Healthcare Delivery in a Pre Hospital Setting

An Interdisciplinary Qualifying Project Submitted to the Faculty of

Worcester Polytechnic Institute in Partial Fulfillment of the Requirement for

the Degree of Bachelor of Science

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Abstract

Despite the importance of pre-hospital care, much equipment used by Emergency Medical Services personnel is outdated and causes personal injury. Furthermore, EMS effectiveness is based on the provider's educational background. For this project, a survey was conducted with EMTs of various levels and several companies in order to identify problematic equipment. For the second part, a CPR course was setup to determine the efficacy of current education guidelines through the students' evaluations of current teaching techniques.

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Introduction

Emergency Medical Services (EMS) provides health care to the sick and injured in a pre-hospital setting. Since its official implementation in the 1970's, EMS has been a cornerstone in medical evaluation and treatment. Despite its rapid rise and success in the last thirty years, EMS lacks a stable workforce and technological drive. This project has two major components: exploring the effectiveness of current EMS education; and providing research into the improvement of EMS technology. The remainder of this report will examine the motivation for the project, the project architecture and associated results and conclusions.

Motivation

The current healthcare system is highly reliant on private business. Since businesses tend to be more concerned about profit over function, Emergency Medical Services suffer from a lack of technologically advanced equipment. This lack leads to great difficulties for the EMS worker, ranging from constant repetition of menial tasks to injuries suffered from inefficient equipment. Furthermore, private EMS companies do little to entice future employees to begin a career in EMS, leading to a shortage in

qualified EMS personnel. By surveying the need for modification in EMS equipment and examining the success of EMS education, it will be possible to determine what actions can be taken to make EMS more effective and desirable for the employee while being efficient and productive for the EMS company.

Details

The aim of this project was to evaluate the efficacy of a basic EMS education program and the need for improved EMS equipment. To do this, EMS equipment was surveyed and the plausibility of their economical improvement was explored. It is hoped that equipment will not only be more effective, but will also be cheap enough to implement into a privately owned EMS system. A First Responder class was set up and taught in order to examine the interest in EMS. The class provided insight into the need for any future changes that can be made in order to improve interest in EMS as a profession.

Environment

This project was conducted in two environments: private EMS companies and a classroom of students. The private EMS companies were presented with inquiries questioning the need for improving equipment. The project then explored the possibility of improving the equipment on a practical and economical level. A First Responder class was taught at a Worcester Polytechnic Institute with the intent of creating and evaluating

interest in EMS. The class was taught by Massachusetts Certified Emergency Medical Technicians (EMTs) who have acquired the certifications necessary to teach a class.

Implementation

The first approach was to survey private EMS companies and find the need for improvement in EMS equipment. Certain EMS equipment can be made more efficient and thus more effective for the EMS employee. Other equipment can help EMS employees perform repetitive menial tasks, and thus improve the efficiency of the employee. The most difficult aspect of this was to provide improvements that are economical enough for a private company to implement.

The second approach was to start a First Responder class at a Worcester Polytechnic Institute. Since First Responder is one of the most basic levels of EMS (and quickest to teach), it was easy to evaluate the interest in EMS. The effectiveness of such an EMS program can be observed in two ways: The number of students who go on to higher levels of EMS education, and the demand for future First Responder classes within the institution. The most difficult aspect of this approach will be to generate initial interest in the First Responder class.

Deliverables

This project produces a report that discusses future actions that would need to be taken to improve EMS. The report includes modifications and/or implementations that would need to be considered in order to improve EMS equipment. Furthermore, the

report includes suggestions that can be considered in order to improve EMS education and interest.

The first phase of the project, completed during 'B' term, documents research into current EMS equipment and the need for their modifications. The information collected from this phase was used in the second phase to help propose any needed changes. First Responder teaching certifications were acquired in order to teach the class in the third phase.

The second phase, completed during 'C' term, consisted of research into economical and practical modifications of the equipment surveyed in phase one.

The third phase, completed during 'D' term, was the teaching and survey phase. A first responder class was taught at a Worcester Polytechnic Institute, and its effectiveness was documented. Suggestions are made that will outline future changes that can be made to help raise interest in EMS and raise effectiveness of EMS education.

Timeline

1. B Term
    a. Survey EMS companies for any suggested changes in EMS equipment
    b. Acquire First Responder teaching certificates
2. C Term
    a. Research and discuss EMS equipment improvements and implementation
3. D Term
    a. Teach First Responder Class
    b. Asses effectiveness of EMS education and interest

c. Suggest improvements to help EMS education to raise interest in EMS

Results and Conclusions

EMS Technology

EMS is a very important aspect of the health care system. Providing information to improve the efficiency, interest and education of EMS will help relieve some of the stresses placed on EMS providers. This project provided the groundwork for such information, opening the door to technological and societal advances for Emergency Medical Services.

To gauge the affect of technology on current EMS equipment, a survey was created and handed out to various EMS services. The survey (see Appendix A) was filled out by all levels of EMTs and with varying degrees of experience. The two last questions in the survey are open ended so that EMTs could provide information that they would deem pertinent to the survey. The surveys were filled out over the course of a month at Eascare LLC and General Ambulance Co. Two different companies were used in order to judge trends (if any) between EMS services. Although most companies use similar equipment, discrepancies between company's survey results can be analyzed to find differences in equipment technology. Both company's surveys came back with very similar results, indicating that EMS technology has the same characteristics irrespective of company differences.

Despite recent developments in metal alloy technology, most EMS equipment employs older technology. The stair chair, a device used to carry patients up and down stairs and/or through narrow passageways, is comprised of little more than a folding chair

with carrying handles. The majority of EMTs report the stair chair is the most dangerous piece of equipment to their personal health (Fig. 1), beating out the two-man stretcher for the top worst spot.

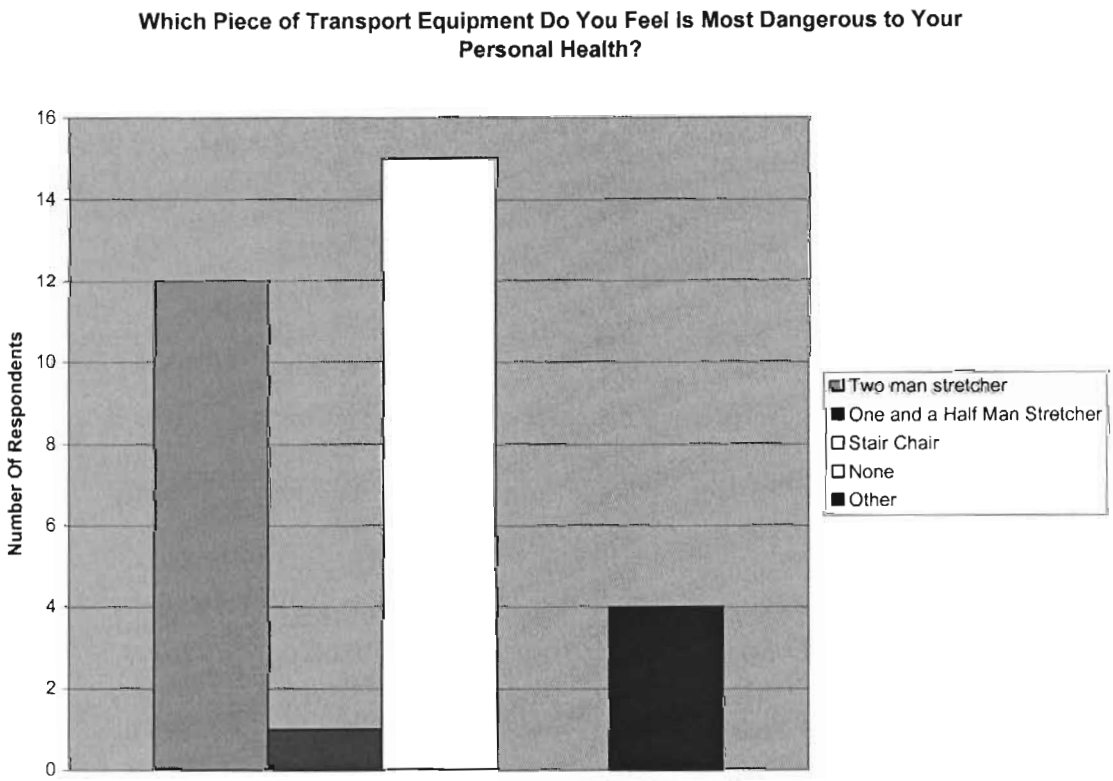

Figure 1: Responses to EMT Technical Survey, Question 2.

This device is dangerous because it requires proper lift technique at every stage of usage, which can be exceedingly difficult in small hallways or rooms. Often times an EMT must hold the device far away from his/her torso, which puts excessive strain on the muscles of the back. Furthermore, an EMT can easily trip while using the stair chair, causing injury to both EMTs and the patient. The stair chair is also difficult to use on obese or otherwise large patients, as it forces the EMT to manipulate the stair chair so as to accommodate the patient. This manipulation occurs during transport of the patient up or down stairs, where the EMT must lift the stair chair to clear the stairwell and prevent the wheels from catching. This usually causes back aggravation for the EMT, which may result in time lost from work, aggravation of previous back injuries, or the possibility of the patient being dropped. EMS services are limited in their choice of stair chairs, often due to financial reasons. Despite the wide availability of technology that would improve the stair chair, many suppliers are hesitant to invest funds in the mass production of an improved model.

A stretcher is the most important piece of equipment to an EMT. The stretcher transports the patient to and from the ambulance, and is capable of being raised and lowered to accommodate the situation. The stretcher's height is controlled by a switch that, when pulled by an EMT, withdraws a long metal pin from a shaft with slotted holes in it. The holes provide height adjustment for the stretcher. Accidental lowering is prevented by the pin and hole mechanism because the switch is nearly impossible to pull while there is weight on the stretcher. The inherent flaw in the design rests on the need for the EMT to do the actual lifting and lowering of the stretcher. This requires the EMT to have not only excellent lifting skills, but also the physical strength to endure many lifts

per day. Because EMTs come in different sizes, not all EMTs have the same lifting capabilities. Most EMS companies require a physical exam before employment, but this does not ensure that there are no weight-bearing related injuries on the job. According to the survey, EMTs felt that the two-man stretcher was the second most dangerous piece of equipment to their health, and the most dangerous type of stretcher (Fig. 1).

The two-man stretcher requires that at least 2 EMTs lower the stretcher completely to the ground, and then physically lift the stretcher approximately three feet into the ambulance. This can cause a tremendous amount of stress on the EMT, especially with large or obese patients. This stress is compounded by the workload of an EMT. The One and a Half man stretcher uses the ambulance to temporarily bear the weight of the stretcher and patient while they are loaded into it. This eliminates the need to lower the stretcher all the way to the ground and lift it into the ambulance. Despite this, some EMTs still felt that the one and a half man stretcher is very dangerous to their personal help (Fig. 1). A large majority of the EMTs surveys found that either raising the stretch, lowering the stretcher, or both is causes personal injury (Fig 2.)

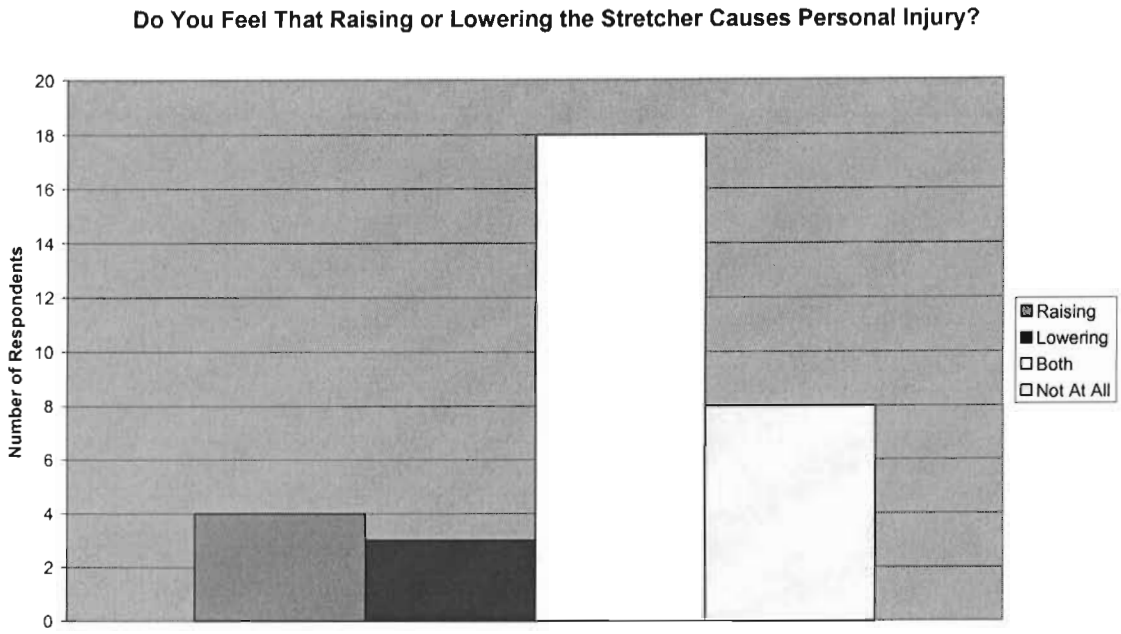

Figure 2: Responses to EMT Technical Survey, Question 8.

This data shows that there is a need for stretcher manufacturers to create and market stretchers that in someway assist the EMT. Although stretchers vary in size and composition, there are no commonly used stretchers that provide assistance (electrical, pneumatic, hydraulic, etc.) in lifting or lowering. There is at least one documented case of an EMT filing a lawsuit against his employer due to the failure of a stretcher.[1]

A few of the survey respondents felt that the ambulance itself is the most dangerous piece of transport equipment (Fig 1). Because there are many factors affecting ambulance operations (driving skills, type of ambulance, operator, etc.) the survey could not address the ambulance's safety or danger. One respondent named the scoop stretcher as a piece of equipment that was felt to be dangerous, but there was little expounding on the matter, and the issue will not be addressed. Many of the EMTs surveys felt that despite these dangers, they will continue to use the equipment that they have available to

[1] http://news.bbc.co.uk/1/hi/england/2491967.stm

them (Fig. 3). This in turn provides very little market force for EMS equipment manufacturers to produce products that improve user safety.

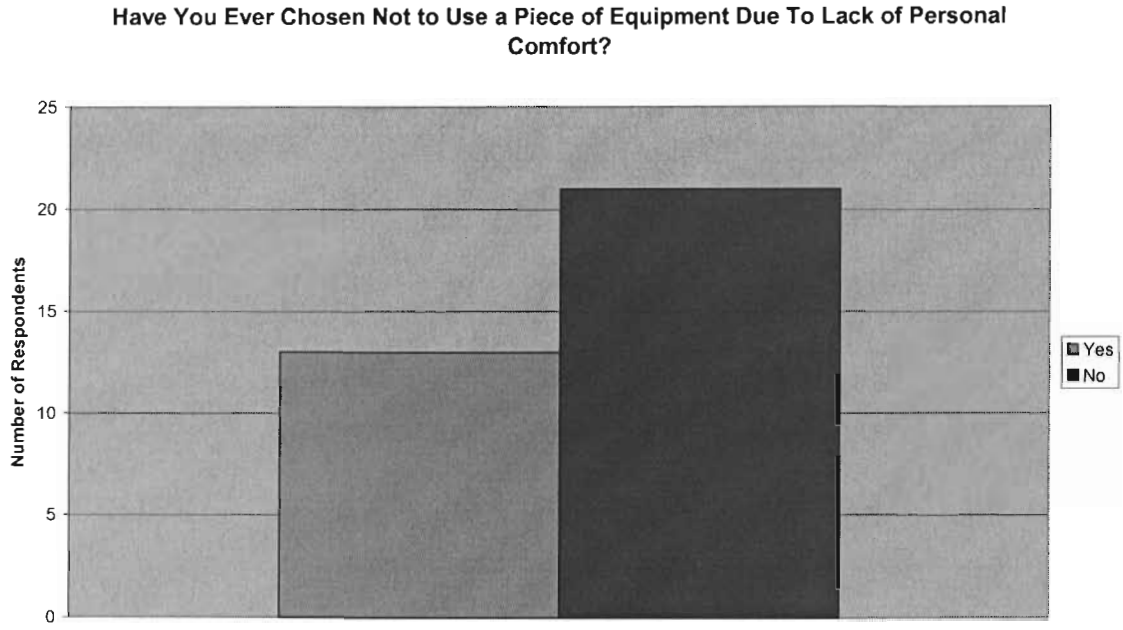

Figure 3: Responses to EMT Technical Survey, Question 7.

Two questions on the EMT Technical Survey were dedicated to determining what actions could be taken to improve EMS technology. A huge majority of those surveyed said that they would benefit working in an environment with more advanced EMS equipment (Fig. 4).

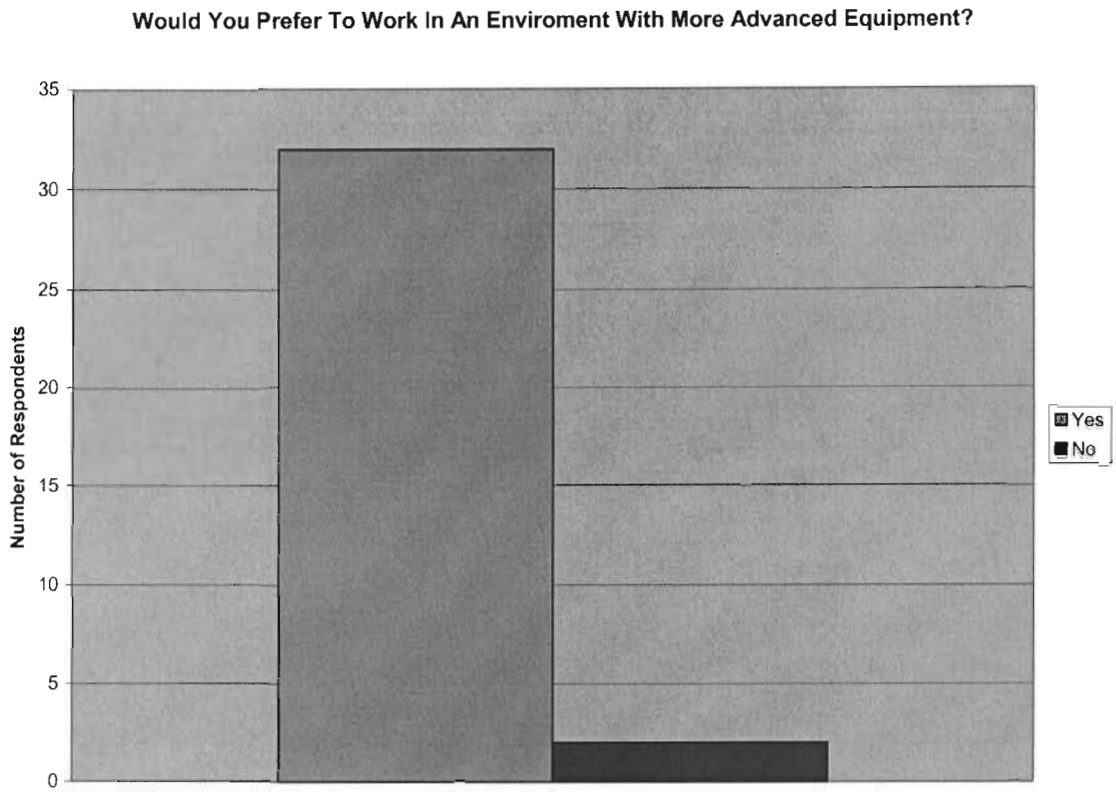

Figure 4: Responses to EMT Technical Survey, Question 5.

This shows that there is interest in improving EMS technology. To further support this interest, a specific technology related question was given on the survey. This question asked whether it would be beneficial to have an automated device to monitor vital signs. Once again, the majority of survey respondents showed interest in the improvement of EMS technology (Fig 5).

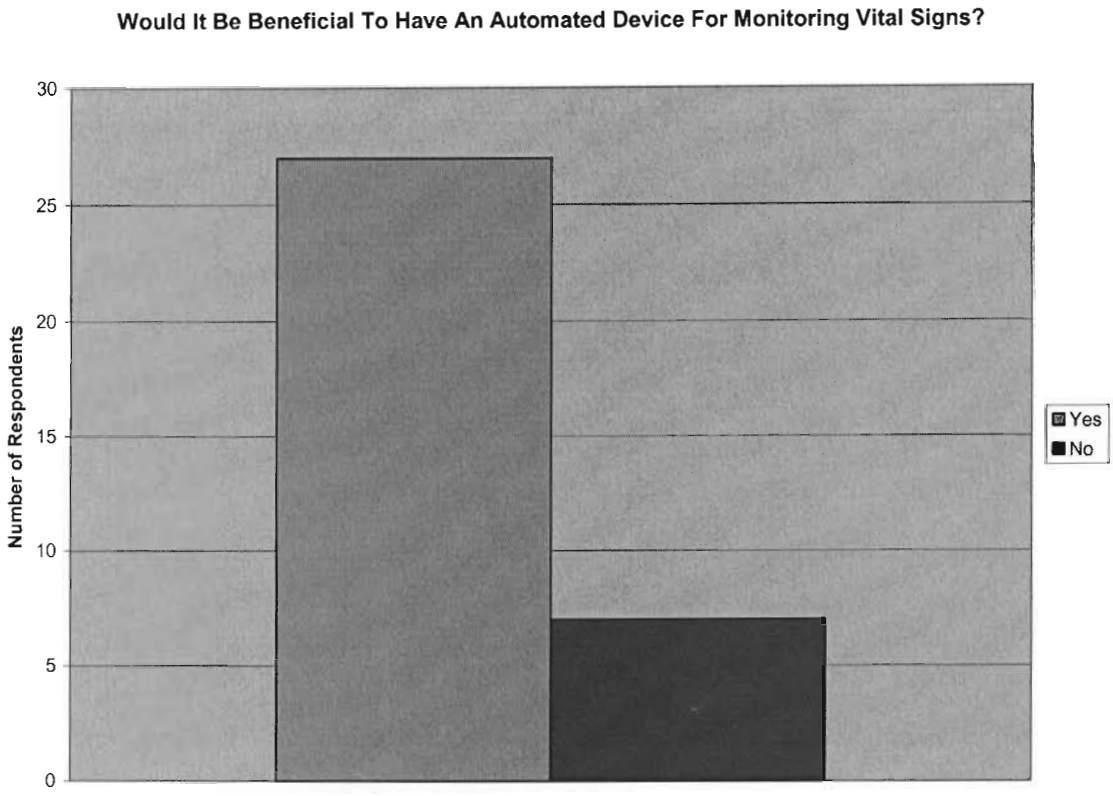

Figure 5: Responses to EMT Technical Survey, Question 4.

To determine what steps were taking to improve EMS technology and EMS equipment safety, several EMS suppliers were contacted via email, though none responded. Intensive research using the internet, electronic journals, the library, and industry journals yielded very few articles regarding the safety of EMS equipment. There was documented research however, by postgraduate student Robert Henderson and Associate Professor John Raine at University of Canterbury in New Zealand on the elevation of stretchers in the ambulance to reduce patient trauma.[2] Though this research doesn't address the topic of EMS equipment safety, it does show that there is interest in the advancement of EMS technology.

[2] http://www.canterbury.ac.nz/publish/research/97/A23.htm

There are many ways to improve EMS equipment using inexpensive technology. The use of hydraulics or pneumatics would greatly relieve the lifting strain on an EMT, and such technology is widely available, inexpensive, and relatively light weight. Further study into the implementation of such devices could greatly improve the quality of EMS equipment.

Stair chair technology has been improved slightly with the implementation of a multi-wheel system for navigating stairs. A product, the Sirocco™ Stair Chair, is available through the Ferno Corporation for approximately $1500. Given that most conventional stair chairs cost between $500 and $800 dollars[3], the price of this device is not competitive. As mentioned before, private ambulance companies are more concerned about profit than function, so it is unlikely that the market will become competitive enough to drop the price of these devices. An alternate construction is highly suggested, one that could drop the price into a more acceptable range.

EMS Education

The base of any EMS professional is their education. Without a thorough understanding of concepts and materials of critical care, equipment, and patient care skills, it is impossible to succeed as a healthcare provider. It is therefore essential that all types of training are well thought out and planned, and most importantly effective in each area. According to the results from the EMT Technical Survey, a large percentage of respondents felt that it was there should be more training on EMS equipment in the classroom, prior to using it in the field

[3] http://www.ambulancia.com/respuestos/stair-chairs.html

(Fig. 6).

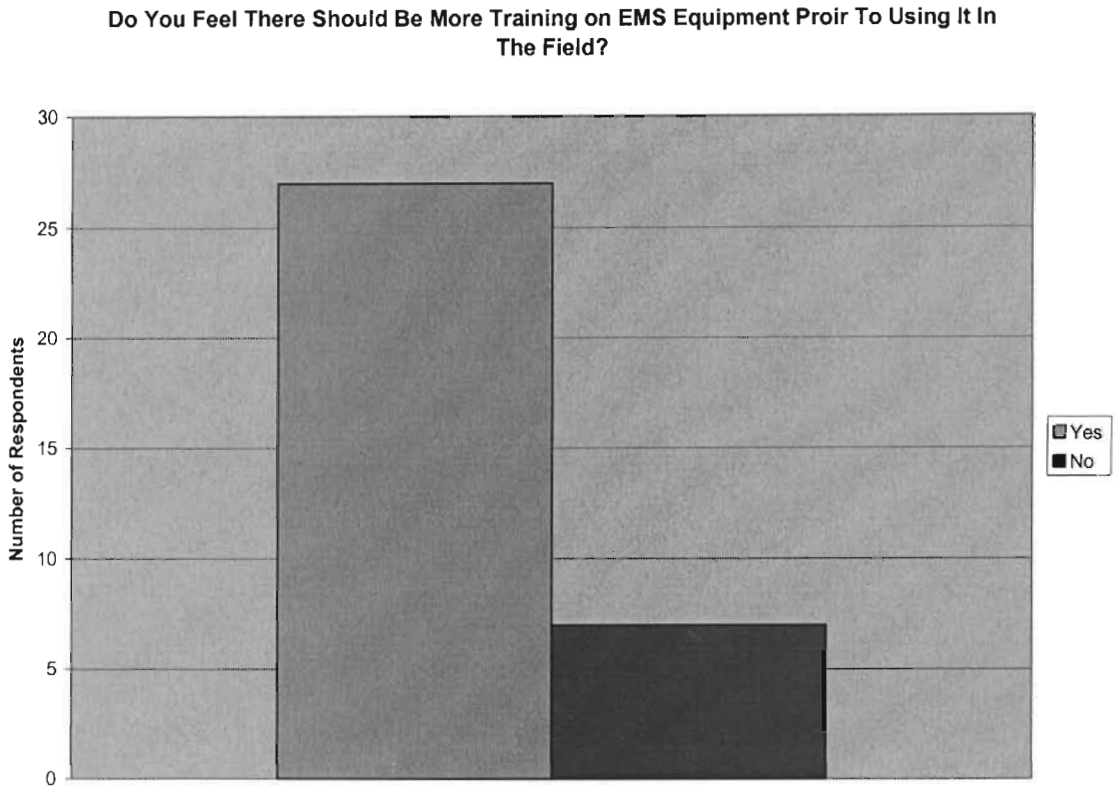

Figure 6: Responses to EMT Technical Survey, Question 6.

To investigate this response further, a First Responder class was set up at Worcester Polytechnic Institute, with the intention to evaluate teaching guidelines as set by the American Heart Association and the effectiveness of the EMS education.

The American Heart Association (AHA) is one of the nation's leading providers of basic life support education. It has very strict and universal guidelines by which the all courses must be taught. The most typical course consists of a video provided by the AHA that shows each skill, followed by a practical demonstration by the instructor(s), a list of scenarios which the class goes over together, followed by practice on manikins to aid in the development of practical skills. The instructor is free to comment on skills, answer questions, provide their own lectures on the material, and distribute the

examination. All material on the exam is covered in the descriptive video. After teaching the class, an experienced based analysis was conducted of the current standards of teaching the skills of Cardiopulmonary Resuscitation (CPR), the use of an Automated External Defibrillator (AED) and abdominal thrusts (commonly known as the Heimlich maneuver).

The instructional video provided by the AHA is emphasized as the most important teaching tool in the course. The video provides a basic step-by-step instruction of each type of skill for every age. There are separate segments for basic CPR for each age group, abdominal thrusts combined with CPR for each age group and AED and CPR for individuals over 8 years of age. This creates a lot of repetition of basic CPR skills. The AHA does this for a reason – because the course is designed for all types of students, the video must cater to a variety of learning styles. Whereas some individuals only need to see the information once, others might have to hear it several times for effectiveness. A CPR/AED course therefore has a universal format.

The two of us taught a CPR/AED class at Worcester Polytechnic Institute, and evaluated the performance of the 24 students. Through a survey (Appendix B), they were then given an opportunity to state their opinions of how they thought the class should be taught, which areas they felt more time needed to be spent on, which skills they felt the most confident with, and the overall difficulty of the material presented to them. Years ago, many individuals in CPR courses did not feel confident in their ability to perform medical skills. Since the AHA has issued this new protocol for teaching CPR/AED courses, many people feel that courses have been more effective. In general, our students had no difficulty with the material provided by the AHA. From this, we were able to

determine that skill confidence was determined by the way in which the material was being presented as well as the time intervals set aside for each skill. Our surveys show that the video was very descriptive and one student commented "The video was so repetitious that I almost fell asleep". Two students felt that the video was too long and boring. Three different students commented that they are more attentive with lectures rather than video, and more time should have been set aside for lecture. Thirteen of the 24 students felt that more practical time was needed when learning infant and child skills. Twenty-one of the 24 students admitted they were not as confident in their ability to pass the practical portion of the exam as the written part. Many become nervous with the idea of an audience the first time they are evaluated on these skills. Practice examinations and role plays might be useful tools in the future for overcoming this anxiety.

As instructors, we were able to judge how effective the AHA's guidelines were for teachers. The AHA gives very specific instructions to the teachers via a teacher's edition CPR book. This book contains all the information necessary to teach the class, and stresses the importance of going over every single point with the class. The AHA recommends four hours as a minimum for a basic CPR class, though that time can be extended at the instructor's discretion. Judging by the general consensus of our class and by the survey results (see Appendix B), it might be prudent for the instructor to lengthen the amount of time taken to practice the practical aspect of the class. Overall, we felt that through the constant repetition of skills and tasks, the AHA's guidelines were effective in helping instructors present the proper information to the class.

Future Studies and Suggestions

Due to the importance of the welfare of EMS personnel, it is vital that new or improved equipment be manufactured and be made widely available. Hydraulic, pneumatic or power assisted stretchers should be made widely available at a relatively low cost. This will ensure that fewer injuries and hardships are endured by EMTs. Improvements in stair chair technology would also greatly reduce the amount of strain on an EMT during the workday. Since the majority of EMTs complained about stair chairs, this should be the first priority for anyone looking to market or manufacture EMS equipment.

EMS education should stress practical skills over memorized knowledge. More time should be spent practicing skills on dummies than studying for the written exam. If students come into the practical exam feeling confident in their skills, then they will feel confident when they encounter a real emergency situation.

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Appendix A: EMT Technical Survey

EMT Technical Survey

1. My current level of training is:

    a) EMT-B
    b) EMT-I
    c) EMT-P

2. I have worked in EMS for ___ years.
3. Which piece of transport equipment (if any) do you feel is most dangerous to your personal health?

    d) two-man stretcher
    e) man-and-a-half stretcher
    f) stair chair
    g) none
    h) other _____

4. Would it be beneficial to have an automated device for monitoring vital signs?

    Yes/No

5. Would you prefer to work in an environment with more advanced equipment?
    Yes/No

6. Do you feel there should be more training on EMS equipment prior to using it in the field?

    Yes/No

7. Have you ever chosen not to use a piece of equipment due to lack of personal comfort?

    Yes/No

8. Do you feel that raising or lowering the stretcher (or both) cause personal injury?

    i) Raising
    j) Lowering
    k) Both
    l) Not at all.

9. Something I would like to improve regarding EMS equipment is:
10. Other Comments:

Appendix B: EMS Educational Survey

EMS Educational Survey

1. Was the material required by the American Heart Association (AHA) easy to understand?

2. Do you feel comfortable using all types of the training equipment?

3. Do you feel the videos were descriptive enough of the tasks being performed?

4. Do you feel the recommended amount of time was sufficient for learning and practice?

5. Did you feel more confident in your ability to take the written or practical portion of the exam? Please comment.

6. Are there any areas in which the instructors should spend more or less time on?

7. How do you feel this course can be improved?

Appendix C: Responses to EMS Educational Survey

Question:	*Class Response:*
1	Yes
2	Yes - More time needed
3	Yes, some felt they were too descriptive
4	13 students felt that more was needed for pediatrics
5	21 felt nervous about the practical
6	Infant/Pediatrics AED practice
7	2 - Less video, 3 - More lecture