be skill-oriented:
(a) Examination and assessment of the victim;
(b) Orientation to the EMS system;
(c) Suspected heart attack or stroke;
(d) Fainting, convulsions, and/or suspected drug abuse;
(e) Heat exhaustion, heat stroke, hypothermia and frost bite;
(f) Mouth to mouth breathing and care for choking victims whether conscious or unconscious;
(g) Types of wounds and control of bleeding;
(h) Shock, and its causes, infection and closed wounds;
(i) Eye, face, scalp, jaw and ear injuries;
(j) Injuries of the head, neck, back, trunk, arms and legs;
(k) Exposure to toxic substances;
(l) Bites and stings by snakes, marine life and insects;
(m) Bandaging techniques, first aid kits and supplies;
(n) Determination of the severity of burns, including first, second, and third degree burns;
(o) Fractures, both open and closed, splinting, and care for fractures, sprains, strains and dislocated joints;
(p) Techniques of cardiopulmonary resuscitation; and
(q) Obstetrical emergencies.

APPENDIX D

CALIFORNIA CODE OF REGULATIONS, TITLE 22.
DIVISION 9 CHAPTER 2. EMERGENCY MEDICAL
TECHNICIAN SECTIONS 100063 AND 100075
§ 100063. Scope of Practice of Emergency Medical Technician-I (EMT-I).

(a) During training, while at the scene of an emergency, during transport of the sick or injured, or during interfacility transfer, a supervised EMT-I student or certified EMT-I is authorized to do any of the following:

1. Evaluate the ill and injured
2. Render basic life support, rescue and first aid to patients.
3. Obtain diagnostic signs including temperature, blood pressure, pulse and respiration rates, level of consciousness, and pupil status.
4. Perform cardiopulmonary resuscitation, including the use of mechanical adjuncts to basic cardiopulmonary resuscitation.
5. Use the following adjunctive airway breathing aids:
   (A) oropharyngeal airway;
   (B) nasopharyngeal airway;
   (C) suction devices;
   (D) basic oxygen delivery devices; and
   (E) manual and mechanical ventilating devices designed for prehospital use.
6. Use various types of stretchers and body immobilization devices.
7. Provide initial prehospital emergency care of trauma.
8. Administer oral glucose or sugar solutions.
10. Perform field triage.
11. Transport patients.
12. Set up for ALS procedures, under the direction of an EMT-II or EMT-P.
13. Inflate antishock trousers, under the direction of an EMT-II or EMT-P, if approved by the medical director of the local EMS agency.
14. Perform automated external defibrillation when authorized by an EMT AED service provider.

The EMT-I course content shall include instruction to result in competence in the following topics and skills listed

§ 100075. Required Course Content

(e) MODULE V: RESPIRATORY SYSTEM.

1. Anatomy and physiology, including:
   (A) Composition of gases in the environment.
   (B) Exchange of gases in the lung.
   (C) Regulation of respiration.
   (D) Evaluation of ventilation.
(2) Nature of the illness, patient assessment, complications, and the prehospital management of respiratory disorders, including:
  (A) Airway obstruction.
  (B) Pulmonary arrest.
  (C) Respiratory distress/nontraumatic dyspnea including:
      1. Asthma and chronic obstructive pulmonary disease.
      2. Acute pulmonary edema.
      3. Inhalation of toxic substances.
      4. Pulmonary embolism.
      5. Hyperventilation syndrome.
      6. Other causes of dyspnea.

(3) Nature of the injury, patient assessment, complications and the prehospital management of:
  (A) Rib fractures.
  (B) Flail chest.
  (C) Pneumothorax and hemopneumothorax.
  (D) Tension pneumothorax.

(4) Management skills, including:
  (A) Airway management (Basic Cardiac Life Support) including:
      1. Evaluation of breathing.
      2. Opening the airway.
      3. Expired air ventilation, including:
         a. Mouth to mouth.
         b. Mouth to nose.
         c. Mouth to mouth and nose (infants).
         d. Mouth to stoma (laryngectomies).
      4. Obstructed airway management.
  (B) Airway management with airway adjuncts, including:
      1. Suction.
      2. Basic oxygen delivery—nasal cannulas and mask.
      3. Pocket mask.
      5. Demand-valve positive pressure resuscitator.
      6. Assisting EMT-II and EMT-P with ventilation by esophageal airway and endotracheal tube.
      7. Nasopharyngeal.
      8. Oropharyngeal.
APPENDIX E

BAG VALVE MASK VENTILATION SURVEY
Bag Valve Mask (BVM) Ventilation Survey (Appendix E)

BMV Operator ID: ____________

1. How many years of experience do you have in EMS?
   [ ] 0 – 6 Months
   [ ] 7 – 12 Months
   [ ] 1 – 5 Years
   [ ] 6 – 10 Years
   [ ] 11 or more years

2. What is your gender?
   [ ] Male
   [ ] Female

3. What is your age? ______

4. What is the highest level of care that was completed? (please check one)
   [ ] First Responder
   [ ] EMT
   [ ] EMT-P

5. When did you complete # 4? ______

On a scale of 1 to 4, the number 1 being "strongly disagree" and the number 4 being strongly agree. How would you rate the following questions.

6. My efforts at BVM ventilation have reduced the severity of injury or illness ........................................ 1 2 3 4

7. I am comfortable ventilating patients by BVM .......... 1 2 3 4

8. If I knew for certain my patient would survive with a shortened intensive care unit (ICU) time, my treatment would be different .......................................... 1 2 3 4

9. Scene time is an important factor in providing effective BVM ventilation ........................................ 1 2 3 4

10. Effective BVM ventilation (visible chest expansion, no emesis) is a high priority for me .......................... 1 2 3 4
11. I think there are better ways then currently being used to ventilate patients with BVM .......................... 1 2 3 4

12. I have seen others ventilate BVM and:
   a) not have the chest expanded .............................. 1 2 3 4
   b) have patient emesis........................................... 1 2 3 4

13. I believe research can improve BVM ventilation techniques ................................................................. 1 2 3 4

14. I/we give the best care possible; it cannot improve..... 1 2 3 4

15. I/we need more support, personnel, training, equipment for BVM ventilation ........................................... 1 2 3 4

16. When I see others struggle with BVM ventilations,
   a) I believe they need more experience or training................................................................. 1 2 3 4
   b) I believe some airways are almost impossible to Maintain ................................................... 1 2 3 4
APPENDIX F

BAG VALVE MASK DATA COLLECTION CARD
BVM Data Collection Card (Appendix F)
(Note: Not for intubated patients)

BVM operator ID: ________

<table>
<thead>
<tr>
<th></th>
<th>I was able to achieve chest movement with ventilation</th>
<th>All the time</th>
<th>Not at all</th>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>My patient had abdominal distention</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>I had difficulty maintaining an open airway from mouth to lungs</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
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</table>

Was there patient emesis? (circle one) Yes No

I used the following techniques:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
APPENDIX G

BAG VALVE MASK DATA COLLECTION CARD (VENTILATION)
Bag-Valve Mask (BVM) Ventilation
Scene Data (Addendum G)

Incident Number: __________

Date of Incident: __________

Patient Care Report Number: __________

Location of incident (circle one):
Urban       Rural       Wilderness       Other

Time of:
  Dispatch       :___
  Arrival on scene   :___
  Patient transport  :___
  Hospital arrival   :___

Was the patient intubated (circle one)?  No  Yes  Time of intubation ___:___

ENVIRONMENT

Temperature ________

Precipitation (circle one):
None       Fog       Rain       Snow       Other_________

Number of field staff ________

Fire Department response ________

PATIENT

Glasgow Coma Score__________
APPENDIX H

BAG VALVE MASK VENTILATION PATIENT DATA
**Bag-Valve Mask (BVM) Ventilation**  
**Patient Data (Addendum D)**

Patient ID: __________

Glasgow Coma Score (on admission to ED) __________

<table>
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<th>Hospital Day 1</th>
<th>Hospital Day 2</th>
<th>Hospital Day 3</th>
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<tr>
<td>Chest radiograph infiltrate</td>
<td>Chest radiograph infiltrate</td>
<td>Chest radiograph infiltrate</td>
</tr>
<tr>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
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</table>

Lab Values:

<p>| | | |</p>
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</tr>
<tr>
<td>FO2 ___</td>
<td>FO2 ___</td>
<td>FO2 ___</td>
</tr>
<tr>
<td>Bilirubin ___</td>
<td>Bilirubin ___</td>
<td>Bilirubin ___</td>
</tr>
<tr>
<td>Creatinine ___</td>
<td>Creatinine ___</td>
<td>Creatinine ___</td>
</tr>
</tbody>
</table>

Where was the patient intubated?  (Circle one)

On scene  Transport  Emergency Dept.

Days on mechanical ventilator: __________

Days in Intensive Care Unit: __________

Survived / Dead (circle one)

Injury severity score: __________
REFERENCES


