Bioterrorism and Other Public Health Emergencies
Tools and Models for Planning and Preparedness

Project XTREME

Model for Health Professionals' Cross-Training for Mass Casualty Respiratory Needs

Report

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This program provides training only to extenders specifically delivering care to adult patients. It is not intended for training care providers of pediatric or neonatal patients.

Contents

Figures

Tables

Executive Summary

A Word of Caution

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Objective and Directives

The objective was to develop, implement, and evaluate a model to cross-train non-respiratory therapy health care professionals in providing basic respiratory care and ventilator management in the event of a mass casualty disaster resulting in a surge of patients needing mechanical ventilation. This objective was in response to the recognition that there is likely insufficient surge capacity among trained respiratory therapists to meet staffing needs in such an event.

The specific directives of the project were to: 1) review examples of cross-training, 2) develop core competencies for mechanical ventilation, 3) develop a core curriculum that includes quantifiable performance indicators, 4) identify competency testing models, 5) explore legal/regulatory barriers to cross-training care providers beyond their scope of practice, 6) identify which personnel should be cross-trained and who should not, and 7) discuss how this competency testing and validation might fit with the Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP) program.

Results

Examples of Cross-training

An extensive literature review identified 50 articles that were relevant to this project. Specific issues were addressed in this review and are detailed here.

What cross-training frameworks or models are currently used in health care? Models of cross-training in health care typically follow two basic frameworks: cross-training within a discipline and cross-training across disciplines. Most cross-training occurs within a given discipline. Examples include cross-training medical/surgical nurses in an intensive care setting, cross-training nurses to function in all areas of maternal child care, cross-training within perioperative services, and cross-training medical technologists to various areas of laboratory services.

The other predominant framework, referred to as multicompetent practice or the multiskilled health practitioner, involves cross-training across disciplines. Multicompetent or multiskilled practitioners are cross-trained to provide more than one function, often in more than one discipline, and may include functions across a broad spectrum of health-related jobs ranging in complexity. Examples of multicompetent practice development exist in a number of professions, including nursing, psychology, physical, occupational therapy, and respiratory therapy.

How can the cross-training frameworks/models found in the literature be applied to the current project goals? A number of current concepts in cross-training are applicable to mass casualty scenarios requiring surge capacity. Such training broadens the competencies and skills of staff who are already familiar with the hospital setting, increases staffing flexibility, creates a more agile workforce, provides more efficient use of staff, and expands the workforce to meet future health care demand.

Both cross-training within a discipline and multicompetent practice have been successfully implemented in health care. Each framework has advantages and disadvantages. Due to the anticipated extreme shortage of health care personnel who are trained to independently manage mechanically ventilated patients, a hybrid model of cross-training that integrates both intra-disciplinary cross-training and multicompetent cross-training would likely be best suited to the goals of this project. The model of cross-training used for this project therefore includes trainees both from respiratory therapy and from other health care related disciplines.

What guidelines should be established for selection of potential trainees? Important criteria for identification of potential trainees include:

- Voluntary participation or self selection. Voluntary participation may achieve higher productivity and identify the most desirable and qualified employees.
- Possession of baseline knowledge or competencies that trainees must have prior to being cross-trained. One means of identifying individuals with the appropriate knowledge base or minimal competencies is to select trainees with specific disciplinary licensure or accreditation. In addition, specific disciplines, such as nursing, have been identified as having the greatest potential for cross-training for multicompetent practice.
- Possession of analytical assessment skills and a large skill base. These qualities facilitate adding new skills through cross-training.
- Experience working within a care team framework.
- Having time during a mass casualty event to perform the newly acquired cross-trained duties and competencies. Potential trainees should be from professions whose normal practice responsibilities will not be used or in increased demand during a disaster.

Other criteria identify professions that may be more amenable to cross-training in general. These include experience in delivering care on a “24/7” schedule, providing care in all settings, using clinical practice guidelines, and working collaboratively as a team.

What type and method of training and evaluation can be anticipated to be the most applicable for this project curriculum (readiness training, just-in-time, etc.)? The cross-training curriculum needs to be designed to ensure that:

- Skill development is founded on sufficient theory to enable trainees to identify and solve clinical problems.
- Selected trainees understand the need for safety procedures, practice in a safe manner, and recognize when safety is breeched.
- Trainees recognize the limits of their abilities and how to request assistance.

Using evidence-based practice guidelines and protocols developed by professional organizations for the basis of the curriculum content provides skill development founded on theory. Safety is particularly salient in mass casualty scenarios resulting from infectious epidemics since there will likely be mass respiratory casualties with associated high risk for secondary transmission of contagious disease to health care workers and other patients. Education in infection control techniques and precautions is of paramount importance.

The process of education incorporated into this project was based on a five-step training sequence based on: 1) description of the skill, 2) demonstration of how it is performed, 3) practice, 4) provision of feedback, and 5) continuation of practice until the learner proves competence.

Teaching strategies that have been used in cross-training programs include didactic methodology, hands-on training in a lab and/or with live patients, peer-training, preceptorship/coaching, and self-paced learning (videos, computer-based learning). Each has advantages and disadvantages, and most programs employ a combination of techniques. For this project, a DVD video was produced that incorporated visual demonstration of techniques and procedures, voice overlay describing content, and feedback in the form of interactive questions that trainees must answer in order to complete training. Additional feedback was provided through the opportunity to return to relevant portions of the video to review material for incorrectly answered questions. Practice and additional feedback is provided by an interactive competency skills lab after completion of the video training.

A wide range of training times has been used in cross-training models. The urgency of a mass casualty scenario may not allow for an extended training timeframe. The issue becomes how much training is enough? All current cross-training programs reviewed were competency-based, which allowed for sufficient evaluation and measurement of newly acquired skills. The goal of cross-training in this program is to produce not clinical expertise but rather clinical competency. Trainees who met the course competencies were considered successfully trained.

The other timing issue relates to whether just-in-time training or readiness training is most appropriate. Most currently available disaster preparedness courses use readiness training designed to increase the number of trained health care personnel in various aspects of disaster management. New training, knowledge, and skills acquired in this fashion, however, are subject to skill degradation over time. Few programs provide any means to renew the competencies related to the subject area other than repeating the course content. Due to the current early stage of development of research in disaster medicine and mass casualty management, it is not clear if the model of readiness training is more effective than other models. Just-in-time and just enough training would be an alternative to readiness training. The curriculum developed for this project was flexible enough to be used for both readiness and just-in-time training. It is envisioned that this program could be used to pre-train respiratory extenders through readiness training; pre-trained extenders would need to refresh their training through just-in-time training in the event of a disaster. The program could also be used to train extenders through just-in-time training alone. This approach is based on the premise that in an epidemic mass casualty event there would likely be adequate time and community resources to allow for just-in-time training if the epidemic were

recognized early. It is unknown if this latter approach would be as effective as the two-step process.

What existing relevant courses and curricula have already been developed and implemented? Two courses involve training on the mechanical ventilators maintained by the Strategic National Stockpile (SNS) program, which is managed jointly by the U.S. Department of Health and Human Services (DHHS) and U.S. Department of Homeland Security (DHS). The Society of Critical Care Medicine has developed the Hospital Mass Casualty Disaster Management course, offering critical care cross-training for hospital-experienced health professionals. The 2-day course includes a 2-hour hands-on training session on setting up and operating the SNS ventilators. The course was first offered in April 2005. In July 2005, the DHHS released a letter to the members of American Association for Respiratory Care (AARC) seeking a cadre of geographically dispersed registered respiratory therapists (RRTs) or certified respiratory therapists (CRTs) who would be hired under DHHS' emergency hiring authority to respond to disasters. Those hired would receive training that includes familiarization with the SNS ventilator models and equipment. As of July 2006, 35 respiratory therapists have been trained with this program on the SNS ventilators. .

Core Competencies for Mechanical Ventilation

The scope of the extenders' practice should be established by the institution and determined by the available resources for oversight and training, as well as the nature of the mass casualty event. The goal of the training program is not to train extenders to function as respiratory therapists, but rather to assist respiratory therapists by performing the more basic respiratory care procedures that they provide. Extenders will not have the training or experience to perform all respiratory care functions. However, with appropriate oversight and the Project XTREME training, they could supplement the workforce of typical respiratory therapy departments by assisting with the following tasks:

- Airway cuff maintenance
- Artificial airway care
- In-house patient transport
- Manual ventilation via endotracheal or tracheostomy tubes
- Mechanical ventilator setting adjustment
- Mechanical ventilator setup
- Observe standard precautions and other infection control guidelines
- Oral care
- Pulse oximetry
- Routine suctioning
- Securing artificial airway
- Ventilator circuit change
- Ventilator monitoring and patient system check.

Though not an exhaustive list, functions that would likely be outside the competence of extenders without additional training/experience include:

- Arterial blood gas analysis and interpretation
- Administration of medication
- Arterial line catheterization
- Arterial puncture (for blood gas acquisition)
- Assisting bronchoscopy
- Bedside spirometry
- Clinical assessment of patients
- Chest physiotherapy
- Delivery of high-frequency ventilation
- Endotracheal intubation/reintubation
- Hyperinflation therapy
- Inter-facility patient transport
- Specialty gas administration
- Ventilator troubleshooting and problem analysis (beyond recognizing when alarm parameters are being exceeded and manually ventilating patients pending assessment of the situation by a respiratory therapist).

The importance of appropriate oversight cannot be overstated. Competency in all procedures performed by XTREME extenders should first be evaluated by a respiratory therapist or an appropriate hospital patient care provider. Performance should be assessed routinely.

Competencies for the above skills were formulated using published organizational standards and recommendations from AARC, specifically the *Orientation & Competency Assurance Documentation Manual for Respiratory Care* (Grady, 1997*)*. This manual was developed by a panel of respiratory therapy experts for two purposes: to fulfill Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements and to provide a method to objectively assess and document level of skill and proficiency in respiratory care providers. The manual identifies specific skill areas in which a health care professional would need to demonstrate competency to be deemed proficient in providing basic respiratory care and ventilator support. The competencies developed by the AARC have been modified for this project to follow the abridged curriculum of the training. The following skill areas were identified as critical for basic respiratory care training:

- Infection control
- Terms and definitions
- Manual ventilation
- Mechanical ventilation
- Airway maintenance
- Airway suctioning.

A Core Curriculum with Quantifiable Performance Indicators

The core curriculum was designed using existing materials and references (see page 90.) The specific material taught for each competency included:

Infection Control

- Standard precautions (e.g., gowns, gloves, masks, etc.)
- Isolation techniques (contact, airborne, droplet)
- Hand hygiene

Terms and Definitions

- Manual ventilation
  - Glossary of terms
  - Normal ranges
- Mechanical ventilation
  - Glossary of terms
  - Normal ranges

Manual Ventilation

- Equipment assembly
- Equipment function
- Oxygen settings
- Technique
- Monitoring
- Assessment of adequacy of ventilation

Mechanical Ventilation

- Introduction to mechanical ventilation
- Hazards of mechanical ventilation
- Assembly and testing of ventilators
- Ventilator setting adjustment
- Alarm limit settings
- Assessment of adequacy of ventilation
- Monitoring
- Troubleshooting

Although some of the material is universal and applicable to all ventilators, the mechanical ventilation material focuses on the ventilators in the SNS, the Impact® Uni-Vent® Eagle™ and the Puritan Bennett LP10.

Airway Maintenance

- Assessment of tracheal tube placement
- Securing endotracheal tubes
- Cuff inflation techniques
  - Minimum occluding volume
  - Minimal leak technique

Airway Suctioning

- Indications for need
- Hazards
- Equipment
- Complications
- Procedure technique
- Expected outcomes.

Competency Testing Models

Testing and documentation of core competencies were developed using the model advocated in the AARC *Orientation & Competency Assurance Documentation Manual for Respiratory Care* (Grady, 1997). The five-point scale and deficiencies checklist set forth in the AARC competency manual provide an objective and quantifiable method for validating and documenting the extenders' understanding of the material.

Two methods are employed to test and document competency. First, trainees must correctly answer all of the questions following each module in the video. Second, trainees must complete a competency lab during which they are directly observed performing the competencies by a credentialed respiratory therapist.

Legal and Regulatory Barriers to Cross-training Care Providers Beyond Their Scope of Practice

Critical issues that may limit trainees' ability to provide mechanical ventilation involve licensing, civil liability, and immunity.

The practice of respiratory therapy is regulated in 48 States. The use of a mechanical ventilator falls within the definition of respiratory therapy. Pursuant to State respiratory care practice laws, it is unlawful to practice respiratory therapy unless licensed to do so under the applicable State regulation. A review of State respiratory practice laws revealed that 43 States have specific exemptions from their licensing requirements (see Product A, State Survey of Respiratory Care Statutes).

Two commonly found exemptions that might allow a cross-trained health care professional to operate a mechanical ventilator in the course of a mass casualty disaster are the performance of any respiratory care services in the case of an emergency and providing respiratory care services within the health care professional's scope of practice.

For purposes of the respiratory care practice acts, the term “emergency” is not defined. The common understanding of the term emergency includes a medical emergency and a public disaster/epidemic emergency. In the case of a public disaster/epidemic, most States have adopted emergency response laws that define emergency. In the event of a public disaster or emergency epidemic, the emergency exception to the licensing requirement for providing respiratory care services would most likely apply, and therefore a cross-trained health care professional could operate a mechanical ventilator without violating the applicable respiratory care practice statute. The question of whether the health care professional would be subject to penalties for practicing outside the scope of his or her license must then be addressed.

Scope of practice is determined by State regulations. States, however, do not use consistent terminology and may authorize different scopes of practice. A review of State respiratory care practice acts revealed that several States specifically exempt certain health care professionals from their licensing requirements if the practice of respiratory care is within their scope of practice. Other States allow for the practice of respiratory care by a licensed health care professional who has received special training.

Respiratory care services would generally fall within the scope of practice for physicians, physician assistants, and nurses, and therefore, these health care professionals make ideal candidates for this respiratory cross-training model. Applying the criteria recommended in the literature review (pre-existing knowledge base, minimal competencies, skill base, experience, and availability in a mass casualty disaster), the core development team identified several additional professionals for this cross-training model, including second-year respiratory therapy students, anesthesiologists, certified registered nurse anesthetists, veterinarians, dentists, and physical therapists.

The scope of practice for these targeted health care professionals may expand with additional training and experience. This cross-training model will provide competency-based learning and evaluation. Trainees who successfully complete the course will be provided with a certificate of completion as evidence of competency and, therefore, their newly acquired skills may be included in their expanded scope of practice. In a mass casualty disaster, a facility may consider credentialing and granting temporary or disaster privileges to the above cross-trained health care professionals to provide respiratory care services, such as using a mechanical ventilator, if such function is outside their normal scope of practice.

In a disaster or public emergency, State governors have broad powers to respond to the emergency conditions. Governors have, after declaring a state of emergency, issued Executive Orders suspending the State licensure requirements for out-of-State medical professionals and personnel who volunteered in their States as long as those volunteers met certain criteria, such as possessing current licenses in good standing in their respective States of licensure, practiced in good faith, and performing within the reasonable scope of their skills, training, or ability. The declaration of a disaster also serves to extend immunity from civil or criminal liability to health care providers and others who act pursuant to an Executive Order. Additionally, Executive Orders may be issued to provide State tort liability coverage to all out-of-State health care professionals who possessed current licenses in good standing in their respective States of

licensure, and who practiced in good faith and within the reasonable scope of their skills, training, or ability.

The Executive Orders that were issued in response to past disasters addressed the licensing and liability issues for out-of-State health care professionals, and provided for waivers of licensing requirements and immunity from liability for out-of-State medical personnel *practicing within their licensed disciplines*. It is unknown whether an Executive Order would specifically address licensing issues for respiratory cross-training across health care disciplines.

Depending on the nature and severity of the mass casualty disaster, a facility may be able to meet the surge-capacity needs of patients for respiratory care with just its current employees, or the facility may need to go beyond its current staff and recruit volunteers to be cross-trained to use mechanical ventilators. If a facility uses its own employees, such employees would be held to the normal negligence and liability standards. According to the *Emergency System for Advance Registration of Volunteer Health Professionals — Interim Technical and Policy Guidelines, Standards, and Definitions* (Health Resources and Services Administration [HRSA], 2005; www.hrsa.gov/esarvhp/guidelines), there is no evidence to support a reduced standard of care during a mass casualty disaster or emergency.

Employees and authorized volunteers performing services for public hospitals are protected by State governmental immunity laws. Governmental immunity applies to public employees and volunteers as long as they are acting within the course and scope of their responsibilities for the public entity. It is unclear whether a cross-trained health care professional who provides medical services outside their licensed scope of practice would be considered acting within the course and scope of their responsibilities for purposes of coverage under the State immunity law.

The ESAR-VHP Guidelines provided a comprehensive overview of the legal issues surrounding civil liability for volunteers. In the report, several sources of limits to civil liability for volunteers were cited, including emergency response laws, volunteer protection laws, Good Samaritan laws, and governmental immunity laws. These laws vary from State to State. Due to the variances in State law, a complete survey of the above State laws was beyond the scope of this review. It is strongly recommended that facilities considering the use of volunteers in a mass casualty respiratory cross-training program review their appropriate State statutes related to liability for volunteers.

Who Should Be Cross-trained and Who Should Not

Pilot testing was conducted to determine which subsets of health care professionals could be trained. Health care professionals in each of the following areas were recruited to test the training program: second-year respiratory therapy students, internists, non-critical care nurses, physician assistants, nurse practitioners, veterinarians, physical therapists, dentists, anesthesiologists, and certified registered nurse anesthetists. Testing was limited by the difficulty in recruiting adequate numbers of subjects in a number of professions; only the second-year respiratory therapy student, non-critical care nurse, and physical therapist groups met recruitment goals. No dentists, anesthesiologists, or certified registered nurse anesthetists were recruited.

All subjects who completed the training passed the program and successfully performed the core competencies in the lab. Although anesthesiologists and certified registered nurse anesthetists were not tested, a staff anesthesiologist at Denver Health who reviewed the video for content concluded that the core competencies in the training program were those inherent to the practice of both of these groups and that they could function as respiratory extenders without additional training.

How This Competency Testing and Validation Might Fit with the Emergency System for Advance Registration of Volunteer Health Professionals Program

The ESAR-VHP program was conceived as a way to optimize the use of volunteer health personnel in an emergency. The goal of this program is for each State-based system to include verifiable, up-to-date information regarding volunteers' identities, licensing, credentialing, accreditation, and privileging in hospitals or other medical facilities. This will improve the capability to quickly identify and better use health professional volunteers in emergencies.

Currently, the program includes standards for a few health care professionals but will eventually expand to 65 occupations. Eventually, the ESAR-VHP program will include all the target groups identified in this project for pilot training. Besides standards and credentialing for these specific professions, there will be standards for data and system architecture. However, it may be possible for ESAR-VHP registries to incorporate information relevant to this training program (i.e., individuals indicating interest in the training, meeting minimum requirements, or already having completed it). This will allow rapid identification of appropriate trainee groups both for emergency response and as opportunities for further testing and validation beyond the nine groups used for pilot testing.

Although ESAR-VHP programs will eventually be a resource for identifying most health professional groups for disaster and emergency responses, anyone developing a training program should consider diversified resources for identifying potential trainees.

Background

Literature Review

Previous research identified potential staffing problems associated with mass casualty scenarios characterized by a surge of patients requiring mechanical ventilation. The specific issue identified was how to provide adequate numbers of trained medical professionals to operate ventilators in such a crisis.

As a foundational component of developing an appropriate model for cross-training, a review of literature, including relevant online Web sites and consultation with subject-matter experts, was conducted to determine the current state of the science related to cross-training and mass casualty education relevant to this project. The purpose of the literature review was to inform decisions related to the following questions:

1) What cross-training frameworks or models are currently used in health care?
2) How can they be applied to the current project goals?
3) What guidelines should be established for the selection of potential trainees?
4) What type and method of training would be most applicable for this project (readiness training versus just-in-time)?
5) What existing relevant courses and curricula have already been developed and implemented?

Using the keywords cross-training, multicompetency, multiskilled practitioner, and mass casualty training, a search of OVID databases and online search engines revealed 955 references that were initially reviewed for relevancy and applicability. The initial references were further narrowed to approximately 50 in-depth reviews.

What cross-training frameworks or models are currently used in health care?

A number of cross-training programs have been implemented in a variety of settings. Although there are numerous descriptions of the development, implementation, and evaluation of such programs, little information is available on the operational definition of the concept. Cross-training has been defined as the acquisition of specific skills garnered from separate disciplines or outside one's specialty area, implying a more technical connotation (Holland, 2001). Cross-training has also been presented as an alternative framework of training and education to the popular concept of specialization (Blayney, 1992; Snyder & Nethersole-Chong, 1999). A basic difference in practice philosophy is inferred, specifically cross-training more aligned with the concept of "generalist" than specialization. Health care professionals have become highly specialized and accustomed to working in hospital units that are designated and organized for exclusive patient populations; such specialization is a luxury that most acute care institutions can no longer afford (Komara & Stefaniak, 1998). Similarly, in industrial engineering and management sciences, cross-training is recognized as a means to build workforce agility into production systems (Hopp & Van Oyen, 2004; Jordan, Inamn, & Blemenfeld, 2004).

Cross-training in health care typically has been developed and implemented as a response to several major issues. These include a rapidly changing and unpredictable health care environment, rapid census and acuity fluctuations, cost-containment pressures, and belief that concepts of sound clinical judgment cross patient populations (Komara & Stefaniak, 1998; Masson & Fain, 1997; Phillips, 1999; Snyder & Nethersole-Chong, 1999). The challenge of providing a cost-effective means of maximizing the potential of staff members and available resources while maintaining quality patient care has resulted in creative cross-training programs. Although used in some form in nearly all care areas, cross-training in health care has been developed for the following universal applications and purposes:

1) To broaden the competencies and skill of staff (who are already familiar with the hospital setting)
2) To increase staffing flexibility
3) To create an agile workforce
4) To provide more efficient use of staff
5) To provide cost-effective alternatives
6) To expand the workforce to meet future health care demand.

(Brown, 2003; Del Bueno, 2001; Masson & Fain, 1997; Phillips, 1999; Scholes & Vaughan, 2002).

Models of cross-training in health care typically follow two basic frameworks: cross-training within a discipline and cross-training across disciplines. The majority of cross-training is within a given discipline and includes such examples as cross-training medical/surgical nurses to an intensive care setting (Del Bueno, 2001; Snyder & Nethersole-Chong, 1999); cross-training nurses to function in all areas of maternal child care (Altimier & Sanders, 2001; Hathaway & Longobucco, 1996; Komara & Stefaniak, 1998); cross-training within perioperative services (Masson & Fain, 1997); and cross-training medical technologists to various areas of laboratory services (Bersch, 2005; Shapiro, 2003). The other predominant framework involves cross-training across disciplines, sometimes referred to as multicompetent practice or the multiskilled health practitioner (Drumheller, 1996; Makely, Bamberg, & Mattes, 1991). The multicompetent or multiskilled practitioner is cross-trained to provide more than one function, often in more than one discipline, and may include functions across a broad spectrum of health-related jobs ranging in complexity (Vaughan et al., 1989). The origins of the multiskilled practitioner movement in the United States can be traced back to the 1950s, when the concept of multiskilled practitioners was explored as a possible solution to meet the needs of rural health care. Although no longer an active movement per se, the concepts of multicompetency remain pertinent in the 21st century as shortages of nurses, pharmacists, and other health care professionals reach crisis levels. Over a decade ago, Lathrop (1993) discussed restructuring service delivery and the advantages of multicompetent practice in a patient-centered care setting. Similarly, the Pew Health Professions Commission (1995) and Blayney (1992) predicted the need for health care systems to develop a workforce that is flexible, versatile, productive, and cost-effective to meet future needs. Current health care literature includes examples of multicompetent practice development in nursing, psychology, physical and occupational therapy, and respiratory therapy (Drumheller, 1996; Makely, Bamberg, & Mattes, 1991; Masterson, 2002).

Exemplar Case: Cross-Training and Job Redesign for Respiratory Care Personnel in Florida Acute Care Hospitals.

An exemplar for this project is a model of cross-training and multicompetent practice implemented in Florida acute care hospitals and at Florida's Lakeland Regional Medical Center (LRMC) (Drumheller, 1996). Collaboration between the Florida Hospital Association Licensure 2000 Task Force and the National Health Care Skill Standards Project, with the support of the Pew Health Professions Commission, resulted in the proposal of Florida's Multiskilled Cross-Training Certification (1995). Although this act was not passed into Florida statute, it served as the basis for the LRMC model of cross-training and job redesign for respiratory care personnel.

LRMC has successfully prepared respiratory therapists since 1989 for multicompetent practice with educational preparation in anatomy, physiology, pharmacology, and medical technology (Borfitz, 1993). Four categories and associated competencies were selected based on research and practice for cross-training respiratory care personnel: nursing, cardiopulmonary, clinical laboratory, and radiological technology. The selected competencies included taking vital signs, administering dressing changes, performing electrocardiograms, assisting with cardiovascular (hemodynamic) monitoring, phlebotomy, and performing/processing chest x-rays.

The cross-training model implemented by LRMC was an effort to address a serious productivity problem related to the chronic shortage of nurses and other allied health professionals that resulted in a mismatch between clinical competencies needed and the availability of health care workers possessing them. Restructuring of LRMC included redefining jobs and the delivery of services to a framework consistent with "patient-focused care." In addition, respiratory care personnel in Florida were identified as ideal for cross-training, due to the flexible nature of State regulatory requirements and recognition that respiratory care licensure was based on national credentialing mechanisms, thus allowing greater portability between States (Florida Hospital Association, 1993).

How can the cross-training frameworks/models found in the literature be applied to the current project goals?

A number of current concepts in cross-training are applicable to mass casualty scenarios requiring surge capacity. Cross-training would be a feasible approach to meet the increased need for surge capacity for many of the same reasons it reportedly is beneficial in the current environment of care. It broadens the competencies and skills of staff (who are already familiar with the hospital setting), increases staffing flexibility, creates a more agile workforce, provides more efficient use of staff, and expands the workforce to meet future health care demand. A mass casualty scenario is characterized by a rapidly changing and unpredictable health care environment with rapid census and acuity fluctuations. This is in many ways similar to the current care environment, although the census and acuity fluctuations in a mass casualty event would be more widespread and urgent. Cross-training has been used to address the critical shortage of nurses and other ancillary staff, which would be a greater issue in time of a bio-attack or large-scale epidemic. Therefore, the goal of this project is consistent with the rationale for use and context of cross-training found in the literature.

Two specific models of cross-training have been primarily described independently of each other. Cross-training within a discipline has been successfully implemented to train nurses to practice across hospital units, medical technologists throughout the laboratory setting (Bersch, 2005), and librarians in different areas of library science (Mozenter, Sanders, & Bellemy, 2003). An alternate approach involving multicompetent practice has been successful in combining competencies from nursing and respiratory therapy; radiology and medical laboratory technology; and physical therapy, occupational therapy, and nursing. However, due to the anticipated extreme shortage of health care personnel who are trained to independently manage mechanically ventilated patients, a hybrid model of cross-training that integrated both intra-disciplinary cross-training and multicompetent cross-training would likely be best suited to the goals of this project. The model of cross-training used for this project, therefore, includes trainees both from respiratory therapy and from other health-care related disciplines.

What guidelines should be established for selection of potential trainees?

Review of successful cross-training programs reveals that establishing criteria for selection of trainees is a foundational component of program design and implementation. A well-thought out and well-implemented cross-training program allows for reassignment of staff and high levels of productivity (Riley, 1990). One aspect of such a program is establishing realistic criteria for selection of potential trainees. Voluntary participation or self-selection is a critical component (Ackroyd, 1990; Patterson, 1992; Warren, 1978) that may achieve higher productivity and identify the most desirable and qualified employees (Snyder and Nethersole-Chong, 1999). A number of professional organizations and governmental agencies are in the process of compiling lists of possible health care professionals who would be available to volunteer to assist in the event of a mass casualty or bioterrorist attack.

It is also important to identify baseline knowledge or competencies that trainees must have prior to being cross-trained (Masson & Fain, 1997). Cross-training programs typically are designed for individuals with prior training and experience to acquire additional health care skills (Makely, Bamberg, & Mattes, 1991); therefore, the importance of clearly delineating the appropriate educational and knowledge background cannot be overstated. Baseline competencies should be learner-oriented, behaviorally described, and clearly measurable (Spence, 1994). One means of acknowledging a prior knowledge base or minimal competencies is to select trainees with specific disciplinary licensure or accreditation. Specific disciplines, such as nursing and respiratory care, have been identified as having the greatest potential for benefit by cross-training for multicompetent practice (Beachey, 1988; Drumheller, 1996). The Hospital Mass Casualty Disaster Management course (Society of Critical Care Medicine, 2005) delineates its target audience for cross-training as physicians, physician assistants, nurses, advanced practice nurses, pharmacists, and respiratory therapists expected to have inpatient responsibilities during disasters. Similarly, DHHS has explicit knowledge-base and qualification requirements for respiratory therapists volunteering for training in the new SNS ventilator training program. DHHS has established the following guidelines for their SNS ventilator training program: valid State license, degree from an accredited school, certification as an RRT or CRT, physically able to work under emergency conditions (possibly in a field medical unit), and current clinical experience (AARC, 2005).

In the development of the Florida cross-training and job redesign initiative, AARC (1994) identified the following attributes and rationale for using respiratory care practitioners as multiskilled providers:

- They are on hospital duty 24/7 and are accustomed to providing care in all settings.
- They are one of the allied health professions that have developed and employed clinical practice guidelines to control utilization.
- Their educational preparation requires physics, biology, pharmacology, anatomy, and lab sciences, which increase the opportunities for successful cross-training.
- They possess the necessary analytical and assessment skills and have a large skill base, which makes adding new skills through cross-training a faster process.
- They have a proven track record as care coordinators and candidates for cross-training.
- They are continually expanding their scope of practice and are a positive resource in any care setting.
- They have established a cooperative relationship with the physician community and a have a history of working collaboratively as a team.

The Florida cross-training initiative provides additional issues for consideration related to selection of trainees for this project. Possession of analytical assessment skills and a large skill base may facilitate more expedient cross-training. Given the nature of mass casualty events, timely training would be necessary to increase surge capacity. Successful cross-training may be facilitated by selecting trainees from disciplines that have typically advocated cross-training and have experienced successful cross-training. Having established cooperative relationships and previous experience working collaboratively in a team could also be significant. Hospitals' responses to bioterrorism or large-scale epidemics will require significant coordination (Rubinson et al., 2005) across the continuum from regional levels to the bedside team.

One additional consideration in selecting potential trainees for SNS ventilator training relates to the anticipated increase in both numbers and acuity of patients in a mass casualty scenario. When undergoing cross-training programs, individuals must have time to perform the newly acquired competencies in addition to their regular duties (Borfitz, 1993). It is likely that critical care personnel will be over-tasked in the wake of a disaster resulting in hundreds or thousands of critically ill patients (Rubinson et al., 2005), and they may not be able to provide ventilator care. Individuals should be selected for cross-training from disciplines and professions that are less likely to be directly involved in the care of critically ill patients and whose normal practice responsibilities may not be used during a mass casualty. The Working Group on Emergency Mass Critical Care (Rubinson et al., 2005) recommend a two-tiered staffing model involving non-intensivists and non-critical care nurses to supplement care typically delivered by intensivists and critical care nurses. In addition, the Society of Critical Care Medicine (2005) has developed their Hospital Mass Casualty Disaster Management course for the target audience of non-critical care health professionals.

Based on the current literature and conversations with subject-matter experts, the following concepts should guide the identification of possible trainee candidates for this project:

- Voluntary participation (self-selection)
- Possession of baseline knowledge or competencies

- Possession of analytical assessment skills and a large skill base
- Experience working within a care team framework
- Having time during a mass casualty event to perform the newly acquired cross-trained duties/competencies.

What type and method of training and evaluation would be most applicable for this project curriculum (readiness training, just-in-time, etc.)?

A common theme throughout the cross-training literature is the concept of flexibility. Flexibility implies that within individual programs, there may be various levels of cross-training (beginning, advanced, etc.) and that the curriculum should be developed based on the trainees' past experience or competency assessment (Drumheller, 1996; Holland, 2001; Makely, Bamberg, & Mattes, 1991; Snyder & Nethersole-Chong, 1999). Although a knowledge base for trainee recruitment is established, there are likely to be variations in trainees' past experiences with ventilator support. Developing a curriculum that can be flexible and sensitive to these differences may provide a more timely increase in manpower to address the surge capacity, as some trainees may not require the same intensity of instruction.

A cross-training curriculum should be designed to: 1) ensure that skill development is founded on sufficient theory to enable trainees to identify and solve clinical problems; 2) prepare graduates/trainees who understand the need for safety procedures, practice in a safe manner, and recognize when safety is breeched; and 3) ensure graduates/trainees can recognize the limits of their abilities and how to request assistance when needed (Blayney, 1992). Using evidence-based practice guidelines and protocols developed by professional organizations (AARC, 2005; Ely et al., 2001) for the basis of the curriculum content provides skill development founded on theory. Safety is particularly salient in a mass casualty scenario that involves an infectious agent. Of great concern is the high risk for secondary transmission of contagious diseases to health care workers and other patients (Grow & Rubinson, 2003; Rubinson & O'Toole, 2005). After the initial SARS outbreak in Taiwan, 94 percent of SARS infections were transmitted within hospitals (McNeil, 2003). Education in infection control techniques and precautions should be integrated into the curriculum, since a contagious disease is a likely scenario resulting in mass mechanically ventilated casualties. Trainees should be made to feel all efforts will be taken to ensure their safety.

A variety of teaching strategies have been used in cross-training programs. These include didactic, hands-on training in a lab and or with live patients; peer-training; preceptorship/ coaching; and self-paced learning using videos and computers (Bokhorst, Slomp, & Molleman, 2004; Drumheller, 1996; Holland, 2001; Komara & Stefaniak, 1998; Short, 2005). Most programs employed a combination of techniques to increase the flexibility and availability of learning. Cross-training has been conducted in a number of formats, including in-house training (hospitals), college courses, commercial courses, training in other care facilities, and on-the-job training (Blayney et al., 1989). Although no single methodology seemed predominant in the cross-training literature, the ability to train significant numbers of qualified individuals quickly, efficiently, and effectively to meet surge capacity needs is a primary concern of this project. Technology such as videos or computers may be an effective and expedient teaching strategy.

However, depending on the nature of the particular mass casualty, the availability of basic necessities such as electricity may be a limiting factor.

Most descriptions of cross-training programs include the specific process of education and training. Although other teaching techniques such as coaching and mentoring have been integrated, training remains organized along five basic steps (Frederiksen, 1986):

1) Description of the skill
2) Demonstration of how it is performed
3) Practice
4) Provision of feedback
5) Continuation of practice until learner proves competence.

A wide range of training times has been used in cross-training models. These include self-paced learning (Hathaway & Longobucco, 1996) and structured training provided within a specific timeframe (Altimier & Sanders, 1999). The urgency of a mass casualty scenario may not allow for an extended training timeframe. The issue becomes how much training is enough? All current cross-training programs reviewed were competency-based, which allowed for sufficient evaluation and measurement of the newly acquired skills. In addition, a clear understanding of the performance goals of cross-training is necessary. Cross-training may not produce clinical expertise, but can produce clinical competency (Nichols & Palmer, 1994). While "expertise denotes an expert level of knowledge that is attained with an accumulation of experiences over time, competency denotes the ability to meet a certain level of practice as defined by specific criteria." (Nichols & Palmer, 1994, p. 36.) For purposes of this project, trainees who have met the course competencies will be considered successfully trained.

The other timing issue relates to a decision regarding which training model to select for this project—just-in-time training or readiness training. A number of disaster preparedness/mass casualty courses are available that use readiness training. These courses are designed to increase the number of trained health care personnel in various aspects of disaster management, and frequently provide certificates in the relevant topic areas. However, the new training, knowledge, and skills acquired in these courses are subject to skill degradation over time. Few programs have any means to renew the competencies related to the subject area other than repeating the course content. Due to the current early stage of development of research in disaster medicine and mass casualty management, it is not clear if the readiness training model is more effective than other models. Just-in-time and just-enough training are alternatives to readiness training. A number of organizations, including computer and information technology industries, use the concept of just-in-time training (Short, 2005). Microsoft uses this approach when technicians must acquire a proficiency quickly before classroom instruction is available or when it is not in the budget. The use of video versions of classroom presentations showing the instructor performing and demonstrating actual tasks has provided a cost-effective means of learning that is readily available and sustainable, because a video can be reviewed as much as necessary. The XTREME External Advisory Committee suggested creating a curriculum that was flexible enough to be used for both readiness and just-in-time training. The committee members point out that just-in-time training may not be effective in natural disasters such as Hurricane Katrina, but

may be efficacious in an epidemic-type event because time and community resources should be adequate to allow for just-in-time training.

The following concepts are integrated into the curriculum development and cross-training methodology:

- Flexibility (ability to be used for various levels of training)
- Development based on a level of experience/competency
- Integration of relevant safety issues
- Skill development founded on theory
- Competency-based learning and evaluation
- Combined teaching strategies/techniques
- Basic five-step training sequence
- Appropriate length of time for learning based on competency validation
- Use of just-in-time and readiness training.

What relevant courses and curricula have already been developed and implemented?

Disaster management and mass casualty courses have been developed by a number of organizations and agencies at the international, Federal, State, and local levels. The World Health Organization (1999), Federal Emergency Management Agency, Centers for Disease Control and Prevention (CDC), U.S. Department of Defense, Agency for Healthcare Research and Quality (AHRQ), DHS (American Hospital Association, 2005), and State-level public health departments (Fraser & Fisher, 2001) all offer a number of courses and conferences on topics related to emergency preparedness, mass casualty, and disaster management. Universities (Center for Health Policy, Columbia University School of Nursing, 2001; University of Texas, 2006) and professional organizations (American Nurses Association, 2006; Gebbie & Qureshi, 2002) have also established courses, competencies, and certifications in a variety of related topics. Professional organizations, such as the American College of Surgeons (2006), have issued formal statements outlining priority areas for disaster and mass casualty education and training. In addition, an American College of Emergency Physicians task force (2001) has developed objectives, content, and competencies for emergency physicians, nurses, and technicians caring for mass casualties.

Some organizations have formed coalitions to combine resources and collaborate in this effort. Of particular note is the International Nursing Coalition for Mass Casualty Education (INCMCE). The mission of INCMCE is to facilitate the systematic development of educational policies related to mass casualty events that impact nursing practice, education, research, and regulation. INCMCE consists of a coalition of schools of nursing, nursing accrediting bodies, nursing specialty organizations, and governmental agencies with the shared goal of ensuring a competent nurse workforce related to mass casualty incidents (Phillips & Lavin, 2004). In 2003, INCMCE completed the development of national, consensus-based, validated competencies for nurses responding to mass casualty events.

Despite the increase in available courses focusing on mass casualty management, only two include training on the mechanical ventilators maintained in the SNS. The Society of Critical Care Medicine (2005) has developed the Hospital Mass Casualty Disaster Management course, offering critical care cross-training for hospital-experienced health professionals. The 2-day course includes a 2-hour hands-on training session on setting up and operating the SNS ventilators. The course was first offered in April 2005 and is a relatively recent development in mass casualty education. In addition, in July 2005, DHHS released a letter to the members of AARC seeking a cadre of geographically dispersed RRTs or CRTs who would be hired under DHHS' emergency hiring authority to respond to disasters. Those hired under this authority would also receive additional training, including familiarization with the SNS ventilator models and equipment.

Legal and Regulatory Review

In a mass casualty disaster, it is likely that temporary modifications of legal and regulatory requirements will be necessary; however, there is still much uncertainty surrounding the impact that a disaster will have on legal issues, such as licensing requirements, civil liability, and immunity. The following is an outline of the legal and regulatory barriers that might restrict cross-trained health professionals from using mechanical ventilators in a mass casualty disaster. (See also Product A, State Survey of Respiratory Care Statutes.)

Licensing Requirements

Professional licensing requirements for health care professionals are rooted in State law. State statutes and regulations establish minimum competencies and mechanisms for granting licenses and establishing the scope of practice for the profession. Health care professionals who practice without a license or outside of their licensed scope of practice may be subject to civil or criminal penalties.

The practice of respiratory therapy is regulated in 48 States. The use of a mechanical ventilator falls within the definition of respiratory therapy. Pursuant to State respiratory care practice laws, it is unlawful to practice respiratory therapy unless licensed to do so under the applicable State regulation. However, a review of State respiratory practice laws revealed that 43 States have specific exemptions from their licensing requirements (see Product A). Two commonly found exemptions that might allow a cross-trained health care professional to operate a mechanical ventilator in the course of a mass casualty disaster are: performance of any respiratory care services in the case of an emergency, and providing respiratory care services within the health care professional's scope of practice.

Emergency Exception. For example, the Colorado Respiratory Therapy Practice Act, C.R.S. 12-41.5-110, states: "This article does not prohibit: Any service provided during an emergency that may be included in the definition of the practice of respiratory therapy." The Arizona Respiratory Care Act, A.R.S. 32-3521, states: "This chapter does not prohibit: The performance of respiratory care in case of an emergency, including an epidemic or public disaster."

For purposes of the respiratory care practice acts, the term "emergency" is not defined. The common understanding of the term emergency includes a medical emergency and a public disaster/epidemic emergency. In the case of a public disaster/epidemic, most States have adopted emergency response laws that define emergency. For example, the Colorado Disaster Emergency Act defines "disaster" and "emergency epidemic" as follows:

> "Disaster" means the occurrence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural cause or cause of human origin, including but not limited to fire, flood, earthquake, wind, storm, wave action, hazardous substance incident, oil spill or other water contamination requiring emergency action to avert danger or damage, volcanic activity, epidemic, air pollution, blight, drought, infestation, explosion, civil disturbance, hostile military or paramilitary action, or a condition of riot, insurrection, or invasion existing in the State or in any county, city, town, or district in the State. ― C.R.S. 24-32-2103(1.5)
>
> "Emergency epidemic" means cases of an illness or condition, communicable or noncommunicable, caused by bioterrorism, pandemic influenza, or novel and highly fatal infectious agents or biological toxins. ― C.R.S. 24-32-2103(1.7).

In the event of a public disaster or emergency epidemic, the emergency exception to the licensing requirement for providing respiratory care services would most likely apply, and therefore a cross-trained health care professional could operate a mechanical ventilator without violating the applicable respiratory care practice statute. The question of whether the health care professional would be subject to penalties for practicing outside the scope of their license must then be addressed.

Scope of Practice. Scope of practice is determined by State regulations. The difficulty lies in the fact that States do not use consistent terminology and may authorize different scopes of practice. A review of State respiratory care practice acts revealed that several States specifically exempt certain health care professionals from their licensing requirements if the practice of respiratory care is within their scope of practice. For example, the New York Respiratory Therapy Law permits the "performance of any of the modalities included in the definition of respiratory therapy by any other duly licensed, certified, or registered health care provider, provided that such modalities are within the scope of his or her practice." The Nebraska Respiratory Care Practice Act permits "the practice of respiratory care by nurses, physicians, physician assistants, physical therapists, or any other professional licensed under the Uniform Licensing Law when such practice is within the scope of practice for which that person is licensed."

Other States allow for the practice of respiratory care by a licensed health care professional who has received special training. For example, the Missouri Respiratory Care Practice Act permits "a licensed health care provider performing a respiratory care procedure that is not within the scope of practice of the licensee, so long as the licensee has received special training deemed sufficient by the board for respiratory care." The Texas Respiratory Care Practitioners Act permits "the practice of respiratory care by health care personnel who have been formally trained in the care used and who are (A) licensed under the law regulating their professions; or (B) acting under the delegated authority of a licensed physician."

Respiratory care services would generally fall within the scope of practice for physicians, physician assistants, and nurses, and therefore, these health care professionals make ideal candidates for this respiratory cross-training model. Applying the criteria recommended in the literature review (pre-existing knowledge base, minimal competencies, skill base, experience, and availability in a mass casualty disaster), the Core Development Team identified several additional professional groups for this cross-training model, including second-year respiratory therapy students, anesthesiologists, certified registered nurse anesthetists, veterinarians, dentists, and physical therapists.

The scope of practice for these targeted health care professionals may expand with additional training and experience. This cross-training model will provide competency-based learning and evaluation. Trainees who successfully complete the course will be provided with a certificate of completion as evidence of competency, and therefore, their newly acquired skills may be included in their expanded scope of practice. In a mass casualty disaster, a facility may consider credentialing and granting temporary or disaster privileges to the above cross-trained health care professionals to provide respiratory care services, such as using a mechanical ventilator, if such function is outside their normal scope of practice.

Effect of an Emergency or Disaster Declaration

In a disaster or public emergency, the State governor has broad powers to respond to the emergency conditions. For example, in any disaster, the Governor of Colorado may declare a disaster emergency and issue orders that:

> "Suspend the provisions of any regulatory statute prescribing the procedures for conduct of State business or the orders, rules, or regulations of any State agency, if strict compliance with provisions of any statute, order, rule, or regulation would in any way prevent, hinder, or delay necessary action in coping with the emergency." — C.R.S. 24-32-2104(7)(a).

When Hurricane Katrina struck, the Governor of Louisiana declared a state of emergency and issued an Executive Order suspending the State licensure requirements for out-of-State medical professionals and personnel who volunteered their services in Louisiana, as long as they possessed current licenses in good standing in their respective States of licensure and they practiced in good faith and within the reasonable scope of their skills, training, or ability.

The declaration of a disaster also serves to extend immunity from civil or criminal liability to health care providers and others who act pursuant to an Executive Order. The Colorado Disaster Emergency Act states:

> "Persons and entities that in good faith comply completely with board of health rules regarding the emergency epidemic and with executive orders regarding the disaster emergency shall be immune from civil or criminal liability for any action taken to comply with the executive order or rule." — C.R.S. 24-32-2111.5(2).

The Louisiana Executive Order also provided State tort liability coverage to all out-of-State health care professionals who possessed current licenses in good standing in their respective

States of licensure and who practiced in good faith and within the reasonable scope of their skills, training, or ability.

The Executive Orders that were issued in response to Hurricane Katrina addressed the licensing and liability issues for out-of-State health care professionals, providing for waivers of licensing requirements and immunity from liability for out-of-State medical personnel. It is unknown whether an Executive Order would specifically address licensing issues for respiratory cross-training across health care disciplines.

Civil Liability

Depending on the nature and severity of the mass casualty disaster, a facility may be able to meet the surge capacity needs of patients needing respiratory care with just its current employees, or it may need to go beyond its current staff and recruit authorized volunteers to be cross-trained to use mechanical ventilators. If a facility uses its own employees, such employees would be held to the normal negligence and liability standards. According to the ESAR-VHP Guidelines (HRSA, 2005), there is no evidence to support a reduced standard of care during a mass casualty disaster or emergency.

Employees and authorized volunteers performing services for public hospitals are protected by State governmental immunity laws. Governmental immunity applies to public employees and volunteers as long as they are acting within the course and scope of their responsibilities for the public entity. It is unclear whether a cross-trained health care professional who provides medical services outside his or her licensed scope of practice would be considered acting within the course and scope of their responsibilities for purposes of coverage under the State immunity law.

The ESAR-VHP Guidelines provided a comprehensive overview of the legal issues surrounding civil liability for volunteers. In its report, several sources of limits to civil liability for volunteers were cited, including:

- Emergency response laws
- Volunteer protection laws
- Good Samaritan laws
- Governmental immunity.

The above laws vary from State to State. A complete survey of the above State laws was beyond the scope of this review. It is strongly recommended that facilities considering the use of volunteers in a mass casualty respiratory cross-training program review their appropriate State statutes related to liability for volunteers. Product B, Legal and Regulatory Checklist, is provided as a tool for facilities considering a mass casualty respiratory cross-training program.

Methodology

Target Audiences

Target audiences were selected based on the following criteria determined from the literature review: 1) having a pre-existing knowledge base/minimal competencies, 2) possessing analytical assessment skills and a large skill base, 3) having experience working within a care team framework, and 4) potentially having time during a mass casualty event to perform the newly acquired cross-trained duties and competencies.

The pre-existing knowledge base/minimal competencies include:

- Medical terminology
- Basic mathematics
- Written and oral communication
- Social/behavioral sciences
- Basic computer science
- Critical thinking skills
- Human anatomy and physiology
- Cardiopulmonary anatomy and physiology
- Cardiopulmonary pathophysiology
- Basic chemistry
- Basic physics
- Basic microbiology.

In addition, individuals charged with caring for patients should have a basic understanding of normal hospital operations, work flow, and communication structure. All trainees should also clearly understand the chain of command as well as the resources available to perform their roles.

Based on these criteria, the following health care professionals were selected for pilot testing:

- Second-year respiratory therapy students
- Anesthesiologists
- Certified registered nurse anesthetists
- General internists
- Non-critical care nurses
- Physician assistants
- Nurse practitioners
- Veterinarians
- Dentists
- Physical therapists.

A review of State respiratory care practice acts during the legal and regulatory review found that some States specifically exempt certain health care professionals from their licensing requirements if the practice of respiratory care falls within their scope of practice. This would

likely apply to most of the target health care professionals, such as physicians, physician assistants, and nurses, since providing basic respiratory care falls within their scope of practice. The exception may be veterinarians, due to issues regarding whether their scope of practice includes the human species.

Competencies

The scope of the extenders' practice should be established by the institution and determined by the available resources for oversight and training, as well as the nature of the mass casualty event. The goal of the training program is not to train extenders to function as respiratory therapists, but rather to train them to assist respiratory therapists by performing the more basic respiratory care procedures. Extenders will not have the training or experience to perform all respiratory care functions. However, with appropriate oversight and the XTREME training, they could supplement the workforce of typical respiratory therapy departments by assisting with the following tasks:

- Airway cuff maintenance
- Artificial airway care
- In-house patient transport
- Manual ventilation via endotracheal or tracheostomy tubes
- Mechanical ventilator setting adjustment
- Mechanical ventilator setup
- Observation of standard precautions and other infection control guidelines
- Oral care
- Pulse oximetry
- Routine suctioning
- Securing artificial airway
- Ventilator circuit change
- Ventilator monitoring and patient system check.

Though what follows below is not an exhaustive list, functions that would likely be outside the competence of extenders without additional training/experience include:

- Arterial blood gas analysis and interpretation
- Administration of medication
- Arterial line catheterization
- Arterial puncture (for blood gas acquisition)
- Assisting bronchoscopy
- Bedside spirometry
- Clinical assessment of patients
- Chest physiotherapy
- Delivery of high frequency ventilation
- Endotracheal intubation/reintubation
- Hyperinflation therapy
- Inter-facility patient transport
- Specialty gas administration

- Ventilator troubleshooting and problem analysis (beyond recognizing when alarm parameters are being exceeded and manually ventilating patients, pending assessment of the situation by a respiratory therapist).

The importance of appropriate oversight cannot be overstated. Competency in all procedures performed by XTREME extenders should first be evaluated by a respiratory therapist or an appropriate hospital patient care provider, and performance should be routinely assessed. Tasks requiring skills not included in the XTREME training DVD should be performed only after appropriate institutional training and competencies have been assured. Extenders trained solely with tools from XTREME should perform only those tasks described in the training DVD and for which they have demonstrated competency.

The competencies for the above skills were formulated using published organizational standards and recommendations from AARC, specifically the *Orientation & Competency Assurance Documentation Manual for Respiratory Care*. This manual was developed by a panel of respiratory therapy experts for two purposes: to fulfill JCAHO requirements and to provide a method to objectively assess and document level of skill and proficiency in respiratory care providers.

The five-point scale and deficiencies checklist (Figure 1) set forth in the AARC competency manual provides an objective and quantifiable method for validating and documenting the extenders' understanding of the material.

Figure 1: The AARC *Orientation & Competency Assurance Documentation Manual for Respiratory Care* Competency Validation Tools

QUALITY OF PERFORMANCE

5 – Outstanding Performance: No prompting required, employee demonstrates mastery of the procedure. No errors noted.
4 – Good Performance: Slight prompting required. No significant errors noted.
3 – Fair Performance: Minor errors noted. Some prompting or intervention required. Deficiencies specified in next section.
2 – Poor Performance: Significant errors noted. Much prompting required. Deficiencies specified in next section.
1 – Unacceptable Performance: Employee was unable to perform procedure without intervention by the preceptor. Deficiencies specified in next section.

Performance Deficiencies (Check Those That Apply)

☐ Excessive time needed to complete procedure
☐ Broke aseptic or sterile technique
☐ Significant inaccuracy noted
☐ Technique may be harmful to patient
☐ Incorrect procedure/sequence
☐ Incorrect equipment assembly/usage
☐ Unable to correctly answer questions about rationale and/or theory related to the procedure
☐ Other: _____

In addition, the manual identifies specific skill areas in which a health care professional would need to demonstrate competency to be deemed proficient in providing basic respiratory care and ventilator support. The competencies developed by the AARC have been modified for this project to follow the abridged curriculum of the training (see Product F, Competency Validation Checklists).

Core Curriculum

The core curriculum was designed using existing materials and references (see page 90). The following skill areas were identified as critical for basic respiratory care training:

Infection Control

- Standard precautions (e.g., gowns, gloves, masks)
- Isolation techniques (contact, airborne, droplet)
- Hand hygiene

Terms and Definitions

- Manual ventilation
  - Glossary of terms
  - Normal ranges
- Mechanical ventilation
  - Glossary of terms
  - Normal ranges

Manual Ventilation

- Equipment assembly
- Equipment function
- Oxygen settings
- Technique
- Monitoring
- Assessment of adequacy of ventilation

Mechanical Ventilation

- Introduction to mechanical ventilation
- Hazards of mechanical ventilation
- Assembly and testing of ventilators
- Ventilator setting adjustment
- Alarm limit settings
- Assessment of adequacy of ventilation
- Monitoring
- Troubleshooting

While some of the material is universal and applicable to all ventilators, most of the mechanical ventilation material presented is specific to the ventilators in the SNS, the Impact® Uni-Vent® Eagle™ and the Puritan Bennett LP10.

Airway Maintenance

- Assessment of tracheal tube placement
- Securing endotracheal tubes (Although application of cloth tape is demonstrated in the training DVD, other means to secure tubes, such as string, are available but would require additional training.)
- Cuff inflation techniques
  - Minimum occluding volume
  - Minimal leak technique

Airway Suctioning

- Indications for need
- Hazards
- Equipment
- Complications
- Procedure technique
- Expected outcomes.

Training Method

The training method uses four formats: 1) outlined narrative education or voice-over, 2) video demonstration, 3) interactive knowledge validation in which question-based competencies follow each module, and 4) clinical competencies validation, either in a lab using a resuscitation dummy or mentored on the floor with live patients.

The training DVD, incorporating the outlined narrative education, video demonstration, and interactive knowledge validation segments, was developed by an expert panel of respiratory therapists. The DVD provides training in the skill areas selected in the development of the curricula.

The DVD training method was selected and developed based on criteria identified in the literature review: flexibility (ability to be used for various levels of training); development, based on a level of experience and competency; integration of relevant safety issues; skill development founded on theory; competency-based learning and evaluation; combined teaching strategies and techniques; basic five-step training sequence; appropriate time for learning based on competency validation; and use of just-in-time and readiness training. While the DVD was primarily designed on the theory of just-in-time training, extenders may be trained in advance of a disaster in order to create a pool of available health care professionals familiar with the material. The extenders who received readiness training would need to review the training DVD via just-in-time training and re-prove competency before beginning direct patient care.

The DVD design uses the basic five-step training sequence described in the literature review:

1) Description of the skill — voice-over
2) Demonstration of how it is performed — video demonstration
3) Practice — interactive knowledge validation and clinical competencies validation
4) Provision of feedback — interactive knowledge validation and clinical competencies validation
5) Continuation of practice until learner proves competence — interactive knowledge validation and clinical competencies validation.

Following each training module, the trainee must answer questions testing their understanding of the material in that module. If questions are answered correctly, the trainee proceeds to the next question. If questions are answered incorrectly, the trainee may review the portion of the module where training specific to that question was provided. After completion of

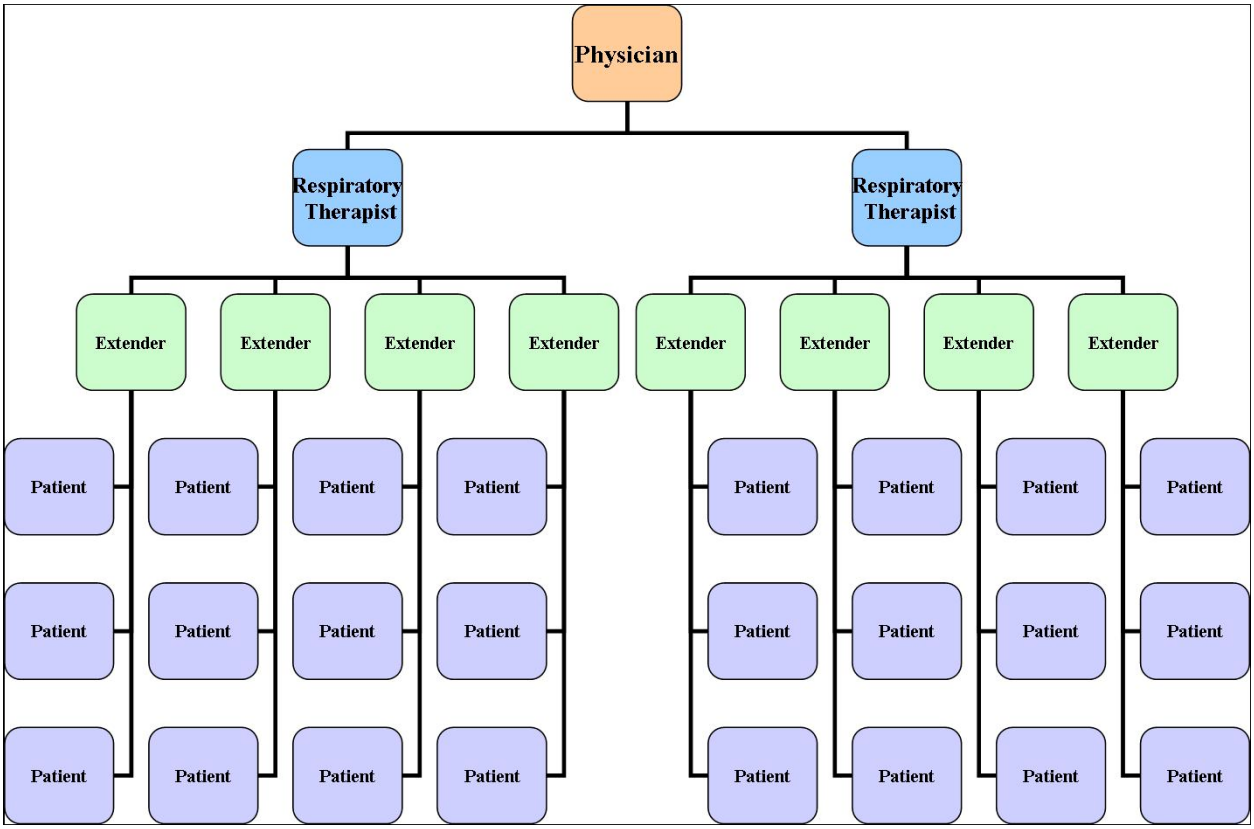
all of the training modules and correctly answering all questions following each module, the trainee completes a competency skill lab in which their understanding of the material is observed and documented by a licensed RRT. The combination of the question-based competencies following each module and clinical competencies validation lab provides opportunities for the trainees to practice the skills and to obtain feedback from both the DVD through the links to question-specific training and from the RRT who is validating their skills.

The DVD was developed with an emphasis on flexibility, allowing trainees to navigate the modules to select skill areas of interest for additional review. It also contains a sample certificate of completion, which is included in this report (see Product J, Certificate of Completion). It may be copied and provided to trainees. The certificate of completion verifies that the trainee has viewed the DVD, has completed the question-based competency tests, and is ready to undergo practical competency verification. As the video was primarily designed to be used in just-in-time training, the certificate only would be valid for the duration of the event requiring assistance from extenders.

Reporting Structure

The reporting structure devised for this project was based on the polio epidemic of the 1950s. In 1955, high demand for mechanical ventilation exceeded the available number of negative pressure ventilators, resulting in the development of positive pressure ventilation. During such shortages, medical students, dental students, trained nurses, semi-retired nurses, and nursing students were deputized to provide positive pressure manual ventilation in shifts of 8 hours, under the supervision of an anesthesiologist who had ultimate responsibility. In the reporting structure for this project, a pulmonary physician supervises several respiratory therapists, who supervise several extenders, who care for several ventilated patients (Figure 2). In some institutions, physicians other than pulmonologists, such as intensivists or anesthesiologists, may have overall responsibility for ventilator and respiratory care. In these situations, respiratory therapists and extenders would report to the most qualified physician trained in the skills necessary to supervise the management of ventilated patients.

Figure 2. Reporting Structure



The number of patients that an extender can manage and the number of extenders who should report to a respiratory therapist have not been validated. The proposed structure was developed in part from the experience of the Denver Health Respiratory Therapy Department in training respiratory therapy students.

Results

Pilot Test of Training Method

Two goals were involved in pilot testing the training DVD. The first was to determine the effectiveness of the training DVD and clinical competencies validation lab in cross-training non-respiratory therapy health care professionals to provide mechanical and basic respiratory care. The second was to begin to identify which subsets of health care professionals could be trained.

Methods

The pilot tests took place in either a conference room or an auditorium with seven to eight subjects per session. Subjects viewed the 90-minute training DVD and completed the question-based competency tests on a data collection form. Upon completion of the computer-based training and testing, subjects engaged in a 90-minute clinical competencies validation lab to evaluate and document competency in each of the six skill areas detailed in the DVD. During testing, subjects moved through five stations where they were observed performing respiratory care or ventilation management skills taught in the training DVD. Competency was assessed and documented by a licensed RRT, using the competency validation checklists. Subjects were considered successfully trained if they completed the question-based competency tests and passed the competency skills lab with a score of 3.0 or better.

Subject Population

Health care professionals in each of the following areas (see Table 1) were recruited to test the training program: second-year respiratory therapy students, general internists, non-critical care nurses, physician assistants, nurse practitioners, veterinarians, physical therapists, dentists, anesthesiologists, and certified registered nurse anesthetists. These health care professionals were selected because they would most likely be available during a mass casualty event and have the pre-existing knowledge base/minimal competencies previously described.

Table 1. Number of Participants by Health Care Profession

Profession	Number
Second-year respiratory therapy students	15
General internists	4
Non-critical care nurses	14
Physician assistants	2
Nurse practitioners	2
Veterinarians	7
Physical therapists	15
Dentists	0
Anesthesiologists	0
Certified registered nurse anesthetists	0
Total	59

Recruitment of Subjects

An advertisement was distributed to health care professionals within Denver Health via e-mail and on paper. This ad was also distributed to emergency medicine and hospital personnel in Colorado who had previously agreed to be contacted via a LISTSERV® created for the Colorado Front Range Metropolitan Medical Response System. The ad was distributed to additional health care professionals, such as veterinarians, via the project's external advisory committee.

Measures

Subject data collected during the pilot test included a non-linked identifier, profession (Table 1), credentials, number of years of experience in current profession and number of years of total health care experience (Table 2), whether the subject currently or previously had worked with mechanically ventilated patients and whether the subject had received other training specific to mechanical ventilation (Table 3), answers to each question from the DVD question-based competency tests, and test scores for the DVD question-based competency tests and for the competency skills lab stations (Table 4).

Table 2. Health Care Experience by Profession

Profession	Average Number of Years Experience in Current Profession	Average Number of Years Total Health Care Experience
Second-year respiratory therapy students	1	3
General internists	6	12
Non-critical care nurses	14	20
Physician assistants	10	11
Nurse practitioners	5	28.5
Veterinarians	16	18
Physical therapists	13	16

Table 3. Experience and/or Training in Mechanical Ventilation by Profession

Profession	% (N) Experience With Patients Receiving Mechanical Ventilation	% (N) Other Training Specific to Mechanical Ventilation
Second-year respiratory therapy students	100% (N = 15)	93% (N = 14)
General internists	100% (N = 4)	75% (N = 3)
Non-critical care nurses	21% (N = 3)	7% (N = 1)
Physician assistants	50% (N = 1)	0
Nurse practitioners	100% (N = 2)	50% (N = 1)
Veterinarians*	43% (N = 3)	29% (N = 2)
Physical therapists	47% (N = 7)	7% (N = 1)

*Training and experience in non-human ventilation.

Table 4. Competency Ratings: Training DVD and Lab Scores by Profession

	Second-Year RT Student	General Internist	Non-critical Care Nurse	Physician Assistant	Nurse Practitioner	Veterinarian	Physical Therapist
DVD Question-Based Competency Test Scores							
Infection control	95%	100%	94%	95%	100%	99%	95%
Terms and definitions	99%	100%	89%	95%	90%	97%	87%
Manual ventilation	93%	95%	92%	90%	95%	94%	86%
Mechanical ventilation	89%	98%	86%	87%	83%	89%	87%
Airway maintenance	97%	93%	86%	85%	95%	97%	85%
Airway suctioning	96%	98%	89%	100%	100%	94%	90%
Competency Lab Scores							
Infection control	4.2	4.9	4.8	5.0	4.5	5.0	4.9
Manual ventilation	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Mechanical ventilation score (Uni-Vent® Eagle™)	4.8	5.0	4.9	5.0	5.0	5.0	4.8
Mechanical ventilation score (Puritan LP10)	4.9	5.0	4.9	4.9	4.9	4.9	4.8
Airway maintenance	5.0	5.0	5.0	5.0	5.0	5.0	4.9
Airway suctioning	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Sample Size

A group was considered to be "untrainable" if 50 percent failed the training. Power analysis using a 2-sided Fisher-Exact test (type I error of $p < 0.05$ and type II error of 0.8) indicated that 15 subjects per profession were needed to test each profession.

Results

The results for each question and lab skill were analyzed to identify areas of difficulty common to a majority of the subjects, suggesting weaknesses in the training methodology. Questions were defined as "scoring low" if at least 50 percent (N = 29) of subjects answered incorrectly, and skill areas were defined as "scoring low" if at least 50 percent (N = 29) subjects required prompting when demonstrating the skill.

One question on the interactive question-based competency tests following the DVD modules scored low. The question tested subjects on the correct action to take in the event of ventilator malfunctioning in the manual ventilation module. Material was added to the training DVD to assist subjects in understanding the concept being tested with this question.

One specific skill area evaluated in the competency validation lab scored low. The skill tested subjects on the steps to properly assemble the Puritan Bennett LP10 ventilator, specifically the external supplemental oxygen reservoir system. Assembly instructions have been developed that provide additional visual and written instruction in the proper assembly of the external supplemental oxygen reservoir system on the ventilator.

Discussion

Approximately 90 minutes were required for viewing the training DVD and completing the question-based competency tests; however, multiple subjects were trained and tested simultaneously. There are some challenges involved with group testing, specifically in terms of pacing the question-based competency tests so that each subject is able to complete each question before moving on to the next.

The training appears to be effective, as each health care professional group was able to complete the question-based competency tests with scores ranging from 83 percent to 100 percent. Physical therapists and veterinarians were expected to score the lowest in both the question-based and clinical competency validation lab assessments, given their baseline skills and knowledge; however, both groups performed very well.

Several biases may have affected the results. First, subjects were able to take notes during the DVD to help answer the questions following the modules. Second, subjects were able to observe each other during the lab, providing additional instruction in the skills being tested. However, bias that may be associated with the observer providing information to subjects during the lab was controlled by the scoring method. Third, the testing was not blinded. Subject recruiting relied heavily on Denver Health staff; the profession of most of the subjects was known to the therapists conducting the skills competency lab. Fourth, testing was conducted by the Denver Health staff members who helped develop the training video and are very familiar with its content, creating the potential for bias from project members who have an interest in its success.

Because of problems with recruiting volunteers, the targeted sample size was only achieved for two professions. Recruiting outside Denver Health was only marginally successful and the amount of time allotted for testing was too limited to achieve the planned sample size. In

addition, some professionals (anesthesiologists and certified registered nurse anesthetists) felt the training focused on skills their professions already possess and use daily in their practices.

Finally, the DVD was initially envisioned to be viewed by trainees on individual computers with DVD players. This was not the method used in the pilot testing. Lack of access to sufficient numbers of computers necessitated projecting the video onto a screen to a group of trainees simultaneously. This prevented tracking the time necessary for individuals to complete training and the number of attempts necessary to correctly answer each question following the modules. It also prevented the trainees from reviewing the video if they missed a question. The success of the pilot testing in spite of these limitations suggests that training may be implemented in a number of different ways and still be effective.

Strategic National Stockpile Exercises

The goals for understanding how an institution or community would be able to operationalize such a training program included:

1) Evaluate the training model in a simulation exercise or table top.
2) Determine the relevancy of the training model with other response systems:
    a) SNS – Use stockpiled ventilators for training (at least one of each type), simulating SNS mobilization of resources to training location.
    b) Health Care Systems – Determine if the model can benefit community medical responses and expand respiratory care capacity.
    c) Emergency Management/Public Safety Agencies – Determine how the model will interface with established response systems for obtaining equipment and personnel.
    d) Health Care Professional Registries – Determine if the professionals fitting the model requirements would be interested and available for training.
3) Identify barriers and obstacles to training model integration and utilization of community resources.

The goals were largely met, but a few adjustments were necessary. It was determined that there was no benefit to conducting the pilot training in conjunction with a community-wide exercise and that the training program could be evaluated separately (see previous section). Although the training program used the two ventilator models stocked by the SNS in the pilot training, it was not possible to actually mobilize any SNS resources. Simulating mobilization of ventilators was considered but not feasible as all State SNS coordinators were already involved in developing plans for requesting and accepting SNS assets. The Colorado State SNS coordinator suggested describing the overall process to obtain SNS resources, with an emphasis on the necessity for potential users of these resources to proactively consult their local emergency management agency and State SNS coordinator to identify all the specifics involved. In addition, various types of resources for locating target trainees (such as registries of health care professionals) were reviewed and their potential to undergo such training in an emergency was assessed.

Not all types of resources for locating target trainees were available in Colorado, so samples of these registries from across the country were evaluated. The registries were not used to locate

trainees for the pilot testing but rather to evaluate the registries themselves. A particular exercise scenario was not considered necessary for such evaluation, other than that the event required mass respiratory care. In a later section, the DHS Planning Scenarios, specific respiratory care impacts, and mechanical ventilation needs are reviewed.

For successful implementation of the model training program in any institution or community, it is important to understand how to integrate the program into the larger structure that is in place for emergency responses, how to obtain additional supplies, and what possible resources exist for additional staffing.

It is important to first understand the established planning framework that has been developed at various governmental levels for emergency responses and asset deployment. This includes the National Response Plan (NRP) and corresponding plans at the State, regional, county, and local levels.

Planning Framework

The NRP (www.dhs.gov/xprepresp/committees/editorial_0566.shtm) was established to provide a comprehensive all-hazards approach to the management of domestic incidents in the United States. The plan uses best practices and procedures from various incident management disciplines, including homeland security, emergency management, law enforcement, firefighting, public works, pubic health, responder and recovery worker health and safety, emergency medical services, and the private sector. The principles and practices from these disciplines are integrated into a unified approach, which allows the Federal Government to coordinate with State, local, and Tribal governments as well as the private sector during domestic incidents.

The protocols established by the NRP focus on ensuring the security of the United States from imminent incidents, including acts of terrorism, as well as saving lives and protecting the health and safety of the public, responders, and recovery workers. In the event of such incidents, the NRP supports and conducts law enforcement investigations for the resolution and apprehension of perpetrators; protects property and critical infrastructure; mitigates damages and impacts to individuals and the surrounding community; and facilitates the recovery of individuals, families, businesses, governments, and the environment.

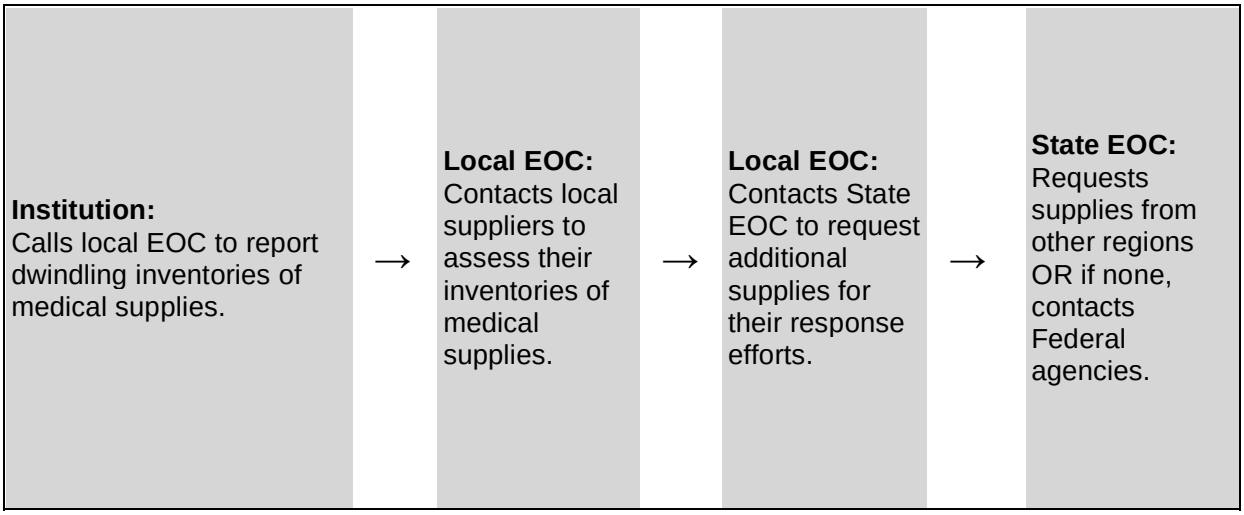
In the event of a national emergency, State, local, and private stocks of medical material would be depleted quickly. Federal assets such as the SNS can be requested by State and local agencies in an effort to bolster their response. The deployment of SNS assets may be based on evidence showing the overt release of an agent that might adversely affect public health. However, it is more likely that subtle indicators such as unusual morbidity and/or mortality identified through the national disease outbreak surveillance and epidemiology network would alert officials of a biological or chemical incident. In order to receive SNS assets, the State's governor's office (or designee) can request assistance directly from the SNS or include the request as part of an overall request for Federal assistance through the national emergency response system. DHHS, CDC, the Division of Strategic National Stockpile (DSNS) within the CDC, and other government agencies will perform an evaluation of the situation in order to determine a prompt course of action.

SNS assets include a 12-hour Push Package, Managed Inventory, or a combination of both (www.bt.cdc.gov/). The 12-hour Push Packages can be delivered anywhere in the United States within 12 hours of a Federal decision to deploy. These 12-hour Push Packages can be loaded either into trucks or commercial cargo aircraft for rapid transportation. A Technical Advisory Response Unit from SNS will coordinate with State and local officials to effectively receive and distribute the SNS assets upon arrival at the site. Once SNS assets have arrived at the designated receiving and storage site, DHHS will transfer authority for the SNS material to the State and local authorities. Breakdown of the 12-hour Push Packages and their distribution will take place under the guidance and supervision of State and local authorities with assistance and advice from Technical Advisory Response Unit members.

SNS Request Overview and Timeline

The following diagram (Figure 3) depicts the evolution of a need for medical supplies/equipment at an institution through the various agencies that can assist in locating such resources at local, State, and Federal levels. Emergency Operations Centers (EOCs) are usually enacted during disasters and emergencies to coordinate response agency activities.

Figure 3. Evolution of an SNS Request



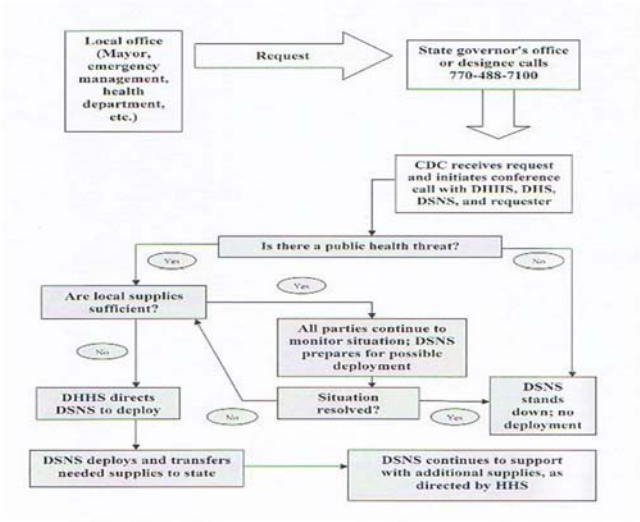
The timeframe for this varies with the scope of the incident. The process for getting from identification of a local need to a State deciding to request Federal assets could take a few hours to days. For specific equipment, such as ventilators that are part of Managed Inventory, the timeframe may also range from several hours to a few days. It is important that communities understand their own processes for making requests of Federal assets as well as the communication pathways and timeline for receiving those assets. Local and State emergency managers can assist in understanding these resource request processes.

Analysis of Need

A request for such Federal assets as the SNS will be evaluated to make sure the need for them is real and whether there are potential needs from other affected areas. This analysis involves medical and public health professionals from Federal to local levels. Figure 4 depicts the process for evaluating such a need and deploying assets.

In community response planning, it is important to develop potential triggers for requesting resources. For example, once a community exceeds all available hospital-based ventilators, a request through appropriate channels for SNS ventilators would be considered. In the interim, the community would try acquiring additional ventilators from medical suppliers, adjacent communities, or across the State. If it were determined that those supplies would not adequately meet the need, an SNS request would be made and the need assessed. Part of this assessment may include whether adequate staffing exists to use the requested resource. Relating that a training program is in place for respiratory care extenders to expand community capacity and use the requested ventilators would help support the SNS request.

Figure 4. SNS Request Analysis



Steps. During a widespread event that affects many areas simultaneously (such as pandemic influenza), availability of supplies from outside the local area may be quite limited or nonexistent. Communities should consider what supplies are available and develop the means to prioritize the use of these limited resources for several likely disaster scenarios.

U.S. Department of Homeland Security Planning Scenarios

DHS has prepared National Planning Scenarios for 15 potential disasters/emergencies to assist in preparedness efforts (www.globalsecurity.org/security/library/report/2004/hsc-planning-scenarios-jul04.htm). A summary of these 15 scenarios is contained in Product G. These scenarios are meant to assist planners and response agencies in addressing the impacts of these events on victims, the health care system, and entire communities. Although specific requirements for mechanical ventilation are not listed in the current DHS version that details these scenarios, groups are working to determine more specific medical response requirements for such events.

Seven of the scenarios will most likely require increased respiratory treatment of victims, including mechanical ventilation:

- Aerosol anthrax release
- Pandemic influenza outbreak
- Plague release
- Blister agent release
- Toxic industrial chemicals release
- Nerve agent release
- Chlorine tank explosion.

Five of the scenarios may require limited mechanical ventilation capability, primarily due to trauma and smoke inhalation injuries:

- Nuclear detonation
- Major earthquake
- Major hurricane
- Radiological dispersion device
- Improvised explosive devices.

Three of the scenarios are not expected to require mechanical ventilation capability:

- Food contamination
- Foreign animal disease
- Cyber attack.

These 15 scenarios should help determine the associated respiratory care needs, potential requirement for mechanical ventilation equipment, and medical staffing levels required to operate it. Many of the scenarios may require both short-term and long-term care strategies.

Personnel Resources

After understanding the emergency response structure, the SNS request process, and the potential requirements to respond to different disasters or incidents, the remaining component needed to expand respiratory care capabilities is to locate and train personnel as respiratory care

extenders. Depending upon the scope of the event, these personnel could come from within an institution or be found throughout a region or State. In setting up a training program, the number of extenders needed and potential sources where they could be obtained should be identified; for example:

- 10 Extenders from within the institution or hospital
- 25 Extenders from several institutions or hospitals
- 50 Extenders from community or county resources
- 100+ Extenders from State or regional resources.

As with medical supplies, there may be difficulty in obtaining personnel from outside a community in a widespread event such as pandemic influenza and prioritization of this resource would have to be considered. For a localized event, there will likely be adequate personnel resources that could be accessed. This section will review several programs or resources for locating health care professionals.

Credentialing

Credentialing is the process of obtaining, verifying, and assessing the qualifications of a health care professional to provide patient care, treatment, and services in or for a health care organization. The just-in-time training model for respiratory care extenders was piloted in groups of health care professionals thought to have certain experience and education. Although a trainee may not be used in their normal capacity, the credentials and licensure of their primary occupation provides some assurance about the capabilities they can call upon in the role of an extender. It is preferable to use trainees with credentials and current professional licensure to benefit from the legal and regulatory protections that they may afford (see Background chapter, Legal and Regulatory Review section).

A crisis situation associated with limited personnel resources may necessitate training other groups of health care professionals than those used in the pilot training. There may also be suspensions of certain regulatory requirements for health care professionals and the practice of medicine. It is important to understand the implications of these factors when training respiratory care extenders.

Evaluation of Health Care Professional Registries

There are many programs, associations, and other resources for locating the groups of health care professionals involved in the pilot training. Additionally, there may be other groups selected as potential trainees by an institution when implementing this training program. Following are three examples of volunteer registries for health care professionals described in detail, as well as an evaluation of the willingness of volunteers in these registries to undergo the extender training. Each community must determine the resources available to it for locating health care professionals for respiratory care extender training.

Colorado Nurse Alert System. This statewide system was developed to identify and mobilize licensed nurses to serve as volunteers during times of emergency or disaster. This system would

help locate nursing professionals such as those who were involved in the pilot training, but not within professional groups outside of nursing. Nurses register with the system ahead of an event (see registration form in Appendix A) and their credentials are verified at that time. Supplied data are entered into a searchable database and can identify registrants by geographical location or advanced/specialty training (pediatric, adult, anesthesia, etc.).

In an emergency event, nurses would be contacted based upon their supplied information and would then decide about volunteering in the required capacity. As of March 2006, there were over 11,000 registrants in the system. A limitation of this system is that although credentials are verified upon registration, maintenance of database records is the responsibility of each county public health planner, due to limited support for administration of the system.

An e-mail survey was conducted to determine whether nurses in this system would be interested in potentially undergoing this just-in-time training program. With the assistance of the administrators of the Nurse Alert System, e-mails were sent to three groups of nurses residing in Denver County that corresponded to groups undergoing the pilot testing: nurse practitioners (NPs), certified nurse anesthetists (CNAs), and registered nurses not in emergency medicine or critical care (RNs). E-mail recipients were instructed to respond to the survey within 72 hours by sending an e-mail to the YES or NO e-mail addresses provided. Anonymity was assured. A database search resulted in 131 registrants meeting the group criteria out of the 1,253 registrants residing in Denver County (11 percent). Totals for each group, the number with e-mail addresses, and the number of responses were:

- #NPs = **32 —** 23 (72 percent) had e-mail, 2 responses (9 percent; 1 yes, 1 no)
- #CNAs = **8 —** 3 (38 percent) had e-mail, 0 responses
- #RNs = **143 —** 105 (73 percent) had e-mail, 5 responses (5 percent; 5 yes, 0 no).

For this survey, 20 e-mails were returned as "undeliverable," 111 registrants received the survey, and 7 responded (6.3 percent response rate with 86 percent favorable response). Although the response rate was low, the exercise was done as a no-notice survey to evaluate the ease of using e-mail to rapidly contact professionals for potential just-in-time training. The Nurse Alert System administrator suggested that promoting the training program to State nursing boards and other nurse professional organizations would increase awareness, interest, and likely response. This strategy of program promotion was used for the launch of the Nurse Alert System and led to widespread acceptance and large registrations.

Medical Reserve Corps. The Medical Reserve Corps (MRC) is a program of DHHS (www.medicalreservecorps.gov) that began in 2002. The mission of the MRC program is to establish teams of local volunteer medical and public health professionals who can contribute their skills and expertise throughout the year and during times of community need. It is a specialized component of Citizen Corps (www.citizencorps.gov), a national network of volunteers dedicated to ensuring hometown security. Citizen Corps, AmeriCorps, Senior Corps, and the Peace Corps are part of the USA Freedom Corps (www.usafreedomcorps.gov), which promotes volunteerism and service nationwide. The MRC National Program Office oversees the activities of the 10 MRC Regional Coordinators, who collaborate with national, State, and local emergency preparedness and response, including medical and health care personnel.

MRC units are community-based and function to locally organize and use volunteers who want to donate their time and expertise to prepare for and respond to emergencies, as well as promote healthy living throughout the year. MRC volunteers supplement existing emergency and public health resources. They include medical and public health professionals such as physicians (MDs), nurses, pharmacists, dentists, veterinarians, and epidemiologists. Many community members, such as interpreters, chaplains, office workers, and legal advisors, fill key support positions.

Each MRC unit is unique in structure, size, and composition. Many have limited resources for administration, although there are several large units based in governmental agencies. Some units are under development while others are active in their communities and have responded to events such as hurricanes and floods. As of May 2006, there were over 430 MRC units with more than 70,000 registrants in the 10 regions of the United States and its Territories. MRC units range in size from 0 to over 6,300 registrants. The MRC units in a State or region can be identified at this Web site: www.medicalreservecorps.gov/FindMRC.asp.

The five Colorado MRC units exemplify the wide variation that exists in the structure, size, and composition of MRC units:

- Larimer County – established 2004, based in public health department, 110 registrants (41 percent RNs, 20 percent non-medical/health, 13 percent MDs)
- Southern Colorado – established 2004, based in non-governmental organization, 151 registrants (33 percent MDs, 26 percent RNs, 9 percent dentists)
- Mesa County – established 2005, based in non-governmental organization, 95 registrants (36 percent RNs, 21 percent other medical personnel, 14 percent MDs)
- Pueblo County – established 2006, under development, 0 registrants
- Southwest Colorado – established 2006, under development, 0 registrants.

Due to the limited resources available in Colorado, an e-mail survey of the registrants within the Fairfax Medical Reserve Corps of Virginia was conducted in April 2006 to assess the potential for utilizing MRC units and to locate the groups of extender trainees selected for the pilot training, as well as their interest in such training. The Fairfax MRC is a large unit with sufficient administrative resources to conduct such a survey. It is led by a physicians task force and was formed in 2004 through a partnership between the Fairfax County Health Department and the medical community. This MRC unit currently has over 3,300 volunteers, approximately 800 of whom are physicians, nurses, and other medical professionals. The purpose of this MRC is to administer vaccines or dispense medications to the public in response to a bioterrorism event or naturally occurring epidemic. The Fairfax MRC offers training to all members and solicits both medical and nonmedical volunteers interested in responding to a public health emergency. The Fairfax County Health Department provides a Web-enabled application process through www.fairfaxmrc.org; this Web site also provides for regular nonemergency communication with members regarding assignments and training. Registrant alerting can also be done via e-mail, cell phone text messaging, and pagers.

An e-mail survey was conducted to determine whether registrants in this system would be interested in potentially undergoing the just-in-time training program. With the assistance of the administrator of the Fairfax MRC, e-mails were sent to four groups that corresponded to groups

undergoing the pilot testing: MDs, RNs, NPs, and physician assistants (PAs). E-mail recipients were instructed to respond to the survey within 96 hours by just sending an e-mail to the YES or NO e-mail addresses provided. Anonymity was assured. A database search resulted in 788 registrants with e-mail addresses who met the group criteria out of the 3,313 registrants (24 percent). Totals for each group, the number of e-mails returned, and the number of responses were:

- #NPs/PAs = **61 —** 2 (3 percent) returned e-mails, 8 responses (14 percent; 8 yes, 01 no)
- #RNs = **552 —** 26 (5 percent) returned e-mails, 72 responses (14 percent; 61 yes, 11 no)
- #MDs = **175 —** 8 (5 percent) returned e-mails, 20 responses (12 percent; 17 yes, 3 no).

A total of 36 e-mails (5 percent) were returned as "undeliverable," 752 registrants should have received the survey, and 100 responded (13.3 percent response rate with an 86 percent favorable response). The response rate was twice that of the Colorado Nurse Alert System. Again, the exercise was conducted as a no-notice survey to try to determine the ease of using e-mail to rapidly contact professionals for potential just-in-time training. One of the limitations of this MRC's database was the inability to search for professionals by specialty training (i.e., CNAs, anesthesiologists). However, the administrator thought that the database could be modified to include such information if necessary.

Emergency System for Advance Registration of Volunteer Health Professionals. In 2002, Congress recognized the need to make optimum use of volunteer health personnel in an emergency and authorized the development of ESAR-VHP (www.hrsa.gov/esarvhp). HRSA was delegated the responsibility for this program and of assisting States and Territories in establishing a standardized, volunteer registration system. The goal is that each State-based system includes verifiable, up-to-date information regarding the volunteers' identity, licensing, credentialing, accreditation, and privileging in hospitals or other medical facilities. This should improve the capability to quickly identify and better use health professional volunteers in emergencies. In addition, these State-based systems will, ultimately, enable the sharing of pre-registered and credentialed health care professionals between States and on the national level. Each State's ESAR-VHP system will be built to standards that will allow quick and easy exchange of health professionals with other States, thereby maximizing the size of the population able to receive services during a time of a declared emergency.

There are three components to HRSA's assistance to States: 1) development and implementation of ESAR-VHP Guidelines; 2) provision of supplemental funding to each State to support development of their system; and 3) technical assistance. The Guidelines, supplemental funding, and technical assistance will be provided to awardees of HRSA's National Bioterrorism Hospital Preparedness Program grant program. Awardees of these grants are responsible for developing their State ESAR-VHP systems. In FY 2004, $6 million in supplemental funding was provided to help 30 States develop their ESAR-VHP systems. Supplemental funding to the remaining States and territories occurred in FY 2005.

Through collaboration with States, professional associations, accrediting organizations, and Federal partners, HRSA developed the draft *Emergency System for Advance Registration of Volunteer Health Professionals—Interim Technical and Policy Guidelines, Standards, and Definitions* (HRSA, 2005; www.hrsa.gov/esarvhp/guidelines). The program is being rolled out in

three phases. Pilot testing of these Guidelines began in 2005 (in phase 1 are Illinois, Massachusetts, Minnesota, Missouri, Texas, Connecticut, Wisconsin, Ohio, West Virginia, and the District of Columbia). However, the phase designation of a State does not represent their current status or preparedness (some States are using already developed databases or systems and adapting them for their ESAR-VHP system).

The current Guidelines (Version 2) include standards for the following health care professionals (those underlined equate to extender trainee groups):

- Physicians
- Registered nurses
- Behavioral health professionals (marriage and family therapists, medical and public health social workers, mental health and substance abuse social workers, psychologists, and mental health counselors).

The next version of the Guidelines will include standards for the following occupations (those underlined equate to extender trainee groups):

- Advanced practice nurses (nurse practitioners, nurse anesthetists, certified nurse midwives, clinical nurses specialists)
- Physician assistants
- Dentists
- Emergency medical technicians and paramedics
- Pharmacists
- Licensed practical nurses
- Respiratory therapists
- Respiratory therapy technician
- Cardiovascular technologist and technicians
- Radiological technologists and technicians
- Surgical technologists
- Medical and clinical laboratory technologists
- Medical and clinical laboratory technicians (includes phlebotomists)
- Diagnostic medical sonographers
- Veterinarians.

Subsequent versions of the Guidelines will include additional occupations. Ultimately, the Guidelines will include emergency credentialing standards for approximately 65 health and health-related occupations.

Development of the ESAR-VHP program has not progressed as originally expected, although progress is being made in establishing the foundations for these systems. The HRSA ESAR-VHP program coordinators were contacted to determine if any of the State systems could participate in registrant surveys similar to the Colorado Nurse Alert System and MRC. None of the ESAR-VHP systems could be surveyed. The attitudes of physicians and nurses (the only target groups covered by the current Guidelines) for potentially undergoing the respiratory extender training had already been surveyed in other registries. Eventually, the ESAR-VHP program will include all the target groups identified by this project for the pilot training. Besides standards and

credentialing for up to 65 specific professions, there will be standards for data and system architecture. It may be possible for ESAR-VHP registries to incorporate information relevant to this training program (i.e., individuals indicating interest in the training and those who may have already had it).

Many States are revising their current systems, such as the Colorado Nurse Alert System, to meet ESAR-VHP program requirements. In addition, several States are considering a proprietary system that can also accommodate notifications via multiple means, and thereby result in more rapid volunteer mobilizations.

ESAR-VHP programs will eventually be a resource for identifying most health professional groups for disaster and emergency responses. However, planners currently developing training programs should proactively consider other diversified resources to locate potential trainees.

Other Resources to Locate Personnel

Other potential resources for locating the groups of health care professionals included in the pilot training for this project include the following organizations:

- State Board of Nursing (www.ncsbn.org/regulation/boardsofnursing_boards_of_nursing_board.asp)
- State Nursing Associations (www.nursingworld.org/cmas/cmaaddr.cfm)
- State Nurse Anesthetist Associations (www.anesthesia-nursing.com/assoc.html)
- State and Local Nurse Practitioner Associations (www.aanp.org/AANPPublicPages/OrgListing.asp)
- State and Local Medical Societies (www.ama-assn.org/ama/pub/category/7630.html)
- State Anesthesia Societies (www.asahq.org/Links/associationsus.htm)
- State Veterinary Medical Societies (www.avma.org/advocacy/state/vmas.asp)
- State Respiratory Care Associations (www.aarc.org/links/links_affiliates.asp)
- Respiratory Therapy Schools/Programs (www.allalliedhealthschools.com/featured/respiratory-therapy)
- State Physician Assistant Academies (https://members.aapa.org/extra/constituents/chapter-menu.cfm)
- State Physical Therapist Associations (www.apta.org/AM/Template.cfm?Section=Components1&Template=/aptaapps/componentsonline/componentsonline.cfm)
- State and Local Dental Associations (www.ada.org/ada/organizations/searchcons1.asp)
- Metropolitan Medical Response System programs (www.mmrs.fema.gov/main/jurisdictions.aspx).

Training Program Implementation Guidance

It is important for any institution or community to determine the resources that it has for communication and emergency response structure, acquisition of medical supplies, and location of health care personnel to be deployed during disasters or other incidents. This training program should be incorporated into already established plans that institutions or communities have

developed for responding to emergency events. Not all resources discussed in this report will be available in all areas. The following tools will help to initiate the process of implementing a respiratory care extender training program and integrate it with the necessary community resources:

- Curriculum and training materials
- Institutional planning guidance
- Community integration guidance
- Exercise guidance.

The following three guidance areas are not an exhaustive list of the steps required or issues involved in implementing this respiratory care extender training program within an institution or community. They provide a starting point for beginning the process of developing this training program as another tool for responding to a health emergency. As with any tool, it is important to understand how it can be used for the desired application. Please also review this report's recommendations for other issues to consider during the process of implementation.

Institutional Planning Guidance

The following steps should be taken in advance of an event to incorporate the respiratory care extender training into an institution's emergency response plans:

- Incorporate the training into planning and exercises for the facility, including person(s) authorized to implement.
- Determine under which exact conditions it is appropriate to utilize such a measure for emergency response (i.e., for a State-declared emergency, including certain provisions for liability protection for volunteers).
- Create an internal multidisciplinary planning committee to identify likely scenarios for implementing the training, including possible trigger points (i.e., 95 percent of ventilators in use with expected increases in demand). Potential members of the committee are hospital personnel responsible for respiratory care, staffing, training, and emergency response planning.
- Estimate potential increases for respiratory care that may be required. HRSA used the following case estimates for the National Bioterrorism Hospital Preparedness Program FY 2005 Continuation Guidance (www.hrsa.gov/bioterrorism/hrsa05001.htm):
    - 500 cases per million population for patients with symptoms of acute infectious disease, especially smallpox, anthrax, plague, tularemia, and influenza;
    - 50 cases per million population for patients with symptoms of acute botulinum intoxication or other acute chemical poisoning, especially that resulting from nerve agent exposure;
    - 50 cases per million population for patients suffering burns or trauma;
    - 50 cases per million population for patients manifesting the symptoms of radiation-induced injury, especially bone marrow suppression.
- Identify the person(s) responsible for coordinating the training program.
- Identify potential trainees and create a mechanism for contacting them (i.e., call down list, e-mail group, pager list).

- Inform potential trainees about requirements for the training program and expectations for their being an extender during an emergency.
- Determine the potential increased capacity that internal trainees would provide and for what length of time (i.e., five extenders per shift for up to 2 weeks).
- Identify local resources for obtaining additional ventilators and institute appropriate mechanisms for facilitating procurement (i.e., memos of understanding, contracts).
- Determine at what point and for what type of incidents would internal personnel and ventilator resources be insufficient to meet increased respiratory care demand, and which community resources would be needed.
- Determine if utilization of extenders may have an impact on getting reimbursed from payers or governmental agencies and take appropriate measures (i.e., having licensed respiratory therapists review and sign all entries into patient medical records).

Community Integration Guidance

The following steps should be taken in advance of an event to incorporate respiratory care extender training into a community's emergency response plans:

- Create or integrate into an established local, regional, or State emergency response planning committee. Suggested members of the committee include:
  - Hospital representatives;
  - Local or State public health agency personnel responsible for bioterrorism, communicable disease, and emergency response planning;
  - Local or State emergency management personnel;
  - State SNS coordinator; and
  - Local or State hospital preparedness coordinator.
- Determine how a community would decide to employ respiratory care extender trainees and under what circumstances (i.e., declared emergency or disaster involving more than 100 patients needing ventilator support).
- Determine who will be responsible for recruiting appropriate health care volunteers for extender training in an emergency.
- Create a list of health care professional associations or agencies and their points of contact (see Other Resources to Locate Personnel in this chapter for various types of these groups).
- Consider promoting the training program to these groups in advance of an event to identify potential trainees and create a mechanism for contacting them (i.e., call down list, e-mail group, pager list).
- Identify points of contact for local and State health departments and begin the process of coordinating a given facility's plans with community and State response plans.
- Identify area hospitals' points of contact and develop mechanisms for sharing resources and coordinating emergency response procedures.
- Develop a plan for expediting the credentialing and training of non-facility staff brought in from other locations to provide patient care when the facility reaches a staffing crisis.

Testing Your Community Resources. Once the structure and resources required for utilizing health care professionals for respiratory care extender training have been identified, the potential

for those professionals to participate in and successfully complete such training must be assessed. Please refer to the Methodology chapter, which details the training of target groups and the techniques that were used. In order to locate trainees for this exercise, a sample e-mail that can be used for recruiting is included as Product I. The content can be revised and also used for phone, fax, or mail surveys of prospective target trainees. Local emergency management agencies should be included in planning the exercise, as they likely have experience in developing exercises and their involvement helps satisfy certain exercise requirements of the Joint Commission on Accreditation of Healthcare Organizations.

Exercise Guidance

- Develop a scenario or determine an increased need for providing respiratory care to patients (e.g., accommodating 60 additional patients on ventilators).
- Determine the number of extenders required to reach this capacity (e.g., one extender per three patients per 8-hour shift).
- Determine within what period of time this capacity needs to be in place (e.g., 96 hours).
- Determine whether internal resources are sufficient or if external community resources would be required to develop this increased capacity.
- Contact potential extender trainees through established mechanisms to determine their availability and willingness to participate in training.
- Determine if sufficient personnel can be located within the appropriate timeframe to develop the desired increased capacity:
  - Number of registrants/pre-identified trainees = X
  - Number available for training = Y
  - Number of extenders needed = Z
  - Ideally: X > Y > Z.
- Have the potential extender trainees located through the exercise complete the extender training curriculum and competency evaluations.

Recommendations

Exercising the Interface Among Community and Federal Resources

This project examined how the training program could be integrated with available community resources for locating personnel to train as well as how to obtain SNS assets, such as ventilators. Institutions and communities should determine the likely incidents and emergencies that may require mass respiratory care and use of respiratory extenders. The DHS National Planning Scenarios can assist in understanding the impact of certain disasters on communities and health care systems, including possible limitations on the availability of Federal resources in widespread events.

This training program can be implemented within a health care institution to address short-term disasters. Integration with other community agencies involved in the request and receipt of SNS services will likely be needed for larger and more prolonged events.

There is not any single resource for locating the appropriate health care professionals to undergo this training; each community will need to determine what the appropriate and available resources are for locating potential trainees.

The ESAR-VHP program is currently being implemented by each State and will eventually provide guidance for the credentialing of most health care professionals identified as likely respiratory care extender trainees. Institutions should contact their State ESAR-VHP coordinator to determine how to best establish a system that can access potential extenders in an emergency.

Surveys of the groups of health care professionals selected for pilot training indicate that they have been generally interested in the just-in-time respiratory care extender training program, and most respondents would be potentially interested in undergoing such training.

Health Care Provider Support Capabilities Requirements

It is envisioned that this program will be used for both readiness and just-in-time training. It is highly likely that in the event of a mass casualty disaster, hospitals and medical centers will have to rely on their own resources for the first few days of the event while Federal resources are mobilized. It is also likely that in a nationwide disaster, such as bird flu pandemic, there may be an inadequate or absent Federal response. It is strongly recommended that the training video and program be disseminated to directors and medical directors of all respiratory care departments throughout the United States. The program should be reviewed by supervisory staff of those departments and incorporated into their disaster planning. At minimum, directors of respiratory care should consider how they would anticipate using this program. Critical issues that must be considered include which personnel to train within their institution, location of adequate space to conduct training, personnel available to supervise training, and the necessary technological

resources. The latter includes DVD players to view the video and several "resuscitation dummies." In addition, the following equipment is necessary for demonstration during training:

- Mechanical ventilators that would likely be provided in a mass casualty event
- Suction catheters
- Ambu bags
- Endotracheal tubes
- Alcohol-based hand rub
- Personal protective equipment, including gloves, gowns, surgical mask or N95 particulate respirator, and eye protection
- Respirometer
- Manometer
- Ventilator circuits
- External supplemental oxygen reservoir system for the LP10
- Oxygen flow meters
- Oxygen tanks
- Oxygen regulators
- Tongue depressors
- Tape
- Syringes
- Vacuum source
- Calibrated suction regulator, collection bottle, and connecting tubing.

Ideally, a cadre of potential respiratory care extenders would be identified at each institution; these staff would complete readiness training. Pre-trained extenders would have to undergo just-in-time retraining if a true disaster occurred. The feasibility of this approach would depend upon the expected staff turnover rate between readiness and just-in-time training. At minimum, the institution should conduct disaster exercises that included Project XTREME training to improve the capabilities of staff to supervise the training.

The training program depends heavily on the availability of credentialed respiratory therapists to perform training, competency testing, and supervision of extenders. In some institutions, ventilator and respiratory care may be delivered by health care providers other than respiratory therapists. Successful implementation of this training program requires the presence of credentialed respiratory therapists. Institutions without this resource should develop a disaster plan that includes provisions to emergently acquire a minimal number of respiratory therapists to implement the training program or, alternatively, to transfer patients requiring mechanical ventilation to institutions with the necessary resources.

Policy Decisions and Implementation Considerations

A number of issues must be addressed before this model can be deployed as national policy. These include the following:

1. Legal/Regulatory

The legal/regulatory review conducted as part of this project suggested that in declared emergencies, significant exceptions to licensing, immunity, and civil liability standards may be enacted through Executive Orders to permit nonrespiratory therapy health care workers to provide mechanical ventilation. However, most of the statutes reviewed relate to health care practitioners practicing within their licensed discipline. Whether these statutes would permit and protect cross-trained individuals practicing outside their discipline has not been clearly delineated. It is strongly recommended that State and Federal authorities specifically address these issues. It is unlikely that health care practitioners will volunteer to provide medical services outside their licensed scope of practice in significant numbers, unless such concerns are addressed. This is especially true for groups such as veterinarians, whose licensure and scope of practice does not extend to care of human patients. Indeed, during the Internet recruitment of veterinarians to undergo pilot testing in this project, an e-mail response from an official at the U.S. Department of Agriculture to our recruitment advertisement strongly discouraged veterinarians from participating because of these concerns.

2. Standard of Care

The purpose of this program is to train respiratory care extenders in order to supplement the health care workforce during an emergency. The goal is not to produce experts in respiratory care, but rather a corps of providers who are competent to deliver basic respiratory care and mechanical ventilation under close supervision in a disaster. The standard of care provided by such providers is unlikely to be equivalent to that of respiratory therapists. The respiratory care extenders will not have the same breath of knowledge and skills as registered respiratory therapists. It will hopefully be adequate to meet the population's needs in a disaster.

This program is strictly intended to be used in the event of, or for preparation for, mass casualty disasters. It is strongly recommended that policy be developed to limit the delivery of mechanical ventilation and respiratory care by extenders trained under this program to officially acknowledged emergencies declared by Executive Orders of appropriate State and Federal officials. Although it may be used as an aid in the normal cross-training in mechanical ventilation that occurs in hospitals, other uses, such as to meet temporary staffing shortages in non-emergency situations, should be strictly prohibited.

3. Compensation

It is unlikely that hospitals and medical centers will endorse the use of either this training program or respiratory care extenders unless they are compensated for services delivered by these health care providers. Respiratory care extenders are likely to be non-critical care staff members of hospitals, especially in the early stages of a mass casualty event, and therefore salaried employees. Hospitals will have to bear the cost of the salaries of employees diverted from their normal responsibilities, overtime costs, and the costs of the services delivered. It is strongly recommended that policy be developed to ensure that hospitals and medical centers are compensated for the services delivered by the respiratory care extenders. In addition, charges may decrease due to the use of extenders. This policy should include provisions for hospitals and medical centers to bill and collect payment from private payers for respiratory care services provided by non-respiratory therapists. For short term use of extenders, reimbursement issues

will not be as critical and hospitals may be willing to accept a small loss of revenue. However, if this is a sustained response practice (such as influenza pandemic) with weeks of billing at risk, these issues will need to be addressed.

Products

A. State Survey of Respiratory Care Statutes

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Alabama	Respiratory Therapists Code of Ala. Section 34-27B	**34-27B-11 Permitted activities**: Nothing in this chapter shall be construed as preventing or restricting the practice, services, or activities of any of the following: 4) Any emergency medical technician licensed by the Alabama State Board of Health who is providing care to a patient at the scene of an emergency, or during transport of the patient in a licensed ground ambulance, provided that such care may not exceed the scope of care permissible under the rules of the Alabama State Board of Health. (6) Any individual who has demonstrated competency in one or more areas covered by this chapter as long as the individual performs only those functions that he or she is qualified by examination to perform. The standards of the National Commission for Certifying Agencies, or its equivalent, shall serve as a standard with which to evaluate those examinations and examining organizations.
Alaska	None	
Arizona	Respiratory Care 32-3501	**32-3521: This chapter does not prohibit**: 3. The performance of respiratory care services in case of an emergency, including an epidemic or public disaster. 4. The performance of respiratory care services by registered, certified or licensed individuals as provided pursuant to chapters 7 (podiatry), 8 (chiropractic), 11 (dentistry), 13 (medicine and surgery), 14 (naturopathic medicine), 15 (nursing), 17 (osteopathic physicians and surgeons), 18 (pharmacists), 19 (physical therapists), 21 (veterinarians), 25 (physician assistants), 28 (radiology technicians) and 29 (homeopathic physicians) of this title and title 36, chapter 21.1 (emergency medical services providers).

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Arkansas	Respiratory Care Practitioners Ark Code 17-99-101	**17-99-301 Exceptions**: (2)(A) A licensed physician or a licensed advanced practice nurse shall be exempt from the requirement of obtaining a license to practice respiratory care. (B) A licensed registered nurse or a license practical nurse qualified in and engaged in respiratory care under the supervision of a licensed physician or a licensed advanced practice nurse within the terms of their collaborative agreement shall be exempt from the requirement of obtaining a license to practice respiratory care. (3) Nothing in this chapter shall be construed to prohibit or to require a license hereunder with respect to: (A) the rendering of services in case of an emergency or acute care situation.
California	Respiratory Care Practice Act Section 3700	**§ 3765. Acts not prohibited:** This act does not prohibit any of the following activities: (d) The performance of respiratory care by paramedical personnel who have been formally trained in these modalities and are duly licensed under the provisions of an act pertaining to their specialty. (e) Respiratory care services in case of an emergency. "Emergency," as used in this subdivision, includes an epidemic or public disaster.
Colorado	Respiratory Therapy Practice Act CRS 12-41.5-101	**12-41.5-110 Exceptions**: This article does not prohibit: (c) Any service provided during an emergency that may be included in the definition of the practice of respiratory therapy.
Connecticut	Respiratory Care Practitioners Sec. 20-162n-q	**20-162q Exempt activities**: Nothing in this section shall be construed to require licensure as a respiratory care practitioner for the performance of the following: (4) emergency cardiopulmonary resuscitation provide to a person who requires such emergency measures.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Delaware	Respiratory Care Practitioners DE Code Title 24 Ch. 17 Sections 1775 - 1779	**1776(c)** Nothing in this subchapter is intended to limit, preclude, or otherwise interfere with the professional activities of other individuals and health care providers formally trained and licensed by the State.
District of Columbia	None	**§ 3-1205.02. Exemptions to Licensing of health professionals** The provisions of this chapter prohibiting the practice of a health occupation without a license shall not apply: (1) To an individual who administers treatment or provides advice in any case of emergency.
Florida	Respiratory Therapy Title XXXII, Ch. 468, Part V 468.35	**468.368 Exemptions:** This part my not be construed to prevent or restrict the practice, service or activities of: An individual providing respiratory care services in an emergency who does not represent himself or herself as a respiratory care practitioner or respiratory therapist.
Georgia	Respiratory Care Practices Act 43-34-140	**43-34-150(b)** The prohibition in subsection (a) of this Code does not apply to: (1) The delivery of respiratory care by health care personnel who have been formally trained in these modalities and who are duly licensed to provide that care under any other provision of this title; (4) Respiratory care services rendered in the course of an emergency or disaster.
Hawaii	None	
Idaho	Respiratory Care Practice Act 54-4303	**54-4308 Exemptions**: Nothing in this chapter shall be construed as preventing or restricting the practice or performance of respiratory care or requiring licensure or a temporary permit pursuant to this chapter: (f) of any person who administers cardiopulmonary resuscitation (CPR) in an emergency situation.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Illinois	Respiratory Care Practice Act 225 ILCS 106	**225 ILCS 106.15 Exemptions**: (e) Nothing in this Act shall be construed to prevent a person who is a registered nurse, an advanced practice nurse, a licensed practical nurse, a physician assistant, or a physician licensed to practice medicine in all its branches from providing respiratory care. (j) Nothing in this Act shall be construed to limit an unlicensed practitioner in a licensed hospital who is working under the proximate supervision of a licensed health care professional or other authorized licensed personnel and providing direct patient care services from performing basic respiratory care activities if the unlicensed practitioner (i) has been trained to perform the basic respiratory care activities at the facility that employs or contracts with the individual and (ii) at a minimum, has annually received an evaluation of the unlicensed practitioner's performance of basic respiratory care activities documented by the facility.
Indiana	Respiratory Care Practice Act Ind. Code 25-34.5-1-1	No exceptions.
Iowa	Respiratory Care Iowa Code 152B	**152B.7A Exceptions.** 2. This chapter does not prohibit any of the following: *a.* Respiratory care services rendered in the course of an emergency.
Kansas	Respiratory Therapy KSA 65-5501 - 5517	**65-5514: (b)** Nothing in this act is intended to limit, preclude or otherwise interfere with the practices of other health care providers formally trained and licensed, registered, credentialed or certified by appropriate agencies of the State of Kansas. The practice of respiratory therapy shall not be construed to include the following individuals: (1) Persons rendering assistance in the case of an emergency; (6) Dentists practicing their professions, when licensed and practicing in accordance with the

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
		provisions of law. (7) Nurses practicing their professions, when licensed and practicing in accordance with the provisions of law or persons performing services pursuant to the delegation of a licensed nurse under subsection (m) of K.S.A. 65-1124 and amendments thereto. (8) Health care providers who have been formally trained and are practicing in accordance with the training or have received specific training in one or more functions included in this act pursuant to established educational protocols or both.
Kentucky	Respiratory Care Practitioners KRS 314A00	**314A.105 Permitted activities:** 1. This chapter does not prohibit: (c) Respiratory care services provided in the case of an emergency; (e) The performance of respiratory care by trained paramedical personnel. 2. Nothing in this section shall limit, preclude or otherwise restrict the practices of other licensed personnel in carrying out their duties under the terms of their license.
Louisiana	Respiratory Therapists LRS 37-335	No exceptions.
Maine	Respiratory Care Practitioners Title 32 Sec 9701	**9706-A Persons and practices exempt:** (1) Licensed or credentialed persons. Any health care personnel licensed by this State or who currently hold a nationally recognized credential in a health care profession engaging in the delivery of respiratory care services for which they have been formally trained. That training must include supervised preclinical didactic and laboratory activities and supervised clinical activities and must be approved by the board or an accrediting agency recognized by the board. It also must include an evaluation of competence through a standardized testing mechanism that is determined by the board to be both valid and reliable.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Maryland	Respiratory care Practitioners 14-5A-01 – 14-5A-25	**14-5A-02 Scope of subtitle:** This subtitle does not limit: (1) The right of an individual to practice a health occupation that the individual is authorized to practice under this Article (Health Occupations).
Massachusetts	Respiratory Care Practice Act 261 CMR 2.00	**2.05 Respiratory care services not requiring a license**: (7) emergency CPR provided to a victim who requires such emergency measures.
Michigan	Respiratory Care 333-18701	**333.18707: Practice of respiratory care**: (2) Subsection (1) does not prevent any of the following: (a) An individual licensed under any other part or act from performing activities that are considered respiratory care services if those activities are within the individual's scope of practice and if the individual does not use the titles protected under section 18703. (b) An individual not licensed under this part from performing activities that are considered respiratory care services while under the supervision of an individual who is licensed under this part as a respiratory therapist or respiratory care practitioner, if the individual does not use the titles protected under section 18703.
Minnesota	Respiratory Care Practitioners 147C.01	**147C.10 Other health care practitioners.** (a) Nonphysician individuals practicing in a health care occupation or profession are not restricted in the provision of services included in section 147C.05, as long as they do not hold themselves out as respiratory care practitioners by or through the use of the titles provided in subdivision 1 in association with provision of these services. (b) Physician practitioners are exempt from this chapter.
Mississippi	Respiratory Care Practice Act 73-57.1	**73-57-35. Unlicensed practice;** (2) This chapter does not prohibit: (c) Respiratory care services rendered in the course of an emergency.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Missouri	Respiratory Care Practice Act 334.800	**Sec. 334.900:** So long as the person involved does not represent or hold himself or herself out as a respiratory care practitioner as defined in subdivision (12) of subsection 2 of section 334.800, nothing in sections 334.800 to 334.930 is intended to limit, preclude or otherwise interfere with: (2) Respiratory care rendered, by any provider in the course of emergency care; (4) Persons from engaging in cardiopulmonary research; (7) The practice of respiratory care by: (a) A licensed health care provider performing a respiratory care procedure that is within the scope of practice of the licensee; (b) A licensed health care provider performing a respiratory care procedure that is not within the scope of practice of the licensee, so long as the licensee has received special training deemed sufficient by the board for respiratory care; (c) A health care provider who is not licensed but is certified or registered, so long as the provider has received special training or passed an examination approved by the board for respiratory care.
Montana	Respiratory Care Practitioners 37-28-101	**37-28-201. License required -- exceptions -- respiratory care not the practice of medicine.** (1) Except as otherwise provided in this chapter, a person may not practice respiratory care or represent to the public that the person is a respiratory care practitioner unless licensed under the provisions of this chapter. (2) This chapter does not prohibit respiratory care rendered in the course of an emergency.
Nebraska	Respiratory Care Practice Act 71-1-227	**Section 71-1,235 Practices not requiring licensure** Sections 71-1,227 to 71-1,236 shall not prohibit: (3) The practice of respiratory care by nurses, physicians, physician assistants, physical therapists, or any other professional licensed under the Uniform Licensing Law when such practice is within the scope of practice for which that person is licensed

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Nevada	Respiratory Care NAC 630.500	No exceptions.
New Hampshire	Respiratory Care Practice 326-E:1	**326-E:6 Exemptions From Licensure.** I. This chapter shall not prohibit: (f) Respiratory care rendered in an emergency. II. This chapter shall not restrict a person licensed under any other law of this State from engaging in the profession or practice for which that person is licensed if that person does not represent, imply, or claim that he or she is a respiratory care practitioner or a provider of respiratory care.
New Jersey	Respiratory Care Practitioner Licensing Act 45:14-E1	**45:14E-9**: Nothing in the Act is intended to limit the provision of respiratory care services rendered in the course of an emergency by a certified emergency medical technician or paramedic or other person licensed to practice medicine, dentistry, podiatry, or other health care professional trained to render emergency services.
New Mexico	Respiratory Care Act 61-12B-1 – 61-12B-17	**61-12B-4**: Nothing in the Respiratory Care Act is intended to limit, preclude or otherwise interfere with: respiratory care services rendered in case of an emergency.
New York	Respiratory Therapy Education Law § 8500 - 8513	**§ 8505. Exempt persons. This article shall not prohibit:** 2. The performance of any of the modalities included in the definition of respiratory therapy by any other duly licensed, certified or registered health care provider, provided that such modalities are within the scope of his or her practice.
N Carolina	Respiratory Care Practice Act NC General Statutes 90-646	**90-664 Persons and Practices not affected.** The requirements of this Article shall not apply to: (1) Any person registered, certified, credentialed, or licensed to engage in another profession or occupation or any person working under the supervision of a person registered, certified, credentialed, or licensed to engage in another profession or occupation in this State who is performing work incidental to or within the practice

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
		of that profession or occupation and does not represent himself or herself as a respiratory care practitioner.
North Dakota	Respiratory Care Practitioners 43-42	**43-42-05 Application of chapter**: (4) This chapter does not prevent a licensed and qualified member of another health care profession from performing any of the duties of a registered respiratory therapist or a certified respiratory therapist that are consistent with the accepted standards of that person's profession, provided the person is not represented as a registered respiratory therapist or certified respiratory therapist. (7) This chapter does not prohibit any individual licensed or registered as a respiratory therapist in another State or country from providing respiratory care in an emergency in this State.
Ohio	Respiratory Care 4761.01	**4761.11. Exceptions to provisions;** (A) Nothing in this chapter shall be construed to prevent or restrict the practice, services, or activities of any person who: (1) Is a health care professional licensed by this State providing respiratory care services included in the scope of practice established by the license held, as long as the person does not represent that the person is engaged in the practice of respiratory care; (5) Provides respiratory care only to relatives or in medical emergencies; (C) Notwithstanding division (A) of section 4761.10, in a life-threatening situation, in the absence of licensed personnel, unlicensed persons shall not be prohibited from taking life-saving measures.
Oklahoma	Respiratory Care Practice Act Title 59 Section 2042	**Sec 2042**: The Respiratory Care Practice Act does not prohibit: (4) Respiratory care services rendered in the course of an emergency.
Oregon	Respiratory Therapists 688.800	**688.805 Practice of respiratory care by unlicensed practitioner prohibited; exceptions;** (3) Nothing in ORS 688.800 to 688.840 prohibits: (c) Respiratory care services rendered in the course of an emergency.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Pennsylvania	Respiratory Care Practitioners 49 PA Code 18.301	No exceptions.
Rhode Island	Respiratory Care Act 23-29-1 – 23-29-15	**§ 23-39-4 License required.** (b) Nothing in this chapter is intended to limit, preclude, or otherwise interfere with the practices of other persons and health providers licensed by appropriate agencies of Rhode Island, self-care by a patient, or gratuitous care by a friend or family member who does not represent or hold himself or herself out to be a respiratory care practitioner, or respiratory care services in case of an emergency.
South Carolina	Respiratory Care Practice Act 40-47-500 – 40-47-660	**40-47-530(A) This article does not affect:** (3) an individual or other health care professional who is licensed by the State or who has proven competency in one or more of the functions included in the definition of Respiratory Care Practice as long as the person does not represent themselves as a Respiratory Care Practitioner. To qualify for this exemption, an individual must provide proof of formal training for the functions which include an evaluation of competence through a mechanism that is determined by the Board and committee to be both valid and reliable.
South Dakota	Respiratory Care Practitioners 36-4C-1	**36-4C-7:** Nothing in this chapter may be construed to prevent or restrict the practice, services, or activities of: (5) A person rendering respiratory care in an emergency; (7) A person, other than a respiratory care practitioner, employed by a hospital or related institution as licensed pursuant to chapter 34-12 who performs simple oxygen administration, incentives spirometry or chest physiotherapy under the direction of a licensed physician, registered nurse, licensed practical nurse, licensed respiratory care practitioner, certified nurse practitioner or certified physicians assistant.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Tennessee	Respiratory Care Practitioner Act TN Code 63-27-101 – 63-27-117	**63-27-110 Exemptions**: (a)(1) Nothing in this part shall prohibit: (A) Any person licensed or certified to practice any of the other health-related professions in this State under any other law from engaging in the practice for which such person is licensed or certified; or (c) With respect to licensed health care professionals that lawfully engage in the practice of respiratory care within the scope of practice of their professions, the board may develop mechanisms and standards for ensuring the competency of such licensed professionals in their practice of respiratory care, and may recommend to the health-related board for each such profession that that board adopt, by rule or otherwise, mechanisms and standards for ensuring competency in the practice of respiratory care; provided, that the board has no authority to regulate a health care professional subject to regulation by another health-related board.
Texas	Respiratory Care Practitioners 604.001	**§ 604.003. EFFECT OF CHAPTER. This chapter does not prohibit:** (2) the employment by a health care facility of a person to deliver limited respiratory care support services under the supervision of another person who holds a certificate issued under this chapter, if the person delivering the services does not perform an invasive procedure related to critical respiratory care, including a therapeutic, diagnostic, or palliative procedure, as part of the person's employment and if that person; (4) care provided in an emergency by a person who does not claim to be a respiratory care practitioner; (6) the practice of respiratory care by health care personnel who have been formally trained in the care used and who are:(A) licensed under the law regulating their professions; or (B) acting under the delegated authority of a licensed physician.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Utah	Respiratory Care Practices Act Utah Code 58-57-1	**Exemptions from licensure:** (b) any person who is a licensed or qualified member of another health care profession, if this practice is consistent with the accepted standards of the profession and if the person does not represent himself as a respiratory care practitioner; (d) any person who acts under a certification issued pursuant to Title 26, Chapter 8a, Utah Emergency Medical Services System Act, while providing emergency medical services.
Vermont	Respiratory Care 26 V.S.A 4701	**§ 4712. Exemptions from licensure** (6) Respiratory care rendered in an emergency. b) This chapter does not restrict a person licensed or certified under any other law of this State from engaging in the profession or practice for which that person is licensed or certified if that person does not represent, imply, or claim that he or she is a respiratory care practitioner or a provider of respiratory care. This chapter does not expand the scope of practice of any other profession or occupation referred to in this chapter.
Virginia	Respiratory Care 54.1-2954	No exceptions.
Washington	Respiratory Care Practitioners RCW 18.89.010	**RCW 18.89.040 Scope of practice.** (2) Nothing in this chapter prohibits or restricts: (a) The practice of a profession by individuals who are licensed under other laws of this State who are performing services within their authorized scope of practice, that may overlap the services provided by respiratory care practitioners.
West Virginia	Respiratory Care 30-34-2	**§30-34-15. Exceptions.** (b) This article does not prohibit: (3) Respiratory care services rendered in the course of an emergency.

STATE	RESPIRATORY CARE ACT CITATION	EXCEPTION TO LICENSURE REQUIREMENT
Wisconsin	None	Under the Medical Practices Act, Wis. Statute 448.03, Nothing in this subchapter shall be construed either to prohibit, or to require, a license or certificate under this subchapter for any of the following: (i) Any person furnishing medical assistance or first aid at the scene of an emergency. (j) Any person assisting a respiratory care practitioner in practice under the direct, immediate, on-premises supervision of the respiratory care practitioner.
Wyoming	Respiratory Care Practice Act 33-43-101 – 33-43-118	**33-43-117 Exceptions.** (b) This act does not prohibit: (iii) Respiratory care services rendered in the course of an emergency. (c) Nothing in this act is intended to limit, preclude or otherwise interfere with the practices of other persons and health providers licensed by appropriate agencies of the State of Wyoming.

B. Legal and Regulatory Checklist

What are the legal and regulatory issues affecting the Model for Cross-Training Health Care Professionals to use mechanical ventilators?

State licensing requirements:

☐ Does the State have a respiratory care practice law?
☐ Does the respiratory law include any exemptions to license requirements?
☐ Would the exemption permit the use of a mechanical ventilator by a health care provider other than a licensed respiratory therapist in the case of a disaster emergency?

Effect of an emergency or disaster declaration:

☐ Does the State have a statutory definition of “emergency”?
☐ Does the State have an emergency response law?

Liability for volunteers:

☐ Does State law provide volunteer health professionals with immunity from civil liability?

C. Manual and Mechanical Ventilation: Terms and Definitions

Mechanics of Ventilation

Mechanical ventilation is a patient care modality that artificially provides a means of breathing for patients in respiratory failure. Respiratory failure can occur under a variety of circumstances including conditions that involve the heart, lungs, brain, spinal cord, or muscles that involve ventilation. Under normal conditions, we use a large muscle in the torso called the diaphragm to generate negative pressure in the chest and lungs to draw in fresh air into the body. When fresh air is introduced into air sacs called alveoli, oxygen diffuses into the blood stream to be delivered to muscles and other tissues and organs. At the same time, a byproduct of metabolism called carbon dioxide is diffused back into the air sacs to be exhaled from the lungs before the next breath. This cyclical motion and exchange of gas is the normal process we associate with spontaneous breathing. Mechanical ventilation uses positive pressure to force air and oxygen into a patient's lungs. Positive pressure ventilators require an artificial airway such as an endotracheal or tracheostomy tube.

Airway Pressures

Airway pressure is a result of positive pressure being delivered to the lungs artificially via a ventilator or resuscitation bag. This value is monitored on the ventilator by a "manometer". Spontaneously breathing individuals have very low to zero positive pressure in the lungs. However, when positive pressure is introduced to the lungs via a mechanical ventilator or manual resuscitator, airway pressures rise proportionately with tidal volume. The degree of positive pressure rise with each unit of volume is determined by the patient's lung compliance. Lung compliance changes greatly with lung disease and should be monitored closely in volume ventilation. In general, lung pressures above 35 cm H_2O are considered to be unsafe and should be avoided.

FIO_2

FIO_2 is the fraction of inspired oxygen concentration delivered by the ventilator. Room air that we normally breathe is 21% oxygen. Supplemental oxygen can be delivered when warranted by the patient's condition. Supplemental oxygen should also be given before procedures such as suctioning. The care provider determines the amount of oxygen based on clinical information such as pulse oximetry and arterial oxygen values. Though hazards of supplemental oxygen do exist, the benefits far outweigh the risks. Supplemental oxygen should always be given when the patient's medical status is in question.

High Pressure Alarm Limit

The high-pressure alarm limit is a setting on the ventilator that designates the highest possible pressure that will be delivered by the ventilator. An airway pressure that reaches this set value will result in an alarm as well as premature stop of an inspiratory tidal volume. This setting acts as a safety mechanism to prevent patients from experiencing airway pressures that are too high. Airway pressures that are too high could cause serious injury. Airway pressures

above 35 cm H20 should be avoided. However, intermittent breaths with higher pressures can be acceptable as long it resolves in a short period of time. In general the high-pressure setting should be set 10 to 15 cm H_2O above the average monitored peak airway pressure.

Ideal / predicted body weight (PBW)

Male = 50 + 2.3 (Height in inches - 60)

Female = 45.5 + 2.3 (Height in inches - 60)

I:E ratio

The I:E ratio in many cases is a result of the set respiratory rate and set inspiratory time and usually cannot be changed independently. Normal I:E is at least 1:2. I:E ratios of 1:3 and even greater are acceptable. I:E ratios of less than 1:1.5 should be used only in highly specialized circumstances to avoid ill effects of mechanical ventilation. I:E ratios are often calculated on mechanical ventilators, but not all ventilators provide this function. The calculation is a bit complex but generally higher respiratory rates require faster inspiratory times to achieve an appropriate I:E ratio.

Inspiratory Time

Inspiratory time is the time in seconds required to achieve one full inspiratory tidal breath. The inspiratory time is selected by the care provider to achieve comfortable synchronization between the patient and ventilator. It is also determined by maintaining an appropriate inspiratory to expiratory time ratio (I:E). Normal inspiratory time in adults is .75-1.25 seconds.

Low-pressure Alarm Limit

The low-pressure alarm limit is an alarm setting on the ventilator that activates when inspiratory pressure does not exceed the set value. This value is generally set 5-10 cm H20 above end expiratory pressure. In most cases, activation of this alarm is a result of disconnected circuitry and prompt action may be required.

Lung Compliance

Lung compliance is a calculated value that is expressed in units of volume (L) per unit of pressure (cm H_2O). It may be thought of as the opposite of stiffness; i.e. compliance decreases as lungs become stiffer. This calculated value changes greatly with lung disease. It may not be necessary to know exact values of lung compliance as long as peak airway pressures are monitored closely.

Mode of Ventilation

The mode of ventilation determines the manner in which breaths are delivered to the patient. Modes can be classified into two categories; those that provide complete ventilatory support and

those that provide partial ventilatory support. The care provider determines the mode of ventilation primarily by the patient's underlying condition and ability to breathe spontaneously. Careful monitoring should take place after all ventilator changes, especially when switching ventilation modes.

PEEP

PEEP is an acronym for Positive End Expiratory Pressure. PEEP is pressure left in the lungs after exhalation of a tidal breath. PEEP is used to help patients get higher values of oxygen to the blood from the lungs. This value is determined by the care provider based on the patient's need for higher levels of oxygen in the blood. Generally PEEP is set between 0 and as high as 20 cm H20 in special circumstances.

Respiratory Rate

The respiratory rate is the frequency of respirations expressed per minute. The care provider determines the respiratory rate primarily based on patient's age and degree of lung disease. Normal respiratory rates for healthy adults range from 12-18 breaths per minute (bpm). A rate of 12 breaths per minute is equal to 1 breath every 5 seconds (12 bpm / 60 sec = 5 sec). Sometimes respiratory rate is abbreviated as RR or *f* for frequency.

Tidal Volume

Tidal volume is the amount of air that is delivered with each breath. The care provider determines the tidal volume primarily based on age, height, and degree of lung disease. Normal tidal volumes for healthy adults are approximately 5 - 10 ml per kilogram of ideal body weight. Thus a 65 kilogram or 143 pound person would have a spontaneous tidal volume of 325 ml (65 kg x 5 ml/kg = 325 ml). Careful consideration must be taken to determine mechanical tidal volumes in the face of lung disease to avoid detrimental complications. Tidal volume is sometimes abbreviated as V_t.

Ventilator Sensitivity

Ventilator sensitivity is a value set on ventilators that allows patients to tell the machine that a breath is required. The lower the value of sensitivity, the easier it is for the patients to automatically trigger a breath. If not automatically determined by the ventilator, sensitivity is set as low as possible but not so low as to allow the ventilator to trigger automatically. Usually the set value for adult is 2-3 cm H_2O below the set end expiratory pressure or PEEP**.** If there is no end expiratory pressure then sensitivity may be a negative value (i.e. –2 cm H_2O). Ventilator sensitivity may also be known as "trigger," "breathing effort," or simply "sensitivity."

D. Assembly Instructions: The External Supplemental Oxygen Reservoir System

The external supplemental oxygen reservoir system consists of several key pieces.

a) valve and bracket assembly

b) corrugated hose

c) oxygen tubing

d) intake adaptor

e) reservoir bag

Step 1: Attach the valve and bracket assembly (a) to the side of the ventilator unit by sliding the grooved opening onto the accessory arm.

Step 2: Attach the reservoir bag (e) to the bottom adaptor port underneath the bracket arm (a)

Step 3: Attach one end of the white corrugated hose to the adaptor port on the top of the bracket arm (a).

Step 4: Use the intake adaptor (d) on the other end of the white corrugated hose (b) to connect to the intake port of the ventilator.

Step 5: Attach one end of the small-bore oxygen tubing (c) on the top of the valve to the small nipple connection and the other end to an available oxygen source.

E. Parameter Settings (for Assessing Function of Ventilator)

Impact® Uni-Vent® Eagle™

Mode	AC
Respiratory Rate	12
Inspiratory Time	I:E default at 1:2
Tidal Volume	600cc
FiO_2	100%
High pressure	50 cm H_2O
Low Pressure	5 cm H_2O
PEEP	10 cm H_2O

Puritan Bennett LP10

Mode	AC
Respiratory Rate	12
Inspiratory Time	1 second
Tidal Volume	600cc
High pressure	50 cm H_2O
Low Pressure	4 cm H_2O