Developing EMS Staffing Standards using Task Analysis and Experimentation

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Certification Statement

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ABSTRACT

Over the decade, a significant amount of study has focused on scientifically evaluating the much-discussed NFPA 1710 fire scene staffing recommendations, most recently and principally by the National Institute of Standards and Technology (NIST). Little research however, has been conducted regarding the EMS scene staffing recommendations also contained in NFPA 1710. In 2010, NIST published the Report on EMS Field Experiments, specifically addressing the NFPA 1710 EMS scene staffing suggestion of two advanced level providers and two basic level providers on every EMS scene. Though the study examined skill-level distribution on EMS scenes, it did not examine the actual need for a second paramedic.

Also in 2010, a study submitted by the current researcher to the National Fire Academy attempted to determine the feasibility of designing a task analysis model for determining the number of ALS providers necessary on EMS scenes. Using data, determinations, and recommendations from the 2010 study to develop experimental models, the current research attempts, though actual experimentation, to evaluate the findings of the former study.

Findings from the experiments indicated that though the actual required rescuer time (aRRT) for the ALS provider was less by approximately fifty percent than the perceived required rescuer time (pRRT) from the 2010 research, there was still insufficient time for a single ALS provider to perform all necessary skills by the skill completion time-line benchmarks established in the same research, though additional statistical evaluation was suggested. In addition, using data gathered from the Central Jackson County Fire Protection District (CJCFPD) Emergency Medical Information Database entered as a result of recommendations from the 2010 study, qualitative value may be assigned to the presence of a second Paramedic on a call, independent of skill performance sharing.

Recommendation was also made in the current study to improve CJCFPD data gathering regarding the number of times multiple ALS providers are on critical call scenes. Additionally, suggestion was made to determine, through a deliberate and planned process, if and how CJCFPD should comply with the EMS staffing quantity and skill distribution recommendation in NFPA 1710 as validated by the NIST study and the completed experimentation.

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Much attention and study since 2001 has been paid to the National Fire Protection Administration's release of NFAP 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments. Though the standard addresses both fire and emergency medical roles, the balance of the body of research focused on NFPA 1710 has been almost exclusively related to the staffing standards directed specifically at fire-related responses. Through the stated process of "task analysis" (National Fire Protection Association, 2010, Sec. 5.2.2), the standard established times by which response components like response times, critical task completion time, and travel times could be measured. In addition, NFPA 1710 suggested "safe" minimum staffing standards for personnel on a given emergency based on the number and priority of tasks requiring performance. Using the structure described in NFPA 1710 (in addition to task analysis break-downs described in NFPA 1410), in 2010 the National Institute of Standards and Technology (NIST) supported specifically the staffing standards for residential structure fires presented in NFPA 1710 (National Institute of Standards and Technology, 2010).

Until NIST published the Report on EMS Field Experiments in 2011, little research had been directed toward testing the staffing recommendation contained in NFPA 1710 regarding emergency medical calls in sections 5.3.3.2 and 5.3.3.3. In 2010, an applied research project completed for the Executive Development section of the National Fire Academy's Executive Fire Officer Program examined among other things, the feasibility of performing a task analysis and experimentation based on the type of call to identify time components necessary for safe, effective, and efficient mitigation of emergency medical scenarios. In doing this, the project attempted to determine the number of responders trained to the level of Advance Life Support (ALS) necessary for a given response. Because only general response recommendations exist in

NFPA 1710 and no task completion time standards were included, the 2010 Executive Fire Officer Program Applied Research Project (ARP) attempted to determine whether an apparatus could be developed to determine generally accepted task completion benchmarks, establish perceived skill completion times, then determine the likelihood of a single ALS rescuer being able to meet the accepted skill completion benchmarks for a variety of call types (Portz, 2010). While the study did identify a gap in the single ALS provider's ability to complete a given group of skills by the established time benchmarks, the project was based wholly on perceived completion times.

Considering the increasing number of EMS calls for assistance to which the Central Jackson County Fire Protection District (CJCFPD) responds, it is becoming increasingly important to identify the safest and most efficient crew configuration necessary to deliver the best possible care in the safest possible manner to its constituents. Since limited study has been performed to determine the minimum number of ALS providers on a given call that might qualify as "best practice," this research will attempt to determine, through task analysis and experimentation, the amount of time required to perform ALS tasks and compare it to generally accepted call-time benchmarks for interventions. With this analysis, the research will attempt to determine how well a single ALS provider accompanied by a basic life support (BLS) crew meets the needs of a critical patient. In addition, the research will evaluate gathered qualitative data in further effort to quantify the value of multiple ALS providers on a serious call type independent of skill sharing during the call. Using the data and conclusions from the aforementioned 2010 Portz ARP, the current research will use an evaluative approach in attempt to answer the following questions: First, how do actual skill performance times compare to perceived skill performance times identified in the previous research? Next, what value can be

assigned to the presence of multiple ALS providers on a serious call, independent of skill sharing? What conclusions can be drawn based on the experimental outcome regarding the staffing pattern currently followed by CJCFPD? Finally,what future conditions in the current areas of EMS responsibility a likely to affect the ability of CJCFPD to deliver the safest and best possible care?

Background and Significance

The Central Jackson County Fire Protection District (CJCFPD) is a medium-sized, combination department approximately 20 miles east of the Kansas City, Missouri city limit. As indicated by its name, CJCFPD as a political subdivision is classified as a Fire District, established in 1961 and including four different jurisdictions (three incorporated cities and a portion of rural, unincorporated county) spanning approximately 64 square miles. The organization provides fire, specialty response, and contract emergency medical response to the communities it serves in addition to providing traditional Fire Prevention service and Emergency Management coordination. The District employs 105 response personnel on 24-hour shifts, 10 Reserve/Paid-on-call personnel, 12 full and part-time dispatchers and 12 administrative and support staff. The minimum qualification for response personnel is certification to the level of State of Missouri Board of EMS Emergency Medical Technician and State of Missouri Firefighter I and II.

Minimum response at CJCFPD is five personnel for an EMS call. This minimum reflects a recent amendment as there were circumstance over the last 18 months during which an ambulance crew responded by itself. During a trial period, the response standard operating guide change encouraging an ambulance-only response to triaged non-emergency calls was intended to

reduce apparatus usage and increase overall availability of other emergency crews. Unfortunately, there were instances during which while on a non-emergency call, an ambulance crew needed to remove a patient from a scene more complex than first believed at dispatch. In addition, due to incorrect triage at dispatch (usually secondary to a lack or inaccuracy of call information), instances occurred during which a critical call was initially assigned an ambulance only. These complications were noted during the trial period assessment and in the interest of responder safety and patient care standards, the practice of dispatching only an ambulance to a 911 call was discontinued.

Beginning with the incoming class of new shift employees in 2006, CJCFPD required the new employee to commit in writing to eventual certification to the level of Paramedic. In 2011, this practice was discontinued due in large part to legal considerations concerning the requirement, and secondarily to the complexities involved in tracking, scheduling, and facilitating the employees' ability to satisfy the requirement. The generally held belief by Command Staff engendering the requirement in 2006 was simply that CJCFPD needed more Paramedics. The goal reflected by the initiation of the requirement was ostensibly to provide the best possible care to CJCFPD constituents. The logic presumed an increase in the mere number of ALS providers would improve the quality of care, or at least guarantee the already established high quality of care. Unfortunately, no generally accepted standard staffing recommendation addressing both numbers and certification level of responders existed at the time beyond the NFPA 1710 recommendation that ALS calls be staffed with at least four providers, two trained to the basic level, and two to the advanced level (NFPA, 2010, 1710, Section 5.3.3.4.4). This recommendation is referenced to the American Heart Association's 2000 Guidelines for

Cardiopulmonary Resuscitation (American Heart Association, 2000) (among other national emergency medical sources) and addresses only one call type, that of "emergency cardiac care."

The problem identified in earlier work by this researcher addressing this issue was that no determination had been made to identify the number of ALS providers necessary for CJCFPD to deliver optimal, safe care. The goal was not that CJCFPD would eventually have a staff made up of entirely ALS providers, but to increase the number ALS certifications to a level ensuring the best care to constituents and at the same time, ensure resources were distributed appropriately to satisfy other responsibilities incorporated in the District's mission. An arbitrary "minimum" number of paramedic licenses necessary to operate as an ALS agency was determined by Administration in preceding years simply by the number of paramedics that happened to be on staff at the time. As a result, there was neither a scientifically supported minimum nor maximum number of ALS providers necessary to accomplish the District's EMS mission. To address this question in the research, it was necessary first to identify a standard number of responders required on each call. With an identified minimum number of responders for each call, a total number of paramedics on staff could then be calculated to determine the necessary staffing levels to achieve this concentration.

Another issue related to the number of ALS providers employed by the organization was specifically budget related. A significant monetary incentive is offered by contract with the employee bargaining unit for employees with paramedic licensure. With no end-point established, the District could conceivably be paying for more Paramedics than is necessary to accomplish its mission, possibly slighting another budget line item of resources and endangering the mission in another area. Even with the discontinuation of the requirement for all new employees to become Paramedics, a ceiling for the number of ALS providers necessary to

provide the best care is yet to be established. This research attempts to help address a responsibility echoed by the United States Fire Administration second strategic goal to "improve local planning and preparedness" by determining how best to distribute available resources for the best possible protection of constituents.

One possible solution to the staffing question would be to simply comply with the NFPA 1710 and AHA Guidelines 2000 suggestion that every ALS call must be handled by at least two ALS providers and two BLS providers. This solution however has more variables than are first apparent. It would be impossible to ensure a response dispatched as a BLS call in which the patient was initially "non-emergent" did not deteriorate to require ALS intervention. For this reason, to comply it would be necessary to ensure two ALS providers on every call. In the case of CJCFPD, simply requiring two ALS responders would affect contractually agreed upon issues, including station bid preference based on seniority. How would CJCFPD ensure a somewhat equal workload distribution so the same paramedics are not always, shift after shift, detailed to the ambulance and therefore possibly subjected to undue fatigue? Because of these variables and complications, it would be irresponsible to simply adopt NFPA 1710 as policy without determining its necessity and feasibility. In other words, CJCFPD must determine, before undertaking the major changes necessary to implement the staffing suggestion, if indeed it does comprise "best practice."

Another approach might be to use the "Community Risk-Reduction Model" presented in the Executive Analysis of Community Risk Reduction section of the Executive Fire Officer Program in attempt to reduce the overall demands on the current staffing structure, thereby presumably maintaining the high level of care already established at CJCFPD. (FEMA-NFA, 2011). Unfortunately, a Community Risk Reduction Strategy aimed specifically at reducing

emergency medical usage is beyond the scope of the current research. Determining the number of ALS providers necessary to deliver the safest and best care (best practice) falls more into the category of a secondary prevention strategy or "risk mitigation." The approach does address the first USFA strategic goal to "reduce risk at the local level through prevention and mitigation." The same Risk-Reduction Model however, can still be employed. The scope of the current research would include steps I (Getting Ready) and II (Assessing Community Risk). Future work in this area should attempt to complete the process identified by the model by developing intervention strategies (either encourage ALS certification or limit the number of allowable licenses), determining appropriate action (develop staffing plans to ensure best practice), then evaluating the results (track patient outcomes).

The community under analysis is obviously the one made up of the constituents of CJCFPD. Like many response agencies, CJCFPD's call and responsibility load is increasing, though not currently at the rapid pace of the past. According to the CJCFPD Firehouse Software database, over the last four years (2008-2011) (Table 1), the District has enjoyed stabilization in call load compared to the seven years previous (2001 – 2007), which saw rapidly increasing requests for assistance (Xerox Corporation and Affiliated Computer Services, Inc., 2011).

Table 1

Calls for Assistance by Year

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
5533	5766	5992	5760	6181	6195	6651	6682	6382	6513

***projected 2011 Calls for Assistance (calculated November 30, 2011) – 6430**

The District continues to grow in population (especially to the east) and with a greater number of constituents comes a predictable increase in call load. Total population within CJCFPD's area of responsibility according to the U. S. Census Bureau's American Factfinder, American Community Survey, 2005-2009 estimate was approximately 68,872 (U. S. Census Bureau). This data was gathered using census tracts within the District. The 2010 data indicated for the same census tracts, a total population of 71,583. Because one city falls partially outside of the District and some constituents are in unincorporated county, calculating an exact population was difficult, but by using the same census tracts in each search, a trend could be observed (U.S. Census Bureau). In addition, when examined by "place" in the Factfinder database, the city of Grain Valley, which lies on the eastern side of CJCFPD, has experienced a 35% population growth since the 2005 census estimates (9,510 in 2005, 12,858 in 2010). Blue Springs, the largest city within the District has shown a slight decrease (-3.8%) during the same periods (54,654 in 2005, 52,575 in 2010).

When evaluating potential future usage of CJCFPD's emergency medical services, it is necessary to identify those subgroups in the community that would most likely use the service and then to evaluate potential future vulnerabilities in those communities. Over the last four years, the heaviest users of CJCFPD EMS have predictably been the middle aged and older population of 55 years old and older. Data collected from the CJCFPD Image Trend Reporting system from the relatively stable call-load years of 2008-2011 (Table 2) reflect a significant concentration of calls for emergency medical service in these age groups (Image Trend, Inc., 2011)

Table 2

Patient Demographics

	% Age >55	% Age > 65	Total Patients all ages
2008	51.3	40	4840
2009	48.3	36.8	4789
2010	52.1	41.7	4856
2011	54.2	41.7	4606 (to Dec. 1)

Patients treated by CJCFPD EMS are 55 years or older more than 50% of the time, but according to the U.S. Census Factfinder, made up only 19.7% of the population of the District in the 2005-2009 estimate, and 21.2% in the 2010 census. The largest portion of this demographic is actually the 55-65 age range amounting to 12.7%.

According to an article appearing in the April 2011 issue of the Population Reference Bureau's "Population Bulletin", when evaluating the potential impact of the aging population to consider the numbers for policy and program decisions, but also their "… health, and disability status…" (Jacobsen, Kent, Lee, & Mather, 2011) should be considered. The article points out the oldest baby boomers, those born between 1946 and 1964, are beginning to turn 65 years old. The youngest of them then, are in their 50's. Nationwide, by some estimates, by the year 2030 a full 20 percent of the U. S. Population will be 65 and older. As CJCFPD plans for the future, it becomes even more imperative to establish a system of "best practice" before the demand on the EMS system begins to increase even more. The Jacobsen article discusses reasons beyond the "baby boom" for this large increase in the elderly population. "The improved ability to treat diseases and chronic conditions has increased the prevalence of most diseases in the elderly population." In addition, as assistive devices and home nursing care become more prevalent,

more disabled and elderly will be remaining in their homes later into life leading to further potential increases in calls for assistance and a higher potential patient acuity.

The Jacobsen article goes further in its analysis of the disability of an aging America. While disability trends in the 80 and above age group have been decreasing, trends among the middle aged (50 to 64) and the "young old" (60-69) are increasing, identifying specifically diabetes and depression as significant causes for disability in the middle-aged group. For CJCFPD, the potential is for an even greater load on its EMS response system as "higher obesity and disability rates among younger baby boomers may signal future declines in the share of elderly who are healthy" (Jacobsen, Kent, Lee, & Mather, 2011).

As previously stated, CJCFPD has not determined nor made commitment to any existing standard related to the distribution of capability on EMS scenes. While NFPA 1710 and the American Heart Association suggest a minimum of two ALS responders and two BLS responders, there is limited data suggesting this arrangement is best practice. Currently, CJCFPD has settled on a minimum number of Paramedics considered "necessary" based purely on what was sufficient in the past, not based on any reasoned evaluation of potential need focused on community analysis and the increasing vulnerabilities in the population it serves. Before the call volume increases, it is imperative the District determine how many (or how few) ALS providers are needed to achieve its mission of providing the best possible care of its constituents. Even should the circumstance occur that CJCFPD's call volume remains near its current level, the factors pointing toward a greater proportion of serious calls secondary to the 55 and older demographic health status and complicating chronic illnesses make the determination of best practice in patient care even more necessary.

Literature Review

As has been well documented in a variety of previous studies, NFPA 1710 has had substantial impact on the Fire Service across the country. With its initial issuance in 2001, career fire service entities at last had guidance from an authoritative source detailing a standard, widely accepted approach to a variety of response and service issues. The component garnering the most attention initially was section 5.2.2.1.1 which stated clearly, "These companies [Engine Companies] shall be staffed with a minimum of four on-duty personnel" (National Fire Protection Association, 2010). Taken frequently out of the context of the standard, this single statement nonetheless sent Fire Chiefs rushing to Fire Boards and city managers, labor unions rushing to negotiations, and most of the profession rushing to judge the standard was not reasonable. There was no scientific support at the time that indicated a four-person engine company was better suited to the fireground than an apparatus with three firefighters onboard.

In April of 2010, the National Institute of Standards and Technology (NIST) released the results of a study seeking to quantify the difference and possible advantage of a four-person crew over a three-person crew. While it is empirically logical that more firefighters would perform tasks more quickly and lend to overall fire scene safety, the Report on Residential Fireground Field Experiments proved the value of larger crew sizes through experimentation. Four-person crews were able to begin extinguishing fire more quickly (6 percent faster than a three person crew, 15 percent faster than and two person crew), thereby enhancing the ability of personnel to save more property and operate in a safer environment (National Institute of Standards and Technology, 2010).

Though the NIST study has been pivotal in validating the fire scene components of the standard, little attention had been paid to the EMS crew size suggestion contained in NFPA

1710, section 5.3.3.4.4 indicating that "Personnel deployed to ALS emergency responses shall include a minimum of two members trained at the emergency medical technician-paramedic level and two members trained at the emergency medical technician basic level…" (National Fire Protection Association, 2010).

In August of 2010, an ARP submitted by this researcher to the National Fire Academy Executive Fire Officer Program for the Executive Analysis section attempted to evaluate the NFPA 1710 staffing suggestion for ALS responses. Using questionnaires submitted to EMS education professionals and policy makers, skill completion benchmark times (the point at which a given skill should be completed during the course of a call) were established for all skills likely to be performed on an ALS scene. Once completion benchmark times were determined, a second questionnaire was distributed with over 40 respondents, and perceived skill completion times (the amount of time required to set up and complete the skill) were collected and averaged to the nearest 5-second interval. Calls were then divided into call types based on categories contained in the Medical Priority Dispatch System. Call categories of "Charlie," "Delta," and "Echo" are the most acute of call types designated by this system. Skills to be performed were then grouped under each call type, resulting in a list of skills likely to be performed in each acuity group. Using the skill completion benchmarks and the perceived skill completion times, required rescuer time (RRT) was calculated for one, three, five and 10-minute benchmarks during the course of a Charlie, Delta, and Echo designated call. One of the findings of the research was that, on a call of high acuity (Delta, Charlie, or Echo), the RRT to perform all likely ALS interventions was greater than time allowed by skill completion benchmarks. Using the resulting study data, by way of example, during the first 300 seconds (five minutes) of a Delta triaged call in which the call details were "bee sting, patient becoming groggy, 37 years old, able

to speak only in 3 or 4 word sentences between breaths," a total of 830 seconds of RRT were necessary to complete all skills by the established benchmark times. Restated, the number of skills predicted to be necessary for the type of call described required almost three times as much time as was available at the five-minute benchmark.(Portz, 2010).

The Portz study found by simply calculating the amount of time necessary to perform skills and by comparing skill performance time to the time by which the interventions should be completed, more than one ALS provider was necessary on ALS calls. One of the limitations of this particular study however, was that the "skill completion times" were perceived durations, that is the length of time the group of questionnaire respondents believed the skill would require. No actual experimentation was performed to confirm the perceived completion times. Another limitation was that the study failed to account for simultaneous skill performance, assuming all intervention were performed in a linear fashion, that is the next skill not begun until the last was completed. Most ALS providers are adept at doing "several things at once," especially with a skilled BLS crew assisting. While the Paramedic cannulates the vein, the crew is getting intubation equipment ready for the next ALS intervention. Since many times the BLS crew is preparing equipment necessary for ALS skill performance independent of the ALS provider, a specific start and stop time reflecting the actual amount of time required of the ALS provider to execute the skill is difficult. Because of the limitations, conclusions in the Portz study were limited to observation of the frequency with which CJCFPD fails to provide two ALS responders to a call of higher acuity, thereby identifying the degree of noncompliance to the NFPA 1710 staffing recommendation.

According to NFPA 1710, the method by which agencies can evaluate their own compliance with appropriate fire ground staff was "through task analysis that took the following factors into consideration:"

(1) Life hazard to the populace protected
(2) Provisions of safe and effective fire-fighting performance conditions for the fire fighters.
(3) Potential property loss.
(4) Nature, configuration, hazards, and internal protection of the properties involved.
(5) Types of fireground tactics and evolutions employed as standard procedure, type of apparatus used, and results expected to be obtained at the fire scene. (NFPA, 2010)

The Portz study pointed out NFAP 1710 did insist the "EMS staffing requirements shall be based on the minimum levels needed to provide patient care and member safety," (Section 5.3.3.2.2) but did not provide a comparable list of considerations for an agency wishing to evaluate its own compliance. To address this gap, an analogous set of considerations for evaluating compliance with EMS staffing was suggested (Portz, 2010, p. 15). The list was refined for current research application:

(1) Life hazard to the populace protected
(2) Provisions of safe and effective emergency medical performance conditions for the EMS responders.
(3) Potential life loss or increased morbidity in relation to the potential patient.

(4) Nature, configuration, and hazards to the EMS responders.

(5) Types of skills and interventions employed as standard procedure, type of apparatus used and results expected to be obtained at the EMS scene.

Shortly after submission of the Portz study, in September 2010 the NIST released a study of experimental design comparable to the 2010 Report on Residential Fireground Field Experiments, though this time addressing the issue of EMS crew size. The study was intended to determine the effect of crew size and certification level distribution in three different specific areas: time-to-task for gaining access and removing the patient, time-to-task for a patient with multi-system trauma, and finally, time-to-task for the care of a patient with chest pain and cardiac arrest (National Institute of Standards and Technology, 2010). Like the fireground study, the EMS experiments measured the length of time required for the various crew configurations to complete critical tasks. In this case, however, the tasks were (in two parts of the study) related specifically to performance of ALS interventions. The study cites several sources stressing the importance of time critical interventions in the instance of defibrillation and treatment of traumatic brain injury and the importance of determining the best crew configuration that would minimize the time-to-task factors for these critical patients. In addition to the patient scenarios, an experiment was designed specifically around patient access and removal and focused more on general safety and efficiency of the EMS crew.

The findings of the study indicated that predictably, larger crews were more efficient in the patient access and removal scenario than were smaller crews. In fact, crews with first responders (in this case a three or four-person engine) completed removal by as much as 2.6 – 4.1 minutes faster than the ambulance crew alone. This finding supports the decision by CJCFPD administration to discontinue the practice of assigning a single ambulance with no fire

crew support to non-emergency (triaged "Alpha" by Medical Priority Dispatch) calls. It validates the determination by staff that responder safety is enhanced by providing more hands and "man-power" if only to facilitate safe removal of the patient from the scene.

In the critical patient scenarios, as a rule the crew composition found to be most efficient in regard to time-to-task measurements was the configuration consisting of one ALS provider on the first response engine, one ALS provider on the ambulance, and three or four BLS providers. The improvement in efficiency was merited to the likelihood of the ALS engine arriving first on the scene (per NFPA 1710 response time benchmarks) and the engine Paramedic beginning ALS interventions earlier.

The Report on EMS Field Experiments examined ALS provider placement, presuming two ALS providers were present. While it examined scenario and skill completion time, it did not measure individually the required ALS rescuer time for various skills. The study in fact addressed the question of where the second ALS provider should be assigned (to the ambulance or the engine) not whether or not a second ALS provider is warranted for ALS work likely to be performed on the scenarios constructed in the experiment.

One other issue noted by this researcher was that it was unclear if a "standard" performance of the skills being performed would have affected the results. While the study indicated, "A number of nationally recognized EMS experts were consulted during development of the scene EMS tasks" (National Institute of Standards and Technology, 2010, p. 21) and "…tasks were standardized by technical experts…" (National Institute of Standards and Technology, 2010, p.17), no indication regarding the degree of standard performance of skills is included. Were all skills presumed to have been performed correctly and successfully or was data eliminated due to non-standard performance? Since the focus of this study was on the

overall "team" times, individual performance times, though collected, did not appear to have been evaluated based on the amount of time necessary for the skill to actually be completed. Conclusions from this study addressed the ability of the entire EMS response crew to complete tasks necessary for each scenario, not the amount of ALS time actually required to perform the skill.

Literature Review Summary

While much attention has been paid to NFPA 1710 staffing recommendation for fire scene staffing, including the NIST Report on Residential Fireground Field Experiments, much less attention and study has involved the NFPA 1710 staffing recommendation for EMS scenes. A recent examination of the recommendation was from the National Institute of Standards and Technology in its Report on EMS Field Experiments published in 2010. The study found, among other conclusions that time-to-task measurements were substantially faster in the three scenarios examined: patient removal, multi-system trauma patient, and cardiac arrest where the distribution of ALS providers was one on the first response apparatus and one on the ambulance. Additionally, time-to-task improved when there were at least four responders on the call.

The NIST examination however, did not evaluate the necessity of more than one ALS provider on scene to help support the recommendation that the response team for each call should include at least two ALS providers and two BLS providers. Former work by this researcher attempted to examine this particular need. Since the recommendation in NFPA 1710 addressed only the cardiac arrest scenario, the 2010 study attempted to develop a model for analysis of all call types based on the Priority Medical Dispatch System. By adding together perceived completion times for call groupings, the research determined there existed more required rescuer time (RRT) to complete the necessary skills than was available to a single ALS provider. A weakness in this study was that the skill times were collected by

questionnaire and were simply the perception of how long the skill would take, as returned by respondents.

Procedures

Through experimentation and data evaluation, this research attempted to determine the amount of time required for a single ALS provider to perform ALS interventions during the course of an emergency call. The researcher was hopeful that in determining the amount of ALS time required for a single paramedic to perform necessary interventions and evaluating the value of a second ALS provider independent of skill performance, recommendation regarding the minimum number of ALS providers necessary on a critical scene could be made. This determination should help ensure CJCFPD is providing the best possible care to its constituents.

Using considerations adapted from this researcher's previous work and outlined in the Literature Review section, a task analysis for a number of skills to be tested was developed. The task analysis was limited to a group of interventions likely to be performed on a Delta triaged call (Portz, 2010). The task breakdown was created using National Registry of Emergency Medical Technicians skill testing sheets available online from the NAEMT website (National Registry of Emergency Medical Technicians, 2011) and CJCFPD Procedural protocols (Central Jackson County Fire Protection District, 2011). The interventions were examined, then scenarios requiring the identified skills were developed. The benchmark timeline for completion of skills during a Priority Delta triaged call from the 2010 Portz study is illustrated in Appendix A. The procedure identification reference chart with procedure names corresponding to the numbers in Appendix A is included in Appendix B.

The researcher recognized, given the limited resources available during experimentation and the extensive evaluation time likely required, not every intervention listed in Appendix B

would be performed, nor was it realistic the majority would be able to be evaluated. During the planning phase of this project, a total of fourteen different skills were identified as likely to be performed for a single scenario, not all of which could be completely evaluated. For this reason, five skills were selected from the Delta list in Appendix A. It was understood the results of the comparison to the perceived times for these skills determined in the 2010 study would serve as a sample for all procedures. The hope was, a conclusion in relation to how the perceived times compared to actual ALS required rescuer time (aRRT) could be made, then generalized for the larger list of procedures.

The five skills selected were intravenous access with line (procedure 26), manual defibrillation (procedure 17), oral endotracheal intubation (procedure 20), medication administration (procedure 35), and 12-lead acquisition and interpretation (procedure 1). A sixth procedure, Autopulse application, was selected for evaluation for overall crew performance. The Autopulse is non-invasive cardiac support pump designed to deliver continuous cardiac compressions and was developed by the Zoll Medical Corporation. With emphasis by the American Heart Association on quality, continuous cardiac compressions during cardiac arrest (American Heart Association, 2010), determining how quickly the Autopulse is deployed upon recognition of its need could be valuable to the CJCFPD EMS Education Division in coordinating future practical skill training.

When constructing the actual call scenario details, the researcher was cognizant of a recommendation from the 2010 Portz study. One of the issues related to constructing any experiment involving EMS interventions identified was that the critical component of call stress would be difficult to simulate. "In the case of the EMS scene, it is difficult to simulate an environment so convincing that call-level stress is elicited in the responder. The experiment

participant will invariably realize that no lives are truly at risk during the exercise," (Portz, 2010, p.37). In effort to create more than the normal degree of stress experienced by participants during a training session, the experiments were designed to include a large number of skills in a relatively short period of time. Though only a small group of interventions would be timed, by compressing skills back-to-back, the hope was a more realistic level of stress could be created. In addition, the simulations were to be performed in a small room (approximately 20 X 20 feet) thereby adding an additional component of stress.

The scenarios selected were:

1. Hypoglycemic patient experiencing seizure. The patient condition deteriorates to cardiac arrest.
2. Acute coronary syndrome patient/Congestive heart failure with concurrent acute myocardial infarction.
3. Multi-systems trauma patient, tension pneumothorax, patient fully accessible by EMS.

In choosing these scenarios, it was hoped that not only would a number of less frequently performed procedures be introduced into the study, but in addition, several interventions would be present in all three scenarios providing a larger sampling for data collection. Once appropriate patient presentations for the scenarios and specific skills to be tested were identified, a proposal to conduct the experiment was presented to the CJCFPD Administration in September of 2011 (Appendix C).

In the proposal made to CJCFPD Administration, the researcher would conduct monthly EMS continuing education training (EMS CEU) for the month of November 2011 with the permission of the Chief of EMS Education. The training would consist of practical performance

of a group of EMS skills submitted to Administration for approval. Each ALS provider would perform three scenarios (also submitted to staff) with the assistance of a BLS crew. Each evolution of a scenario would be videotaped for later evaluation and data gathering.

The EMS CEU's were to be presented on three consecutive Tuesdays in the month of November (regular CEU days), one for each shift, A, B, and C. The location of the experiment would be the simulation room at the CJCFPD Training and Maintenance Facility. If, on a given crew, two Paramedics were present during the experiment, the second would act as a skilled BLS provider. The same crew would perform an additional evolution with the second ALS provider as lead. The training would be conducted on duty and the researcher would coordinate with the Duty Chief of the day to rotate station crews through the training site. The experiment groups would consist of five personnel, four BLS and one ALS. For stations staffed with only four personnel on the day of the experiment, the researcher would act as the fifth crewmember.

In October of 2011, after working through administrative details with the Assistant Chief of EMS Education, the Assistant Chief of EMS Operations, and the Deputy Chief of Operations and Training, a "practical skills review" manual was distributed to each of five stations in the District (Appendix D). District-wide emails were sent detailing the intentions of the study and containing a request that personnel refresh Company Level Training by reviewing the skill sequences provided in the manuals. The decision was made by the researcher not to share with test crews which procedures were being timed. The researcher feared the knowledge might cause the participants to focus on performance of the timed skills only and neglect the others, possibly introducing additional variables into the experiment. The test crews were informed that to be eligible to be included in the study, each skill must be performed with a 90 percent adherence to the steps noted in practical skill review manuals. The goal was for crews to run the

scenarios just as if they were an actual call. Equipment would be provided to allow them to actually set up a bag of IV fluid with administration set and start the IV (on a manikin arm). Crews were expected to place ECG electrodes on the simulation manikin and acquire and interpret a 12 – Lead ECG. Airways were expected to be measured and placed and the Autopulse was expected to be deployed and put in use. In short, any skill the crew felt the scenario required was expected to be actually performed. During the initial stages of preparation, the researcher experienced some pushback from individuals. The fear was that inaccurate performance of skills, because the sessions would be videotaped, would be accessible to the Administration and might result in some sort of disciplinary action. After consulting with Administration it was determined participation in the experiments would not be required if an individual had a fundamental objection.

As the training dates approached, spot checks consisting of encouragement and reassurance were conducted by the researcher with ten of the participating fifteen crews. These contacts were an attempt to clarify the purpose of the experiment. During the final steps of preparation, in response to feedback from the test crews and in the interests of keeping the training sessions a reasonable duration and to reduce the usage of disposable supplies, the trauma scenario (Scenario 3) was eliminated from the experiment. The researcher also faced the possibility of not having actual equipment available to execute the experiment, specifically disposables. Ultimately, CJCFPD provided expired IV solutions and all other training aids and International Association of Firefighters, Local 3133 (the recognized bargaining unit for the labor force) provided funding for IV catheters.

During the course of the three training days, a total of six training sessions were conducted. Prior to engaging in the scenarios, the crews were coached once more by the

researcher. The skill performance points were reviewed and the scripts for the scenarios were discussed. Participants were reminded that all skills would considered to have been performed successfully. The researcher was unable to secure the portable equipment bags typically used by the crews so all necessary equipment was laid out in the simulation area in open bags and the participants were encouraged to familiarize themselves with equipment location prior to the start of the scenarios.

During the experiment, the researcher led the scenario by providing key patient status changes at specific points during performance. Patient status changed only after an intervention was completed. For instance, the participants were not informed of the possibility of the patient's airway being threatened until the IV skill was complete. The patient did not become pulseless until the intubation intervention was complete. With these key patient status changes, the researcher was able to control the flow of the scenario and limit variable performance. In effect, no critical decision making was necessary for participants as the sequence of expected performances was laid out in detail prior to the scenarios and led by the researcher during the performances further reducing the likelihood of variables.

A total of approximately ten hours of videotaped experiments were captured over the six training sessions. Scenario 1 was performed 25 times and Scenario 2 performed 23 times for a total of 48 evolutions, with two performances of each scenario completely eliminated due to interruption by emergency calls (crews were attending on-duty) and non-standard performance. 44 evolutions were used for data collection. There were instances due to time constraints when multiple paramedics on duty the day of the sessions were not able to complete both scenarios, though every ALS provider attending the training performed in at least one evolution.

In effort to assure standardization of individual skill performance, the researcher developed a checklist to utilize during video review. The skill performance steps detailed in the skill performance review manuals were pared down to a smaller number of critical steps (Table 3). A similar tool was used for data collection while evaluating Scenario #2 performances. At least 90 percent of the performance steps listed on the data collection tool had to be either observable on the recorded video or stated as consideration by the ALS provider acting as lead responder for the skill performance to be included in the data. In some cases, a number of the steps were completed by BLS crews during preparation.

Table 3

Scenario #1 Data Collection Tool

Scenario #1	1	2	3	4	5	6	7	8	9	10	11
IV Start											
Check IV Fluid for right fluid											
Check IV Fluid for right clarity											
Check IV Fluid for right date											
Select Catheter											
Select Admin Set											
Connect tubing to bag											
Prepare admin set											
Prepare tape/veniguard											
BSI											
Apply Tourniquet											
Palpate vein											
Cleanse											
Insert stylette											
Note Flashback											
Occlude vein											
Connect tubing to bag											
Dispose sharp											
Release tourniquet											
Run IV											

Secure Catheter											
Adjust flow											
TIME											
Med Admin											
Allergies											
Correct Med											
Assure correct concentration											
Assemble prefilled											
Notes BSI or continues											
Identifes and cleans injection											
Reaffirms medication											
Stops IV flow											
Admin											
Disposes Sharp											
Adjusts drip rate											
Observes patient											
TIME											
Autopulse											
Consider indications											
BSI											
Place patient in seated/upright											
cut clothing if necessary											
Place autopulse											
Lay both down											
Place CPR start Padz											
Turn Autopulse on											
Connect Life band											
Lift band, then lay on patient											
push green button to start											
push green button again											
secure head											
secure torso											
TIME											
Defibrillation											
Apply CPR Start Padz											
Defibrillate at 120J											

Begin Autopulse											
Insert OPA											
Pause at 2 minutes											
Evaluate rhythm											
restart autopulse											
Shock if indicated											
TIME											
Endotracheal intubation											
Consider appropriateness											
Ensure ventilation with BVM											
Gather and test equipment											
suction as appropriate											
Position at head of patient											
Discontinue BVM and OPA											
Position head to sniffing											
Place blade appropriately											
Insert ET tube											
Advance											
Inflate											
Verify											
TIME											
12-Lead and Interp											
Evaluate need for 12-lead											
Place Electrodes											
Attach Cables											
Ensure in Monitor mode											
Enter Patient info											
Ensure patient still											
Aquire											
Interprate											
TIME											

The object of the experiment was ultimately to determine how much ALS provider time was spent on the five specified skills. To ensure the time measurement was as accurate and

realistic as possible, actual required rescuer time (aRRT) for a given intervention was only attributed to the ALS provider if he or she was engaged in the skill or waiting for the skill to be set up by the BLS crew and doing nothing else. For instance, if the provider was performing an intravenous cannulation and in the mean time, his or her crew had placed ECG patches on the patient, connected electrodes, entered patient information, and ran the 12-Lead, the only portion of the actual skill performance attributed to the Paramedic was the time necessary to interpret the tracing. If however, the Paramedic requested the 12-Lead, assisted in setting it up, and waited for the strip to be printed, performing no other skill during course of acquisition and setup, the entire time period, from recognition of need to final interpretation was attributed to the ALS provider as RRT.

During the course of the 2010 Portz study, a variation in perceived skill completion times was noted by the researcher and seemed to be associated with the amount of ALS experience of the ALS provider. To further exam this phenomenon, the actual skill performance times were split into two groups, those with five or more years ALS experience, and those with less than five years. Referring to the chart reprinted from the 2010 study in Appendix E, the respondents with less than five years experience, in four out of the five skills perceived a substantially shorter setup and performance time. During the course of data evaluation for this research, the times were also compared to each experience group's perceived performance times.

A component of this project that has continued to be difficult to quantify is related to the concept of "shared call-stress." As a practicing Paramedic, the researcher attempted in the 2010 study and in the current study to help quantify a feeling experienced by Paramedics during a call that is difficult to explain in scientific terms. The researcher wanted to know if other Paramedics found value in the presence of a second (or multiple) ALS provider on calls, even if the

additional provider did not help with skill performance. As a result of the Recommendation section of the 2010 study, CJCFPD added a field to its Image Trend electronic patient care report (ePCR) reading the following: "Did more than one ALS provider assist in determining the final differential diagnosis?" The question was added as an "optional" field in the electronic report and required the respondent to select "Yes" or "No" from a drop-down menu. Were no selection was chosen, the response field remained blank. Data from this field was collected for a six month time period and divided into the three response possibilities (yes, no, and blank). The field was intended to help quantify the value of multiple ALS providers independent of skill sharing. The presumption by the researcher for this data was, if the ALS provider filling out the ePCR answered "Yes," to the optional question and the procedure fields of the report reflected only one ALS provider, the Paramedic filling out the report found value in the presence of the second provider beyond the actual sharing of skills. The concept of shared call stress will be addressed further in the Discussion section of this project.

Results

The two described scenarios were conducted and videotaped, then analyzed using the procedures described in the previous section. Over the course of the 44 usable scenario evolutions, procedures 1 (12-Lead), and 26 (IV Start) were performed in all evolutions, the results of which are illustrated in Tables 4 and 5.

Table 4

Scenario Data - 12 Lead and Interpretation (all)
(timer started on recognition of need)

Evolution ID	% Compliant with protocol points	Time to perform (sec)	Years ALS Experience
11081016	8 of 8 (100%)	85	5+
11081037	8 of 8 (100%)	53	5+
11081101	8 of 8 (100%)	52	5+
11081110	8 of 8 (100%)	96	5+
11081121	8 of 8 (100%)	61	5+
11081136	8 of 8 (100%)	97	5+
11081226	8 of 8 (100%)	122	5+
11081324	8 of 8 (100%)	68	-5
11081437	8 of 8 (100%)	78	-5
11081450	8 of 8 (100%)	66	-5
11081510	Variable	N/A	-5
11081520	8 of 8 (100%)	57	-5
11081545	6 of 8 (75%)	N/A	-5
11081601	8 of 8 (100%)	107	-5
11151035	8 of 8 (100%)	72	5+
11151057	8 of 8 (100%)	50	5+
11151127	Variable	N/A	5+
11151212	8 of 8 (100%)	50	5+
11151229	8 of 8 (100%)	61	5+
11151240	Variable	N/A	5+
11151331	8 of 8 (100%)	76	5+
11151415	Variable	N/A	5+
11151438	8 of 8 (100%)	115	5+
11151459	8 of 8 (100%)	52	5+
11151508	8 of 8 (100%)	53	5+
11151532	8 of 8 (100%)	100	5+
11151604	8 of 8 (100%)	81	-5
11151624	Variable	N/A	5+
11151637	8 of 8 (100%)	144	5+
11221040	Variable	N/A	5+
11221058	Variable	N/A	5+
11221116	8 of 8 (100%)	96	5+
11221130	8 of 8 (100%)	60	5+
11221207	8 of 8 (100%)	69	-5
11221227	8 of 8 (100%)	74	5+

11221243	Variable	N/A	5+
11221351	8 of 8 (100%)	100	5-
11221458	8 of 8 (100%)	110	5+
11221516	8 of 8 (100%)	110	5+
11221542	Variable	N/A	5+
11221559	Variable	N/A	5+
11221612	8 of 8 (100%)	120	5+
11221625	Variable	N/A	5+
11221644	Variable	N/A	5+
Total Average:		**82**	
Total 5+ Average:		**83**	
Total 5- Average:		**78**	

Table 5

Scenario Data - IV (timer started on recognition of need)

Evolution ID	% Compliant with protocol points	Time to perform (sec)	Time Completed from start	Year ALS Experience
11081016	22 of 22 (100%)	97	123	5+
11081037	22 of 22 (100%)	70	117	5+
11081101	22 of 22 (100%)	52	135	5+
11081110	22 of 22 (100%)	47	151	5+
11081121	22 of 22 (100%)	65	148	5+
11081136	22 of 22 (100%)	81	121	5+
11081226	22 of 22 (100%)	68	148	5+
11081424	20 of 22 (91%)	100	143	5-
11081437	22 of 22 (100%)	102	186	5-
11081450	21 of 22 (95%)	107	177	5-
11081510	22 of 22 (100%)	65	165	5-
11081520	22 of 22 (100%)	80	244	5-
11081545	22 of 22 (100%)	121	201	5-
11081601	22 of 22 (100%)	64	200	5-
11151035	21 of 22 (95%)	113	173	5+
11151057	21 of 22 (95%)	117	194	5+
11151127	21 of 22 (95%)	107	239	5+

11151212	21 of 22 (95%)	86	108	5+
11151229	22 of 22 (100%)	102	158	5+
11151250	22 of 22 (100%)	88	117	5+
11151415	21 of 22 (95%)	100	157	5+
11151438	22 of 22 (100%)	86	182	5+
11151459	22 of 22 (100%)	62	238	5+
11151508	22 of 22 (100%)	98	222	5+
11151532	21 of 22 (95%)	127	227	5+
11151604	22 of 22 (100%)	112	129	5-
11151624	22 of 22 (100%)	67	167	5+
11151637	22 of 22 (100%)	66	303	5+
11221040	22 of 22 (100%)	95	157	5+
11221058	22 of 22 (100%)	90	129	5+
11221116	22 of 22 (100%)	102	209	5+
11221130	22 of 22 (100%)	62	223	5+
11221207	21 of 22 (95%)	101	179	5-
11221227	22 of 22 (100%)	62	187	5+
11221243	22 of 22 (100%)	66	190	5+
11221351	22 of 22 (100%)	91	165	5-
11221458	22 of 22 (100%)	85	125	5+
11221516	22 of 22 (100%)	88	138	5+
11221542	22 of 22 (100%)	84	131	5+
11221559	22 of 22 (100%)	91	136	5+
11221612	22 of 22 (100%)	125	269	5+
11221625	22 of 22 (100%)	102	183	5+
11221644	22 of 22 (100%)	71	217	5+

Total Average (seconds):	**88**	
Total 5+ Average (seconds):	**86**	
Total 5- Average (seconds):	**92**	
Average call time until complete:		**175**
Average call time until complete 5+:		**172**
Average call time until complete 5-:		**179**

Over the 44 usable scenario evolutions, procedures 17 (Manual Defibrillation), 20 (Oral Endotracheal Intubation), and 35 (Medication Administration) were performed 23 times. The

results of the analysis are presented in Tables 6, 7, and 8. The volume chosen for procedure 35 (Medication Administration) during the course of the scenario was 50 ml.

Table 6

Scenario Data - Manual Defibrillation
(timer started on recognition of need)

Evolution ID	% Compliant with protocol points	Time to perform (sec)	Years ALS Experience
11081016	8 of 8 (100%)	18	5+
11081037	8 of 8 (100%)	14	5+
11081136	8 of 8 (100%)	15	5+
11081324	8 of 8 (100%)	50	5-
11081437	8 of 8 (100%)	27	5-
11081450	8 of 8 (100%)	33	5-
11081545	8 of 8 (100%)	16	5-
11151035	8 of 8 (100%)	16	5+
11151057	8 of 8 (100%)	12	5+
11151531	8 of 8 (100%)	22	5+
11151212	8 of 8 (100%)	20	5+
11151415	8 of 8 (100%)	36	5+
11151438	8 of 8 (100%)	22	5+
11151532	Variable	N/A	5+
11151604	8 of 8 (100%)	53	5+
11221040	Variable	N/A	5+
11221058	8 of 8 (100%)	32	5+
11221207	8 of 8 (100%)	48	5-
11221227	8 of 8 (100%)	30	5+
11221458	8 of 8 (100%)	37	5+
11221542	8 of 8 (100%)	37	5+
11221559	8 of 8 (100%)	28	5+
11221644	Variable	N/A	5+
Total Average (seconds):		**28**	
Total 5+ Average (seconds):		**26**	
Total 5- Average (seconds):		**35**	

Table 7

Scenario Data - Endotracheal Intubation
(timer started on recognition of need)

Evolution ID	% Compliant with protocol points	Time to perform (sec)	Years ALS Experience
11081016	12 of 12 (100%)	131	5+
11081037	12 of 12 (100%)	97	5+
11081136	12 of 12 (100%)	104	5+
11081324	12 of 12 (100%)	111	5-
11081437	12 of 12 (100%)	174	5-
11081450	12 of 12 (100%)	136	5-
11081545	11 of 12 (92%)	113	5-
11151035	12 of 12 (100%)	121	5+
11151057	12 of 12 (100%)	125	5+
11151531	12 of 12 (100%)	118	5+
11151212	12 of 12 (100%)	109	5+
11151415	11 of 12 (92%)	103	5+
11151438	12 of 12 (100%)	118	5+
11151532	Variable	N/A	5+
11151604	12 of 12 (100%)	127	5+
11221040	12 of 12 (100%)	125	5+
11221058	12 of 12 (100%)	113	5+
11221207	12 of 12 (100%)	133	5-
11221227	12 of 12 (100%)	70	5+
11221458	12 of 12 (100%)	109	5+
11221542	12 of 12 (100%)	111	5+
11221559	12 of 12 (100%)	87	5+
11221644	12 of 12 (100%)	126	5+
Total Average (seconds):		**116**	
Total 5+ Average (seconds):		**111**	
Total 5- Average (seconds):		**133**	

Table 8

Scenario Data - Medication Administration (50 ml)
(timer started on recognition of need)

Evolution ID	% Compliant with protocol points	Time to perform (sec)	Years ALS Experience
11081016	12 of 12 (100%)	104	5+
11081037	12 of 12 (100%)	23	5+
11081136	12 of 12 (100%)	23	5+
11081324	12 of 12 (100%)	20	5-
11081437	12 of 12 (100%)	36	5-
11081450	12 of 12 (100%)	37	5-
11081545	11 of 12 (92%)	28	5-
11151035	12 of 12 (100%)	45	5+
11151057	12 of 12 (100%)	37	5+
11151531	12 of 12 (100%)	42	5+
11151212	Variable	N/A	5+
11151415	12 of 12 (100%)	109	5+
11151438	12 of 12 (100%)	26	5+
11151532	12 of 12 (100%)	54	5+
11151604	12 of 12 (100%)	38	5+
11221040	12 of 12 (100%)	36	5+
11221058	12 of 12 (100%)	37	5+
11221207	12 of 12 (100%)	58	5-
11221227	12 of 12 (100%)	38	5+
11221458	12 of 12 (100%)	50	5+
11221542	12 of 12 (100%)	49	5+
11221559	12 of 12 (100%)	33	5+
11221644	12 of 12 (100%)	52	5+
Total Average (seconds):		**44**	
Total 5+ Average (seconds):		**46**	
Total 5- Average (seconds):		**36**	

Table 9 is an illustration of the actual required rescuer time (aRRT) for all five procedures collected in the current study and the data from the 2010 study reflecting the

perceived required rescuer time (pRRT), displayed side-by-side for ease of comparison. There is no column on the chart for "pRRT total" because in the 2010 study, the perceptions of the experienced ALS providers were used for recommendations and the less experienced providers' perceptions were recorded but not averaged with the former figure. Also, it should be noted the pRRT from the 2010 study was rounded to the nearest 5-second interval for each procedure. During the Discussion section of the current research, the numbers will be compared using the same process.

Table 9

aRRT Compared to pRRT (in seconds)

Procedure	aRRT total	aRRT 5+	aRRT -5	pRRT 5+	pRRT -5
12-Lead (1)	82	83	78	170	130
Defibrillation (17)	28	26	35	70	90
Intubation (20)	116	111	133	140	110
IV (26)	88	86	92	160	90
Med Admin (35)	44	46	36	90	90

As illustrated in the Table 9, the aRRT is less than the pRRT in every instance. In comparing the "total" columns, for procedure 1, aRRT is 48.2 percent of pRRT. The remaining procedures are 40 percent, 82.9 percent, 55 percent, and 48.9 percent of corresponding pRRT respectively. To generalize, (with exception of procedure 20, Intubation), the actual required rescuer time for the procedures performed during experimentation took approximately half the time ALS providers predicted would be required in the 2010 study.

An additional observation is that in the five timed scenarios, the experienced ALS provider executed the skill more quickly than did the provider with less than five years experience in all save procedure 1, 12 Lead acquisition and interpretation.

In regard to procedure 35 (Autopulse), a total of 23 evolutions including performance of Autopulse application were recorded and 21 of the 23 performances were considered "valid" by the researcher complying to at least 90 percent of the skill performance steps laid out in the task analysis. The average time, from recognition of the need for the device to the point when the device is applied properly and the first compression delivered was 79 seconds.

As noted in the Procedures section, a question was added by CJCFPD Administration to the Image Trend ePCR in response to recommendation from the 2010 Portz study. Data was gathered from the CJCFPD Image Trend database from the dates of June 1, 2011 through November 30, 2011. There were 2,007 total opportunities for the provider filling out the ePCR to answer the question "Did more than one ALS provider assist in determining the final differential diagnosis?" A total of 1,416 responses were entered with 591 instances left blank. The 1,416 reports in which the question was answered were sorted individually by the researcher in order to triage the call priority. Of the 1,416 responses, 413 calls could definitely be triaged into a Delta or Echo call category of the Priority Medical Dispatch System based on interventions performed and documented by the provider completing the report, and the provider answered "Yes" to the question. Of the 413 "Yes" answers in this group of calls, 192 instances (46.5 percent) had only the paramedic completing the report listed as having performed ALS interventions. In 221 calls of the "Yes" group (53.5 percent), more than one ALS provider was documented as having performed ALS procedures. So 46.5 percent of the time, when more than one ALS provider was present on the scene, value was attached to the presence of that additional provider by the Paramedic completing the documentation (the lead Paramedic) independent of any skills performed.

Discussion

As discussed in the Background and Significance section, while calls for assistance to CJCFPD EMS over the last four years have appeared to stabilize, predictable increases in calls and call acuity, especially in the 55 year and older demographic are on the horizon. The importance of scientifically examining the service components now is a critical step in planning for future increases. The question yet to be answered revolves around the issue of the number of ALS providers necessary to provide the safest and best care, or the number of ALS providers necessary to meet "best practice."

In the Results section of this project, the last data set presented related to a quality issue, that of multiple providers sharing call stress. In the 2010 Portz study, a smaller sampling (102 calls of Charlie, Delta or Echo acuity designation) was collected by way of an additional questionnaire. In that study, 44.8 percent of the "Yes" responses reflected only one ALS provider performing skills. Using the CJCFPD Image Trend ePCR, a larger sample of higher acuity was gathered (Delta and Echo) during the current research. In the larger sample, the percentage of instances when a second provider assisted in differential diagnosis determination and did not perform skills compared very closely to the 2010 data (44.8 percent vs 46.5 percent). The necessary presumption is, if the primary ALS provider found value in the presence of a second ALS provider independent of skill performance (46.5 percent of the time), the stress of critical decision-making and primary call stress was shared between the multiple Paramedics. The effects of stress on the decision making process and responder efficiency and the quantitative advantage gained by reducing the primary call stress on the lead ALS provider is beyond the scope of the current project. However, the collected data does allow a qualitative

discussion based on empirical information regarding the probable effects of increased stress on a single provider.

Physiologic stress response has been well documented. The body's initial response is to stimulate the Sympathetic Nervous System, resulting in the release of several hormones (including norepinepherine and epinephrine), and increases in heart rate, cardiac output, peripheral vascular resistance, and blood pressure, all to deliver a larger quantity of oxygenated blood to skeletal muscle and the brain (Bledsoe, Porter, & Cherry, 2009). The psychological response in the emergency situation however, differs from person to person:

> "…an individual's response (subjective or psychological) to demands that threaten an important goal is highly dependent on that individual's perception of the demands and of his or her resources available to meet those demands. Any factor that increases the perceived demands of a task or decreases the perceived resources to meet those demands increases the likelihood of a distress response" (LeBlance, 2009).

The body's response to acute stress is intended to allow mitigation of the immediate threat, so in this sense, call stress is a good thing. Unfortunately, depending upon the individual's ability to address the stressor, a Sympathetic response could potentially turn into "distress" during which there is little ability to address the emergent situation. Using the terms from the LeBlance quote, additional ALS providers on scene may be viewed as "factor(s)" that increase the perceived resources to meet the demands of the threat. While no number can be placed to quantify this "increase in perceived resources" to the individual, additional ALS

providers can qualitatively affect the primary care provider's ability to make critical decisions. Again, one cannot determine using purely the results of the current research how often or how many times, multiple paramedics have a positive impact in critical thinking. One can only suggest additional ALS providers are likely to have a positive impact, therefore positively affect critical calls independent of skill sharing.

It was the researcher's original intention to gather actual skill performance data both during the experiment and during actual calls. After several shifts of attempting to remain uninvolved in emergency calls to facilitate timing skills, it was apparent to the researcher actual emergency calls would not be a reliable source for data. It was invariably necessary to assist in patient care on serious calls. During non-emergent calls, few skills were performed so data was difficult to come by. Ultimately, this portion of the data collection plan was abandoned after having collected little to no usable information during the course of five shifts.

As noted in the Results section, the aRRT was roughly half of the pRRT from the 2010 study. Rounding the aRRT to the "nearest 5-second interval" as was the pRRT, the results can still be generalized as aRRT = ½ pRRT. If this generalization is applied to the entire list of interventions in Appendix E, a comparison to the example used in the 2010 study can be made that might reflect a more accurate representation of time required by the single ALS provider. From the previous study, the call details were "bee sting, patient becoming groggy, 37 years old, able to speak only in 3 or 4 word sentences between breaths." Using the Priority Medical Dispatch System, this call would be triaged as a Delta Priority. Referring to the Priority Delta Call Procedure List in Appendix A, interventions required to be performed within the first 300 seconds (five minutes) took 830 seconds (13 minutes, 50 seconds) of pRRT. Using the finding of the current research, interventions within the first 300 seconds would take roughly 415

seconds of aRRT. Jumping to ten minutes in the call, a total of 22 minutes and 50 seconds of pRRT was predicted. Again, using the same generalization, a total aRRT of 11 minutes and 25 seconds is calculated.

To evaluate any conclusion concerning the need for more than one ALS provider on a critical EMS scene, the circumstances of the experiment must first be reviewed. Each procedure was assumed completed successfully, critical decision making was minimal, equipment was arranged to be easily accessible, the test crews knew what type of call to expect and what would happen, the environment was comfortable and safe, and any simulated bystanders were helpful in providing history if asked. In addition, every evolution had more than one ALS provider present. Given these circumstances, the aRRT for each timed skill was obtained under the best possible circumstances. The aRRT would have to time out at a mere 37 percent of the pRRT for there to be sufficient time for the single provider to perform the required ALS interventions by the established completion benchmarks during a Delta or Echo triaged call. Even had the results of the experiment shown the tasks could be completed at or within the benchmark timeline, during emergency scene performance the added variables of difficult airways, tough IV's, scene complications related to the environment or difficult witnesses would all increase ALS responder attention time.

An interesting result of the experiments in comparing completion times of providers with five or greater years ALS experience to those with less than five years experience was related to the types of skills at which each group excelled. While the difference might be considered minimal, it was interesting to the researcher that the four timed skills that could be considered as "long standing" standards of care (IV, Intubation, Med Admin, and Manual Defibrillation), the experienced Paramedic performed faster. In the one instance where a fairly new skill (12-Lead)

was timed, the newer ALS providers completed the intervention more efficiently. Whether this was a function of the crews each provider was testing with or a familiarity and acceptance of the particular skill is difficult to say. The biggest difference between the two experience groups in seconds was for the skill of oral endotracheal intubation with the experience group completing the skill on average 22 seconds faster (16 percent faster) than the less experienced group. The largest difference in percentage between the groups was in manual defibrillation, which the more experienced group completed 26 percent faster (9 seconds). One possibility for this difference was observed by the researcher during the experiments. As a rule, the providers with more experience tended to place the multi-function pads (or direct them to be placed) earlier than did the less experienced groups. This "preemptive" placement reduced the amount of time between recognition of need and delivery of shock.

Because the problems identified and addressed in this study relate specifically to the number of Paramedics CJCFPD needs, little attention has been paid in this project to the "2 BLS provider" component of NFPA 1710. This requirement is met with a standard response at CJCFPD as pointed out in the Background and Significance section. During the course of experimentation, the researcher noted the high quality of BLS responders and the efficiency with which the BLS members of the test crews assisted the loan ALS provider. One reason, in the researcher's opinion, the differences between the more experienced providers and the less experienced providers were so small was because of the skill and efficiency with which the BLS members predicted the next ALS intervention and typically had equipment ready. While the study has focused on the physiological comfort of having multiple Paramedics on a critical scene, the resource represented by an experienced and aggressive BLS crew should not be underestimated.

Finally, to the point of efficiency with the Autopulse, few conclusions can be derived from the performance times. There were instances during which complications in the deployment of the Autopulse occurred, but without a baseline with which to compare, a comment about the efficiency with which the device was deployed would be premature. An average deployment and activation time of 79 seconds once the need for the device was recognized could serve as that baseline from which the EMS and EMS Education Divisions can improve with repeated drills and training.

While the researcher planned and worked hard to eliminate as many variables in this process as possible, several weaknesses should be pointed out. First, where judgment was necessary to start or stop time, or to add time to one skill and remove from another based on the direction of the ALS provider's attention was determined by a single observer. The analysis process was admittedly very difficult to complete because skills, in some instances, were happening simultaneously and in sections and had to be divided and combined in the proper category. Deciding what exactly qualified as ALS skill time was also complicated. In general, if the Paramedic was waiting for the BLS crew to complete a task before he or she began the next, that time was logged as ALS provider time. Additional camera angles would have made this process much easier though only one was used for the experiments. Additional evaluators would also have been advantageous to gain more than the researcher's opinion.

Another weakness relates specifically to the numbers. Because the 2010 study used straight averages to determine pRRT, the same processes were used for the current study. While such a simplistic approach may not yield the breadth of statistical detail a more extensive analysis would, some conclusions and recommendation can be comfortably made. The results of this study would however, benefit greatly by a more in-depth statistical evaluation.

Recommendations

After the 2010 study completed by this researcher, the only observation the researcher could make related to the number of ALS providers on CJCFPD ALS calls was that at the time, CJCFPD did not comply with the NFPA staffing recommendation of two ALS providers on every critical call. This observation was made after hand-calculating the number of critical calls (Charlie, Delta, or Echo triaged) and counting the percentage on which more than one ALS provider was present. The finding was 15.6 percent of the time, a sole ALS provider is present on a critical call. No major staffing changes, either large increases or decreases in the number of practicing Paramedics at CJCFPD have occurred. Further, as identified in the Background and Significant section of this work, call load has stabilized over the last few years. For these reasons and for the purposes of the current research, the 15.6 percent figure of single Paramedic responses is accurate enough to use as reference in these recommendations.

This researcher recommends first that CJCFPD implement a more efficient method of data collection in regard to the frequency with which more than one ALS provider is on a scene. Currently there is not data mechanism by which this type of information is entered into the Firehouse Software package used by the District for data management, therefore no efficient method to retrieve this type of response information. A solution would be to require documenters to indicate in the program while completing an EMS run report, on the "Incident" page, under the "Units and Personnel" tab, on the "Unit Response Information" page, by "checking" the "Medical" as well as the "Fire" selection in the "Response Type" selection section when an ALS provider is staffed on the fire response apparatus. Currently there is no requirement to differentiate the instance in which multiple Paramedics are present of an emergency medical call.

As determined by this research, even in the best circumstances, without patient or scene complications, and with an experienced and efficient BLS crew, it is improbable a single ALS provider would be able to complete all necessary advanced interventions within the timeline benchmarks identified in the 2010 research. While the actual time required for the ALS provider to complete skills is substantially shorter than what even experienced practitioners perceive it might be, as was determined by experimentation, there is still too much work and too little time for one advanced responder to complete. In addition, though difficult to quantify, the value of additional ALS providers on critical scenes may not be only in sharing skill performance, but in sharing call stress and providing resources which the primary responder can use to address the emergency.

With these findings in mind, and considering the fact that 15.6 percent of the time only one ALS provider is present on predictably high acuity calls in the CJCFPD Emergency Medical Service, CJCFPD is not compliant in those instances with NFPA 1710, Section 5.3.3.4.4 which states, "Personnel deployed to ALS emergency responses shall include a minimum of two members trained at the emergency medical technician-paramedic level and two members trained at the emergency medical technician-basic level…." Further, after experimentation and analysis, the 1710 EMS staffing suggestion appears to be the safest and most efficient deployment of EMS resources to the greatest benefit of the patient and responders.

If with more experimentation and study by others, two "ALS responders and two BLS responders" is confirmed to indeed comprise a minimum staffing for "best practice," the next question for CJCFPD becomes "How do we comply?" The National Institute of Standards and Technology Report on EMS Field Experiments indicates the most efficient distribution of ALS providers to the patient's greatest advantage may well be an ALS provider on an ambulance and

an ALS provider on the first response apparatus. In terms of CJCFPD's current response staffing, the only way ensure two ALS providers on every call would be to use the NIST Report finding. This means requiring an ALS provider on every fire apparatus to ensure best practice distribution of staff and qualification on every call. While this recommendation is stated easily, the researcher recognizes the complications involved. Though predictable increases in calls and call acuity have been discussed, more thorough evaluation by policy makers and those responsible for resource allocation is merited. The current study does not investigate the question of how to comply or whether CJCFPD should comply with the staffing standard, only that CJCFPD does not comply. The researcher suggests a deliberate and planned move toward the standard after assessing and addressing possible impacts on the labor contract, budgetary issues, and public acceptance. It is not the intention of this researcher to advocate immediate nullification of current labor agreements to satisfy the standard. In addition, though the current research does indicate the need, the value is still at this point, completely conceptual. Even at the end of this examination, the extrapolation of data is dependent upon the not-so-empirical conclusion that the critical patient should (and likely will) have a better outcome when two ALS providers are present on the response, appropriate critical decisions are made, and all interventions are completed successfully and efficiently. To date, no patient outcome studies exist validating the presumption of reduced patient morbidity and mortality with multiple Paramedics on critical calls.

The question also remains of how many Paramedics CJCFPD needs to provide the safest and best care possible to its constituents. This question will remain unanswered until further study and cost-benefit analysis by policy makers and those responsible for effective resource

deployment determine the NFPA 1710 staffing recommendation for EMS responses is best practice for CJCFPD.

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Appendix A

Priority Delta Call Procedures List

Immediate	60 Seconds	3 minutes	5 minutes	10 minutes	15 minutes	20 minutes	25 minutes
8	4	17	1	4	4	4	13
15	10	36	3	5	13	13	57
	11	39	4	9	35	28	
	13	52	6	12	49	30	
	18		7	13	58	34	
	21		11	14	59	58	
	31		13	16	60	59	
	32		17	19			
	40		22	20			
	42		23	28			
	44		24	30			
	45		25	33			
	50		26	34			
			27	35			
			29	37			
			30	39			
			36	49			
			38	58			
			39	59			
			43				
			44				
			45				
			51				
			52				
			53				
			56				
			59				

(Portz, 2010, p. 24)

Appendix B

Procedure Number	Procedure Name	Time Benchmark	Number and Cert of Providers
1	12 Lead ECG and Interpretation	5	A1,B1
2	AED	1	B1
3	Assessment (History and Present)	5	A1 or B1
4	Assessment (physical)	1	A1 or B1
5	Automatic Ventilator	10	A1,B1
6	Autopulse	1	B1,B2
7	Blood Sugar Analysis	5	B1
8	BSI	Immediate,1,5	All A, All B
9	Burn Care	5	A1,B1
10	BVM	1	B1
11	Carboxyhemoglobin Sensor	1,5	B1
12	C-Collar application	5	B1,B2
13	Child Birth	Variable	A1,B1
14	Combitube/Dual Lumen Airway	5,10	B1
15	Control Scene	Immediate	All A, All B
16	CPAP	5,10	A1
17	Defibrillation (Manual)	3,5	A1
18	Direct Pressure/Control Bleeding	1	B1
19	End Tidal CO2 Monitoring	5,10	A1
20	Endotracheal Intubation	5	A1,B1
21	External Cooling	5	B1
22	EZIO	5	A1,B1
23	Injection	5	A1
24	Intraosseous Access (Jamshidi)	5	A1,B1
25	Intraveneous Access (saline lock)	5,10	A1,B1
26	Intraveneous Access (with line)	5,10	A1,B1
27	KED	10	B1,B2
28	Load Patient	10,15	B1,B2
29	Log Roll	5,10	B1,B2,B3
30	Long Spine Board	5,10	B1,B2
31	Manual In-line C-spine	1	B1
32	Manual Compressions	1	B1
33	MAST pants	10	B1,B2
34	Medical Control Contact	10,15,20	A1 or B1
35	Medication Administration	5,10	A1
36	Monitor and Interprate Rhythm	3	A1
37	Nasotracheal Intubation	5,10	A1,B1
38	Neb Mask/T-piece Neb/BVM Neb	5	A1
39	Needle Thorcostomy	3,10	A1,B1

Procedure Number	Procedure Name	Time Benchmark	Number and Cert of Providers
40	Oxygen Administration	1,5	B1
41	Pressure Dressing	1	B1
42	Pulse Oximetry	1,5	B1
43	Quick Clot	1	B1
44	Rapid Extrication	1,5	B1,B2,B3
45	Secure Airway (Basic)	1	B1
46	Side stream CO2 Monitoring	5,10	A1,B1
47	Splinting	10,20	A1,B1
48	Standing LSB	5,10	B1,B2,B3
49	Stretcher	10,15	B1,B2
50	Suction	1,5	B1
51	Surgical Cric	1,5	A1,B1
52	Synchronized Cardioversion	1,5	A1
53	Temporal Artery Thermometer	5,10	B1
54	Trach Tube Change	5,10	A1,B1
55	Traction Spint	10,15	B1,B1
56	Transcutaneous Cardiac Pacing	5	A1
57	Transfer to Hospital Staff	15,20,25	A1,B1
58	Transport	10,15,20	A1,B1
59	Vital Signs	5,10,15,20,25	B1
60	Wound Care/Dressing	10,15	B1

(Portz, 2010, p28)

Appendix C

Experimental Proposal
For
Chip J. Portz
Development of EMS Staffing Standards (EFO year 2)

PURPOSE:

To compare perceived Required Rescuer Times (pRRT) determined in previous research against actual Required Rescuer Times (aRRT) using experiments designed to include performance of various critical ALS skills.

METHOD:

The proposed method is to guide and record (by digital video) performance of three predefined scenarios by CJCFPD ALS providers. During analysis, the researcher will replay recordings and calculate skill performance times. An average skill performance time will be determined for two subgroups in the experiment (one for providers with 5 or more years ALS experience, one for providers with less than 5 years ALS experience).

PROCESS:

The experiments will take place (with permission of the Chief of EMS Education and the Chief of EMS) at the CJC Training and Maintenance Facility during scheduled November CEUs. The intent of the researcher is to use the Simulation Lab room to isolate study participants during experimentation and to limit variables.

The participants will rotate by crews to the Simulation Lab at times determined by the Duty Chief on their regularly scheduled CEU day. Each ALS Provider will perform the same three experiments with assistance of a BLS crew. Where more than one ALS provider exists in a given crew, the additional ALS providers will act as BLS providers.

The researcher will review performance objectives with participants immediately prior to performance. In addition, the researcher will review skill protocols (where they exist) and National Registry skill performance sequences in attempt to ensure standard skill performance. Actual skill performance is expected (i.e. actual intubation on manikin, actual IV start on IV arm) and the Simulation Lab will be prepared by the researcher before each scenario begins.

SCENARIOS:

1. Hypoglycemic patient, unconscious, actively seizing, deteriorating to non-breather.

2. CHF patient, STEMI detected, hypotensive.
3. Head injury secondary to MVA, agonal respirations, patient entrapped but accessible by rescuer.

RESEARCHER NOTES:

The intent of the research is not to test decision making but to record skill performance times, therefore it will be necessary to review skills requirements. Actual performances will be evaluated by the researcher for time only, not proficiency and results will be reported as averages for the two study subgroups and not for individual participants.

Appendix D

Scenario 1: Reported Seizure (Hypoglycemia – Code)

Skills to be performed:

1. Physical Exam (Patient Assessment)
2. O2 Administration
3. Pulse Oximetry
4. Patient History (Patient Assessment)
5. Blood Sugar Analysis
6. IV Start
7. Medication Administration
8. BVM (with oral adjunct)
9. Autopulse
10. Monitor and rapid interpretation
11. Defibrillation
12. Intubation
13. CO2 Monitor
14. 12-lead and interpretation

TASK BREAKDOWN FOR SKILLS:

1. **Patient Assessment** (from the NAEMT Advanced Patient Assessment skill sheet, Primary Survey)

    - Verbalizes general impression of the patient
    - Determines responsiveness/level of consciousness
    - Determines chief complaint/apparent life-threats
    - Assesses airway and breathing
    - Assures adequate ventilation
    - Initiates appropriate oxygen therapy
    - Assesses circulation
    - Assesses/controls major bleeding
    - Assesses skin [either skin color, temperature, or condition]
    - Assesses pulse
    - Identifies priority patients/makes transport decision

2. **O2 Administration** (from the NAEMT Basic Oxygen Administration skill sheet)

    - Open the tank

- Check for leaks
- Check tank pressure
- Attach non-rebreather mask to oxygen
- Prefill reservoir
- Adjust flow to 12 liters per minute or greater
- Apply and adjust mask to the patient's face

3. Pulse Oximetry (from CJCFPD Procedural Protocol P 1.0)

- The pulse oximeter is a cutaneous monitor used as an adjunct in the assessment of respiratory status. The device also assists in evaluating improvement or deterioration during treatment. This device is *never* used to withhold 02 to a patient who needs it. Any patient who would currently receive 02 per system protocol, or who appears to clinically need it, should continue to be given oxygen.
- **Indications** - The following is a partial list of situations where pulse oximetry may be used:
    - Only for use in perfusing patient.
    - Respiratory Disorders (e.g. Asthma, COPD, respiratory distress, airway obstruction or injury).
    - Cardiovascular Disorders (e.g. CHF, chest pain, dysrhythmia).
    - Altered Mental Status (e.g. Coma, Overdose, CVA, Seizures).
    - Trauma.
    - The pulse oximeter should be used prior to and after intubation or assisted ventilation of the perfusing patient.
    - The pulse oximeter must be used prior to and after administering sedative agents.
- **Contraindications**
    - Non-perfusing rhythm.
    - Sickle cell anemia.
- **Procedure**
    - Check vital signs.
    - Turn on the device.
    - Select appropriate site. Avoid placing the probe on areas distal to orthopedic injuries or distal to a blood pressure cuff.
    - Place probe on the patient.
    - Read the pulse rate, 02 saturation, and document findings at least every 10 minutes and with any change in therapy or clinical condition.
    - Oxygen will be applied or increased according to the clinical setting. Although normal Sa02 levels are 95%, Sa02 levels above 90% are generally acceptable in almost any adult patient. In the pediatric patient, Sa02 levels <94% should receive supplemental oxygen .
    - For patient's not on home 02 therapy, oxygen should be applied via nasal cannula or mask per system protocol.

- Patients currently on chronic home 02 therapy should have an initial Sa02 reading done. Oxygen may be increased until Sa02 levels of 90%-92% are obtained.

- **Precautions**
  - **Pulse oximetry values may be inaccurate in a variety of situations.**
  - Inaccurate readings can be seen with patient movement, the presence of nail polish, vasoconstriction, decreased peripheral perfusion, hypotension, hypothermia, abnormal hemoglobins, hypovolemia, carbon monoxide poisoning, smoke inhalation, and methemoglobinemia.
  - Prehospital personnel should correlate the Sa02 reading with the clinical status of the patient.

4. **Patient History** (from the NAEMT Advanced Patient Assessment skill sheet, History Taking and Secondary Assessment)*APPLICABLE QUESTIONS OF BYSTANDER ONLY*

- History of present illness
  -Onset
  -Severity
  -Provocation
  –Time
  -Quality
- Clarifying questions of associated signs and symptoms as related to OPQRST
- Radiation

5. **Blood Sugar Analysis** (commonly accepted standard practice)

- Prepare field glucose monitor
- Clean patient skin with alcohol wipe, allow to dry and use safety lancet on patient's finger OR
- Obtain blood sample from IV needle flash chamber
- Expose glucose monitor sensor to blood sample

6. **IV Start** (from NAEMT Advanced Intravenous Therapy Skill Sheet)

- Checks selected IV fluid for:
  - Proper fluid
  - Clarity
  - Expiration date
- Selects appropriate catheter
- Selects proper administration set
- Connects IV tubing to the IV bag
- Prepares administration set [fills drip chamber and flushes tubing]
- Cuts or tears tape [at any time before venipuncture] OR prepares veniguard.
- Takes or verbalizes body substance isolation precautions [prior to venipuncture]

- Applies tourniquet
- Palpates suitable vein
- Cleanses site appropriately
- Performs venipuncture
    - Inserts stylette
    - Notes or verbalizes flashback
    - Occludes vein proximal to catheter
    - Removes stylette
    - Connects IV tubing to catheter
    - Disposes/verbalizes proper disposal of needle in proper container
    - Releases tourniquet
    - Runs IV for a brief period to assure patent line
    - Secures catheter [tapes securely or verbalizes]
    - Adjusts flow rate as appropriate

7. **IV Medication Administration** (from NAEMT Advanced Intravenous Bolus Medications Skill Sheet)

- Asks patient for known allergies
- Selects correct medication
- Assures correct concentration of medication
- Assembles prefilled syringe correctly and dispels air
- Continues to take or verbalize body substance isolation precautions
- Identifies and cleanses injection site closest to the patient [Y-port or hub]
- Reaffirms medication
- Stops IV flow
- Administers correct dose at proper push rate
- Disposes/verbalizes proper disposal of syringe and needle in proper container
- Turns IV on and adjusts drip rate to TKO/KVO
- Verbalizes need to observe patient for desired effect and adverse side effects

8. **BVM (with oral adjunct)**(from the NAEMT Basic Bag-Valve-Mask – Apneic Patient Skill Sheet)

- Voice opening [or open] airway
- Voice inserting [or insert] airway adjunct
- Select appropriately sized mask
- Create a proper mask-to-face seal
- Ventilate patient at proper rate and adequate volume
- Connect reservoir and oxygen
- Adjust liter flow to 15 liters/minute or greater

9. Autopulse

- **Indications:**

The AutoPulse will be used for all patients 18 years of age and older in non-traumatic cardiac arrest, where CPR would otherwise be used. In case of mechanical malfunction of the AutoPulse the EMS responder will resort back to manual CPR for patient care.

- **Contraindications:**
  - Traumatic cardiac arrest
  - Patients under the age of 18

- **Protocol for Management**
  - B.S.I. to include Face Shields
  - Place the patient in a seated upright position
  - Cut clothing down the back and remove from the front side of patient
  - Place the AutoPulse behind the patient's back while still in a seated upright position
  - Lay the AutoPulse and patient down to the ground
  - Place CPR Start Padz defibrillation pads on patients chest
  - Turn the AutoPulse on (switch at top middle of board above patients head)
  - Connect Chest/Life Band across the chest of patient
  - Lift the chest band straight up to ensure it is free of twists and lay the band onto the patient's chest. Do not hold the band above the patient.
  - Push the “Green” button once to start sizing cycle
  - Push the “Green” button a second time to start the continuous compression cycle
  - Place a towel or a Zoll head bed under the patients head and secure with tape to help stabilize in place
  - Secure the torso to the AutoPulse utilizing the torso strap
  - Secure the AutoPulse to a long spine board to assist with egress
  - Replace battery as needed
  - Upon ROSC or to check for pulse press Orange button to pause compressions

- **Documentation: ((section omitted))**

- **Complications:**
  - Care should be used when moving patients with a large abdomen (shifting of excess flesh may cause the life band to move or break)
  - If disruption or malfunction of life band occurs Revert Back to Manual CPR. If a malfunction occurs, an EMS Equipment Failure report shall be filled out and forwarded to the EMS division.

10. Monitor and Rapid Interpretation (from NRMET Advanced Dynamic Cardiology Skill Sheet)

- Check patient responsiveness
- Check ABCs [responsive patient] – or – check breathing and pulse [unresponsive patient]

- Initiate CPR if appropriate
- Attach ECG monitor in a timely fashion or apply paddles for “Quick Look”
- Correctly interpret initial rhythm
- Appropriately manage initial rhythm
- Note change in rhythm
- Check patient condition to include pulse and, if appropriate, BP
- Correctly interpret second rhythm
- Appropriately manage second rhythm

11. Defibrillation (from CJCFPD Adult Medical Protocols , Cardiac Arrest, AM 3.0)

Witnessed VF/Pulseless VT Arrest with defibrillator “immediately” available:

- Quickly apply the Zoll “CPR Start Pads” into proper position ensuring proper placement of the CPR puck on the sternum.
- Defibrillate at 120J (ZOLL E Series).
- Position the patient on the AutoPulse and begin operations, secure to AutoPulse with chest strap. The AutoPulse should be in continuous mode.
- Insert oral airway and place a non-rebreather mask on patient at high flow.
- Following two minutes, and every two minutes of AutoPulse operation, pause the AutoPulse and determine the underlying rhythm.
- If the underlying rhythm is Asystole or PEA, continue the operation of the AutoPulse.
- If VF/Pulseless Ventricular Tachycardia immediately continue the AutoPulse and defibrillate **one** time:
    - **Initial: Defibrillate at 120J (Zoll E Series).**
        - Defibrillate on the **upstroke of the AutoPulse**.
    - **Second: Defibrillate at 150J (Zoll E Series).**
        - Defibrillate on the **upstroke of the AutoPulse**.
    - **Third and subsequent: Defibrillate at 200J (Zoll E Series).**
        - Defibrillate on the **upstroke of the AutoPulse**.
- Continue this pattern until rhythm change, or the return of a spontaneous pulse is seen.
- If after 25 minutes of the resuscitation Asystole is present, consider termination of resuscitation with medical control contact.

During CPR cycles (with manual compressions or AutoPulse operations):

- Establish IV/IO access and begin infusing **4 degree Celsius cold saline** at rapid infusion rate. All fluids administered will be chilled during the resuscitation and infused at a wide open rate. Volume expansion up to 2 liters of fluid.
- Apply ice packs to the axilla, groin, and head.
- Intubation: place endotracheal tube after the 3rd two minute cycle or approximately 6 minutes into the resuscitation. Confirm airway device placement by exam plus confirmation device to include ETCO2. Secure the airway with a commercial tube device.
- Ventilate at 10 breaths per minute utilizing a pediatric bag for lower tidal volumes. If ROSC, utilize the ventilator with tidal volumes of 8 ml/kg.

- Administer medications appropriate for rhythm and condition.
- Search for and treat identified reversible causes.

Formulary/ Pharmacologic Interventions:

- All pulseless rhythms:
  - Epinephrine 1 mg IV push, repeat every 3 to 5 minutes, **OR**
- Ventricular Fibrillation/Pulseless Ventricular Tachycardia ONLY:
- Amiodarone 300 mg SLOW IVP over 1 minute with IV bag wide open. For recurrent VF/pulseless VT, consider administration of a second dose of Amiodarone at 150 mg IV SLOW IVP over 1 minute with IV bag wide open.

Other formulary considerations:

- Magnesium sulfate 1 to 2 g IV in polymorphic VT (torsades de pointes) and suspected hypomagnesemic state.
- Sodium bicarbonate 1 mEq/kg IV is indicated for severe conditions known to provoke sudden cardiac arrest; preexisting hyperkalemia, tricyclic antidepressant overdose, preexisting bicarbonate-responsive acidosis, prolonged arrest time, return of circulation following long arrest time.

Protocol Considerations:

- Rotate compressors every 2 minutes with rhythm checks if manual compressions are being done.
- Minimize interruptions in chest compressions. Resume compressions while the defibrillator charges.
- If ROSC is achieved, follow Post Resuscitation protocol.
- If AutoPulse is utilized, ensure constant operations. Do not turn the AutoPulse off to intubate or initiate IV lines.
- ETCO2 is a powerful monitoring device for the detection of ROSC. A sudden increase in ETCO2 from a trended baseline may be the earliest detection

12. **Endotracheal Intubation** (from CJCFPD Procedural Protocols, Endotracheal Intubation P 10.0)

- **Introduction:**
  Endotracheal intubation is the most definitive means of airway control. It facilitates mechanical ventilation, and allows for the delivery of high concentrations of oxygen. Intubation allows for direct suctioning, and prevents aspiration of stomach content. Intubation should be viewed as a “controlled” procedure rather than an emergent one where Paramedics employee a process of preparation, execution, and verification.

- **Precautions:**
  - Endotracheal intubation is not the initial step in the treatment of a respiratory arrest. Adequate oxygenation/ventilation should be accomplished first using BLS techniques (i.e. bag valve mask with 100% 02, oral airway placement).

- Endotracheal intubation may be safely accomplished in the patient with suspected cervical spine injuries as long as the head and neck are immobilized by an assistant using "in-line stabilization".
- Transport of the unstable trauma patient should not be delayed by attempts at intubation unless the patient cannot be adequately ventilated with BVM.
- Do not use the teeth as a fulcrum.
- Have suction ready since regurgitation is common.

- **Technique:**
  - Preparation**:**
    - Ensure adequate ventilation and oxygenation with BVM and oral airway.
    - Cricoid pressure should be used to avoid regurgitation during BVM ventilation. BURP method: backwards, upwards, rightward, pressure
    - Gather and test appropriate equipment
    - Suction with appropriate catheters
    - Endotracheal tubes with stylets, syringe, lubrication, securing device
    - ETCO2 verification device
    - Endotracheal tube introducer (Bougie)
    - Combitube
    - Special circumstances:
    - Difficult tube due to anatomy, spinal immobilized pt.
    - Consider utilization of the McGrath videolaryngoscope

  - Execution:
    - Position yourself at the head of the patient getting as close to the level of the head as possible.
    - When ready, discontinue BVM and remove oral airway.
    - Position the head of the patient in the "sniffing position"
    - **Keep head in a neutral position if cervical spinal injury is suspected**
    - The laryngoscope blade is inserted utilizing proper technique:
      - Macintosh blade (curved): place in vallecula
      - Miller blade (straight): picks the epiglottis up directly
    - Upon direct visualization of the “cords” insert the ET tube.
      - If only partial view is identified, consider using the Bougie as an introducer.
    - Advance the ET tube the cuff is 2-3 cm beyond the cords.
    - Inflate the distal end of the ET tube with 10 ml of air.

  - Verification:
    - Confirm placement:
    - Direct visualization, auscultation of breath sounds, rise and fall of chest, condensation in tube, absent breath sounds, and ETCO2.
    - Secure the ET tube using an approved securing device.
    - Do not remove your hand from the tube until it has been secured.
    - Reconfirm placement after securing tube.

        - After movement of the patient (i.e. board to stretcher, stretcher to ambulance) tube positioning should be verified.

- **Complications of intubation:**
    - *Esophageal intubation with resultant* hypoxic brain injury.
    - Airway trauma, dental injury, bleeding, vocal cord/tracheal injury.
    - Vomiting/aspiration.
    - Right mainstem intubation with resultant atelectasis.

- **Documentation: ((section omitted))**

- **Notes:**
    - **An intubation attempt is defined as each time the laryngoscope is introduced to the oral pharynx.**
    - Attempts should not take more than 15-20 seconds to complete.
    - If intubation is still unsuccessful after three attempts then another operator may attempt or alternate means of airway control should be considered (i.e. two person BVM).
    - "When in doubt, take it out" and assure oxygenation by another attempt or another method.

13. End Tidal CO2 monitoring (from CJCFPD Procedural Protocols, End Tidal CO2 Capnography – End Cap device procedure omitted, P 2.0)

- End Tidal Carbon Dioxide (EtCO2) detection devices are used as an adjunct to conventional assessment for proper endotracheal tube placement by detecting the exhaled CO2 in tracheal air which is normally not present in the esophagus. Benefits of capnography include the confirmation of endotracheal tube placement, increased effectiveness of cardiopulmonary resuscitation, and the ability to better recognize when termination of resuscitation efforts is applicable. Two detection devices have been selected by the Central Jackson County Fire Protection District for use. These devices are mainstream capnography and end tidal CO2 cap detectors.
    - Mainstream Capnography is considered a “quantitative” device because it assigns a value for the expired CO2. This technology also utilizes the capnogram which is displayed in graph form on the monitor. Because there is only one normal capnogram, any deviation can be an indicator of respiratory compromise.
    - End Tidal CO2 cap detectors are considered “qualitative” devices because they only sense the presence of expired CO2. The presence of CO2 causes a color change on the device. Reliability should be questioned after a period of time due to possible contamination of the detection medium.

- **Indications:**
  Endotracheal tube intubation of any patient, conscious or unconscious, following other physical observable signs of proper tube placement.

- **Procedure (End Tidal Capnography):**

- Confirm endotracheal tube placement as per intubation protocol (visualization, rise and fall of the chest, condensation, present bilateral breath sounds, absent abdominal sounds, etc.).
- Prepare the monitor for EtCO2 (per Zoll operational guidelines
  - Connect the EtCO2 disposable hub to the quick connect device located in the right side pouch of the Zoll E Series case.
  - Connect the ET sensor to the ET tube.
  - The sensor will immediately begin to sense for CO2 following a short warming phase.
  - If observation of a capnogram is desired, in monitor mode, depress Wave 2 until the CO2 Capnogram wave appears.
- Assess for the presence of CO2. Care providers must understand that during the initial stages of a resuscitation, it is possible to have EtCO2 levels of less than 10 mmHg. As perfusion increases, EtCO2 levels will also increase. Optimally, especially in closed head injury patients, the desired EtCO2 level should be between 30-35 mmHg.
- Patients should be bagged with positive pressure ventilation to EtCO2 levels between 30-35 mmHg. Values of less that 28 mmHg are indicative of hyperventilation, therefore the rate of ventilation should be decreased. Values of more than 38 mmHg are indicative of hypoventilation (hypercarbia), therefore the rate of ventilation should be increased.

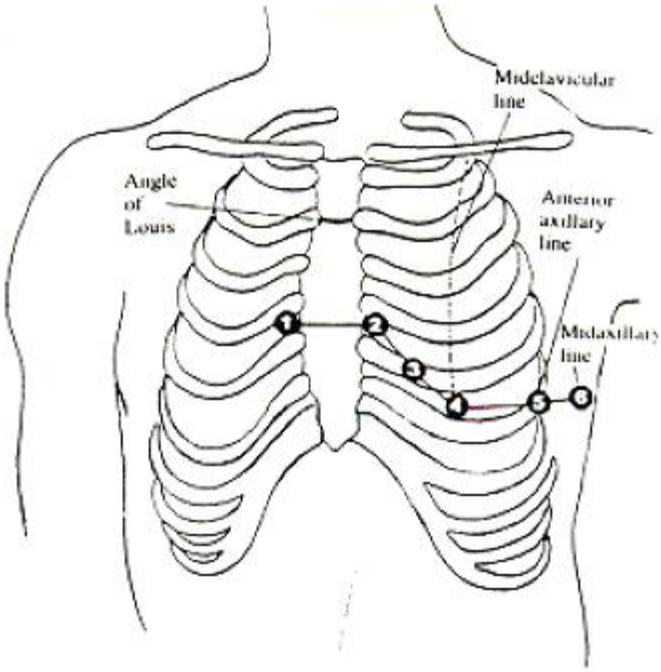
14. **12-lead ECG and Interpretation** (from CJCFPD Procedural Protocol, 12 Lead ECG, (operation of MRL PIC not included), P 9.0)

- **Indication:**
  Any and all patients presenting with typical or atypical chest pain, or any associated symptoms when an Acute Coronary Syndrome (ACS) is suspected. Signs and symptoms of suspected ACS patients include Classic Angina (dull substernal discomfort described as pressure or tightness, with or without radiation), Anginal equivalent (no specific chest pain or discomfort, but presents with **dyspnea, palpitations, presyncope, or syncope)**, and Atypical chest pain (discomfort that is localized to the precordial area but has musculoskeletal, positional, or pleuritic features). The 12 lead should be done within 10 minutes of arrival.

- **Procedure: (Zoll E Series)**
  - Advise the patient of the need for a 12 lead ECG.
  - If the patient is a female, ensure privacy.
  - Remove any clothing covering the thorax (this includes the bra for a female).
  - Patient should be positioned in a position of comfort (supine is preferred).

- Prepare the skin:
  - Shave the chest using the surgical razor.
  - Wipe the sites with a alcohol wipe.
  - Dry the skin using a 4X4 using a firm wiping motion (this removes the top layer of dead skin cells).
- Place the electrodes (See figure):
  - LA- Left arm preferably on the shoulder area.
  - RA- Right arm preferably on the shoulder area.
  - LL- Left side below the diaphragm.
  - RL- Right side below the diaphragm.
  - V1- 4th intercostal space, Right of the sternum.
  - V2- 4th intercostal space, Left of the sternum.
  - V4- 5th intercostal space, midclavicular line.
  - V3- between V2 and V4.
  - V5- anterior axillary line, level of V4.
  - V6- mid-axillary line, level of V4.
- Attach the precordial cables to the main ECG cable at the port.
- Turn the Zoll E Series to “Monitor” mode
- Enter patient information.
- Advise the patient to remain as still as possible.
- Depress the “ACQUIRE” button to begin the acquisition. The Zoll E Series will begin to print out your 12 lead with measurements.
- Sending the 12 lead to medical control:
  - ((omitted))
- Follow the ACS Protocol (AM 1.0).

- Proper placement of the Precordial Leads:



Scenario #2 – Respiratory Distress (CHF – STEMI)

Skills to be performed:

1. Physical Exam (Patient Assessment)
2. Pulse Oximetry
3. O2 Administration
4. Patient History (Patient Assessment)
5. Monitor and rapid interpretation
6. IV Start
7. Medication Administration
8. CPAP
9. 12-lead and interpretation

TASK BREAKDOWN FOR SKILLS:

1. **Patient Assessment** (from the NAEMT Advanced Patient Assessment skill sheet, Primary Survey)

- Verbalizes general impression of the patient
- Determines responsiveness/level of consciousness
- Determines chief complaint/apparent life-threats
- Assesses airway and breathing
- Assures adequate ventilation
- Initiates appropriate oxygen therapy
- Assesses circulation
- Assesses/controls major bleeding
- Assesses skin [either skin color, temperature, or condition]
- Assesses pulse
- Identifies priority patients/makes transport decision

2. **Pulse Oximetry** (from CJCFPD Procedural Protocol P 1.0)

    - The pulse oximeter is a cutaneous monitor used as an adjunct in the assessment of respiratory status. The device also assists in evaluating improvement or deterioration during treatment. This device is *never* used to withhold 02 to a patient who needs it. Any patient who would currently receive 02 per system protocol, or who appears to clinically need it, should continue to be given oxygen.
    - **Indications** - The following is a partial list of situations where pulse oximetry may be used:
        - Only for use in perfusing patient.
        - Respiratory Disorders (e.g. Asthma, COPD, respiratory distress, airway obstruction or injury).
        - Cardiovascular Disorders (e.g. CHF, chest pain, dysrhythmia).
        - Altered Mental Status (e.g. Coma, Overdose, CVA, Seizures).

        - Trauma.
        - The pulse oximeter should be used prior to and after intubation or assisted ventilation of the perfusing patient.
        - The pulse oximeter must be used prior to and after administering sedative agents.
    - **Contraindications**
        - Non-perfusing rhythm.
        - Sickle cell anemia.
    - **Procedure**
        - Check vital signs.
        - Turn on the device.
        - Select appropriate site. Avoid placing the probe on areas distal to orthopedic injuries or distal to a blood pressure cuff.
        - Place probe on the patient.
        - Read the pulse rate, 02 saturation, and document findings at least every 10 minutes and with any change in therapy or clinical condition.
        - Oxygen will be applied or increased according to the clinical setting. Although normal Sa02 levels are 95%, Sa02 levels above 90% are generally acceptable in almost any adult patient. In the pediatric patient, Sa02 levels <94% should receive supplemental oxygen .
        - For patient's not on home 02 therapy, oxygen should be applied via nasal cannula or mask per system protocol.
        - Patients currently on chronic home 02 therapy should have an initial Sa02 reading done. Oxygen may be increased until Sa02 levels of 90%-92% are obtained.
    - **Precautions**
        - **Pulse oximetry values may be inaccurate in a variety of situations.**
        - Inaccurate readings can be seen with patient movement, the presence of nail polish, vasoconstriction, decreased peripheral perfusion, hypotension, hypothermia, abnormal hemoglobins, hypovolemia, carbon monoxide poisoning, smoke inhalation, and methemoglobinemia.
        - Prehospital personnel should correlate the Sa02 reading with the clinical status of the patient.

3. **O2 Administration** (from the NAEMT Basic Oxygen Administration skill sheet)

- Open the tank
- Check for leaks
- Check tank pressure
- Attach non-rebreather mask to oxygen
- Prefill reservoir
- Adjust flow to 12 liters per minute or greater
- Apply and adjust mask to the patient’s face

4. **Patient History** (from the NAEMT Advanced Patient Assessment skill sheet, History Taking and Secondary Assessment)*APPLICABLE QUESTIONS OF BYSTANDER ONLY*

- History of present illness
    - -Onset
    - -Severity
    - -Provocation
    - –Time
    - -Quality
- Clarifying questions of associated signs and symptoms as related to OPQRST
- Radiation

5. **Monitor and Rapid Interpretation** (from NRMET Advanced Dynamic Cardiology Skill Sheet)

- Check patient responsiveness
- Check ABCs [responsive patient] – or – check breathing and pulse [unresponsive patient]
- Initiate CPR if appropriate
- Attach ECG monitor in a timely fashion or apply paddles for "Quick Look"
- Correctly interpret initial rhythm
- Appropriately manage initial rhythm
- Note change in rhythm
- Check patient condition to include pulse and, if appropriate, BP
- Correctly interpret second rhythm
- Appropriately manage second rhythm

6. **IV Start** (from NAEMT Advanced Intravenous Therapy Skill Sheet)

- Checks selected IV fluid for:
    - Proper fluid
    - Clarity
    - Expiration date
- Selects appropriate catheter
- Selects proper administration set
- Connects IV tubing to the IV bag
- Prepares administration set [fills drip chamber and flushes tubing]
- Cuts or tears tape [at any time before venipuncture] OR prepares veniguard.
- Takes or verbalizes body substance isolation precautions [prior to venipuncture]
- Applies tourniquet
- Palpates suitable vein
- Cleanses site appropriately
- Performs venipuncture
    - Inserts stylette
    - Notes or verbalizes flashback
    - Occludes vein proximal to catheter

- Removes stylette
- Connects IV tubing to catheter
- Disposes/verbalizes proper disposal of needle in proper container
- Releases tourniquet
- Runs IV for a brief period to assure patent line
- Secures catheter [tapes securely or verbalizes]
- Adjusts flow rate as appropriate

7. **IV Medication Administration** (from NAEMT Advanced Intravenous Bolus Medications Skill Sheet)

- Asks patient for known allergies
- Selects correct medication
- Assures correct concentration of medication
- Assembles prefilled syringe correctly and dispels air
- Continues to take or verbalize body substance isolation precautions
- Identifies and cleanses injection site closest to the patient [Y-port or hub]
- Reaffirms medication
- Stops IV flow
- Administers correct dose at proper push rate
- Disposes/verbalizes proper disposal of syringe and needle in proper container
- Turns IV on and adjusts drip rate to TKO/KVO
- Verbalizes need to observe patient for desired effect and adverse side effects

8. **Continuous Positive Airway Pressure (CPAP)** (from CJCFPD Procedural Protocols CPAP P 5.0)

- Continuous positive airway pressure (CPAP) provides a positive pressure gradient from the proximal airway to the lower airways, thus increasing transpulmonary pressure and airflow. An increased alveolar ventilation results, along with a decrease in the work of breathing. The goals of applying CPAP include:
  - Relieving respiratory muscle fatigue.
  - Reverse microatelectasis.
  - Decrease the work of breathing and work of inspiration.
  - Increased ventilatory support.
  - Increased cardiac output.

- **Indications:**
  - Acute Congestive Heart Failure.
  - Chronic Obstructive Pulmonary Disease.

- **Inclusion Criteria:**
  - Respiratory distress with 2 or more of the following:
    - Retractions or accessory muscle use.

- Pulmonary edema.
- Respiratory rate >25 minute.
- Pulse Oximeter <92% on high flow oxygen.

- **Exclusion Criteria:**
  - Respiratory or cardiac arrest.
  - Systolic blood pressure <90 mmHg.
  - Unresponsive to verbal stimuli.
  - Inability to maintain airway patency.
  - Major trauma.
  - Vomiting or active upper GI bleeding.
  - Untreated pneumothorax.
  - Obvious signs or symptoms of infection.

- **Procedure:**
  - Assess vital signs, and attach monitor and pulse oximeter.
  - If BP <100, contact medical control prior to beginning CPAP.
  - Prepare equipment, installing 5 cmH2O pressure valve, and oxygen analyzer.
  - Connect the generator to 50 psi oxygen outlet.
  - Turn the "ON/OFF" dial to the "on" position.
  - Turn the "FLOW" valve six to seven turns counterclockwise.
  - Turn the "O2" valve one turn to begin oxygen flow.
  - Adjust the "O2" valve to patient's oxygen saturation and other perfusion markers. Maintain at saturation of >95%.
  - VS q5 minutes. If patient deteriorates to the level of any exclusion criteria, discontinue CPAP and initiate appropriate resuscitative measures.

- **Documentation: (Omitted)**

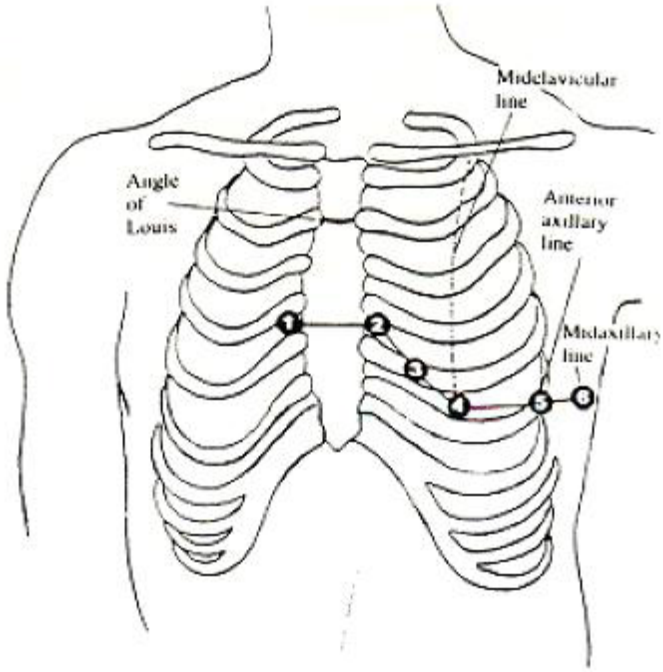
9. **12-lead ECG and Interpretation** (from CJCFPD Procedural Protocol, 12 Lead ECG, (operation of MRL PIC not included), P 9.0)

- **Indication:**
  Any and all patients presenting with typical or atypical chest pain, or any associated symptoms when an Acute Coronary Syndrome (ACS) is suspected. Signs and symptoms of suspected ACS patients include Classic Angina (dull substernal discomfort described as pressure or tightness, with or without radiation), Anginal equivalent (no specific chest pain or discomfort, but presents with **dyspnea, palpitations, presyncope, or syncope)**, and Atypical chest pain (discomfort that is localized to the precordial area but has musculoskeletal, positional, or pleuritic features). The 12 lead should be done within 10 minutes of arrival.

- **Procedure: (Zoll E Series)**
  - Advise the patient of the need for a 12 lead ECG.
  - If the patient is a female, ensure privacy.
  - Remove any clothing covering the thorax (this includes the bra for a female).

- Patient should be positioned in a position of comfort (supine is preferred).
- Prepare the skin:
  - Shave the chest using the surgical razor.
  - Wipe the sites with a alcohol wipe.
  - Dry the skin using a 4X4 using a firm wiping motion (this removes the top layer of dead skin cells).
- Place the electrodes (See figure):
  - LA- Left arm preferably on the shoulder area.
  - RA- Right arm preferably on the shoulder area.
  - LL- Left side below the diaphragm.
  - RL- Right side below the diaphragm.
  - V1- 4th intercostal space, Right of the sternum.
  - V2- 4th intercostal space, Left of the sternum.
  - V4- 5th intercostal space, midclavicular line.
  - V3- between V2 and V4.
  - V5- anterior axillary line, level of V4.
  - V6- mid-axillary line, level of V4.
- Attach the precordial cables to the main ECG cable at the port.
- Turn the Zoll E Series to “Monitor” mode
- Enter patient information.
- Advise the patient to remain as still as possible.
- Depress the “ACQUIRE” button to begin the acquisition. The Zoll E Series will begin to print out your 12 lead with measurements.
- Sending the 12 lead to medical control:
  - ((omitted))
- Follow the ACS Protocol (AM 1.0).

- Proper placement of the Precordial Leads:



Scenario #3 – Respiratory Distress (MVA, entrapped patient, completely accessible, Spinal Injury – Tension Pneumothorax)

Skills to be performed:

1. C-collar application
2. O2 Administration
3. Physical Exam (Patient Assessment)
4. Pulse Oximetry
5. Needle Thorocostomy
6. Patient History (Patient Assessment)
7. Monitor and rapid interpretation
8. IV Start
9. Medication Administration (Fluid bolus)
10. 12-lead and interpretation

1. **C-Collar application** (from CJCFPD Procedural Protocol, Stifneck Collar P 26.0)

- **Indications**
  - Suspected C-Spine injury.
  - Suspected spinal injury.

- **Contraindications**
  - If careful movement of the head and neck into a neutral in-line position results in:
    - Neck muscle spasm.
    - Increased pain.
    - The commencement or increase of a neurological deficit such as numbness, tingling, or loss of motor ability.
    - Compromise of the airway or ventilation.
  - In such patients, the patient's head will have to be immobilized in the position found.

- **Precautions**
  - Do not rely on the cervical collar by itself to adequately immobilize a patient's cervical spine. Collars are tools to aid in immobilization. No collar by itself provides sufficient immobilization.
  - Do not use an improperly sized collar. Too large a collar may hyperextend a patient's cervical spine; too small a collar may not provide appropriate stability. Special sizes of Stifneck collars are available for children and other individuals with small frames.

- **Procedure**
  - Sizing the collar.
    - Proper sizing is critical for good patient care. Too short a collar may not provide enough support, while too tall a collar may hyperextend a patient. Use the tallest collar that does, not hyperextend. The key dimension on a patient is the distance between an imaginary line drawn across the top of the shoulders, where the collar will sit, and the bottom plane of the patient's chin.
    - The key dimension on the collar is the distance between the sizing post (black fastener) and the lower edge of the rigid encircling band (not the foam padding). The importance of proper sizing is emphasized on each stifneck collar by a sticker pointing out the sizing post.
    - When the patient is being held in a neutral position, use your fingers to visually measure the distance from the shoulder to the chin (key dimension).
    - Then use your fingers to select the size of stifneck collar that most closely matches the key dimension of the patient.
  - Assembly and Pre-forming.

        - The collar is assembled by moving the black fastener (sizing post) at the end of the chin piece up the inside wall of the collar and then pushing the black fastener all the way into the small hole. Press firmly.
        - Flex the collar sharply inward until you can touch the hook section of the Velcro to the inner wall of the collar. This will pre-form the collar into a cylinder to simplify application.
    - Application to the patient who is sitting or standing.
        - With the patient's head held in neutral alignment, position the chin piece by sliding the collar up the chest wall. Be sure that the chin is well supported by the chin piece and that the chin extends far enough onto the chin piece to at least cover the central fastener. Difficulty in positioning the chin piece may indicate the need for a shorter collar.
        - Bring the rear of the collar around, and attach the Velcro. Recheck the position of the patient's head and collar for proper alignment. Make sure that the patient's chin at least covers the central fastener in the chin piece. If it doesn't, tighten the collar until proper support is obtained. Select the next smaller size if you think further tightening of the collar may cause the patient to become further extended.
    - Application to the supine patient.
        - If the patient is supine, begin by sliding the back portion of the collar behind the patient's neck. Be sure to fold the loop Velcro inward on top of the foam padding to prevent it from collecting debris that could limit its gripping ability. Once the loop Velcro is visible, turn all of your attention to positioning the chin piece and attaching the Velcro as previously described.
        - An alternative is to start by positioning the chin piece and then sliding the back portion of the collar behind the patient's neck.
    - Final adjustment
        - Once positioned, hold the collar in place by using the track hole. You can avoid torquing the neck by using the track hole as an anchor point while pulling and attaching the loop Velcro so that it mates with, and is parallel to, the hook Velcro.
        - Be sure to maintain neutral alignment throughout this procedure.
- **Notes**
    - This procedure is largely borrowed front the manufacturer's instructions for use.
    - The most important steps of application are proper sizing and proper positioning of the chin piece.

- **Complications**
    - Moving a patient's head into the neutral position may rarely cause neurological complications. See Contraindications for this procedure.

- Immobilizing a patient on a long spine board may rarely cause increased pain or possibly injury. If the patient complains of increased pain, careful evaluation should be done to see whether an alternative means of immobilization should be used.

Documentation (Omitted)

2. **O2 Administration** (from the NAEMT Basic Oxygen Administration skill sheet)

- Open the tank
- Check for leaks
- Check tank pressure
- Attach non-rebreather mask to oxygen
- Prefill reservoir
- Adjust flow to 12 liters per minute or greater
- Apply and adjust mask to the patient's face

3. **Patient Assessment** (from the NAEMT Advanced Patient Assessment skill sheet, Primary Survey)

- Verbalizes general impression of the patient
- Determines responsiveness/level of consciousness
- Determines chief complaint/apparent life-threats
- Assesses airway and breathing
- Assures adequate ventilation
- Initiates appropriate oxygen therapy
- Assesses circulation
- Assesses/controls major bleeding
- Assesses skin [either skin color, temperature, or condition]
- Assesses pulse
- Identifies priority patients/makes transport decision

4. **Pulse Oximetry** (from CJCFPD Procedural Protocol P 1.0)
   - The pulse oximeter is a cutaneous monitor used as an adjunct in the assessment of respiratory status. The device also assists in evaluating improvement or deterioration during treatment. This device is *never* used to withhold 02 to a patient who needs it. Any patient who would currently receive 02 per system protocol, or who appears to clinically need it, should continue to be given oxygen.

- **Indications** - The following is a partial list of situations where pulse oximetry may be used:
  - Only for use in perfusing patient.
  - Respiratory Disorders (e.g. Asthma, COPD, respiratory distress, airway obstruction or injury).
  - Cardiovascular Disorders (e.g. CHF, chest pain, dysrhythmia).
  - Altered Mental Status (e.g. Coma, Overdose, CVA, Seizures).
  - Trauma.
  - The pulse oximeter should be used prior to and after intubation or assisted ventilation of the perfusing patient.
  - The pulse oximeter must be used prior to and after administering sedative agents.
- **Contraindications**
  - Non-perfusing rhythm.
  - Sickle cell anemia.
- **Procedure**
  - Check vital signs.
  - Turn on the device.
  - Select appropriate site. Avoid placing the probe on areas distal to orthopedic injuries or distal to a blood pressure cuff.
  - Place probe on the patient.
  - Read the pulse rate, 02 saturation, and document findings at least every 10 minutes and with any change in therapy or clinical condition.
  - Oxygen will be applied or increased according to the clinical setting. Although normal Sa02 levels are 95%, Sa02 levels above 90% are generally acceptable in almost any adult patient. In the pediatric patient, Sa02 levels <94% should receive supplemental oxygen .
  - For patient's not on home 02 therapy, oxygen should be applied via nasal cannula or mask per system protocol.
  - Patients currently on chronic home 02 therapy should have an initial Sa02 reading done. Oxygen may be increased until Sa02 levels of 90%-92% are obtained.
- **Precautions**
  - **Pulse oximetry values may be inaccurate in a variety of situations.**
  - Inaccurate readings can be seen with patient movement, the presence of nail polish, vasoconstriction, decreased peripheral perfusion, hypotension, hypothermia, abnormal hemoglobins, hypovolemia, carbon monoxide poisoning, smoke inhalation, and methemoglobinemia.
  - Prehospital personnel should correlate the Sa02 reading with the clinical status of the patient.

5. **Needle Thoracostomy** (from CJCFPD Procedural Protocol, Needle Thoracostomy P 34.0)

- **Indications**
  - Tension pneumothorax is a clinical diagnosis which should be considered when the following signs/symptoms are present:
    - Progressing severe respiratory distress.*
    - Progressive shock (BP <80mmHg with decrease in LOC) *
    - Decreased or absent breath sounds on the involved side.*
    - Jugular venous distention.
    - Tympany to percussion on the involved side.
    - Tracheal deviation.
    - Subcutaneous emphysema.
  - Signs 1 and 3 must be present or **approval from a base station physician** should be obtained prior to performing the procedure.
  - Tension pneumothorax is most common in the patient with:
    - Chest trauma.
    - The intubated patient with High airway pressures causing rupture of bronchioles or alveoli.

- **Technique**
  - Locate the second intercostal space in the mid clavicular line on the involved side of the chest.
  - Cleanse with betadine or alcohol as time permits.
  - Insert a 14 gauge "over the needle" catheter (Use 18 gauge if < 2 years of age) puncture, and advance needle to hub of catheter.
  - Insert the needle/catheter into the chest just over the top of the third rib.
  - As you enter the pleural space air and/or blood will escape.
  - Advance the catheter and remove the needle.
  - Secure in place.
  - The catheter has a tendency to kink. If reaccumulation of air in the pleural space is occurring, proceed with repeat needle thoracostomy.

- **Complications**
  - Creation of pneumothorax.
  - Damage to lung or viscera.
  - Bleeding (intercostal vessels are below each rib, therefore always go above the rib).
  - Infection.

- **Documentation (Omitted)**

6. **Patient History** (from the NAEMT Advanced Patient Assessment skill sheet, History Taking and Secondary Assessment)*APPLICABLE QUESTIONS OF BYSTANDER ONLY*

- History of present illness
  -Onset
  -Severity
  -Provocation
  –Time
  -Quality
- Clarifying questions of associated signs and symptoms as related to OPQRST
- Radiation

7. **Monitor and Rapid Interpretation** (from NRMET Advanced Dynamic Cardiology Skill Sheet)

- Check patient responsiveness
- Check ABCs [responsive patient] – or – check breathing and pulse [unresponsive patient]
- Initiate CPR if appropriate
- Attach ECG monitor in a timely fashion or apply paddles for “Quick Look”
- Correctly interpret initial rhythm
- Appropriately manage initial rhythm
- Note change in rhythm
- Check patient condition to include pulse and, if appropriate, BP
- Correctly interpret second rhythm
- Appropriately manage second rhythm

8. **IV Start** (from NAEMT Advanced Intravenous Therapy Skill Sheet)

  - Checks selected IV fluid for:
    - Proper fluid
    - Clarity
    - Expiration date
  - Selects appropriate catheter
  - Selects proper administration set
  - Connects IV tubing to the IV bag
  - Prepares administration set [fills drip chamber and flushes tubing]

- Cuts or tears tape [at any time before venipuncture] OR prepares veniguard.
- Takes or verbalizes body substance isolation precautions [prior to venipuncture]
- Applies tourniquet
- Palpates suitable vein
- Cleanses site appropriately
- Performs venipuncture
    - Inserts stylette
    - Notes or verbalizes flashback
    - Occludes vein proximal to catheter
    - Removes stylette
    - Connects IV tubing to catheter
    - Disposes/verbalizes proper disposal of needle in proper container
    - Releases tourniquet
    - Runs IV for a brief period to assure patent line
    - Secures catheter [tapes securely or verbalizes]
    - Adjusts flow rate as appropriate

9. **IV Medication Administration** (from NAEMT Advanced Intravenous Bolus Medications Skill Sheet)

- Asks patient for known allergies
- Selects correct medication
- Assures correct concentration of medication
- Assembles prefilled syringe correctly and dispels air
- Continues to take or verbalize body substance isolation precautions
- Identifies and cleanses injection site closest to the patient [Y-port or hub]
- Reaffirms medication
- Stops IV flow
- Administers correct dose at proper push rate
- Disposes/verbalizes proper disposal of syringe and needle in proper container
- Turns IV on and adjusts drip rate to TKO/KVO
- Verbalizes need to observe patient for desired effect and adverse side effects

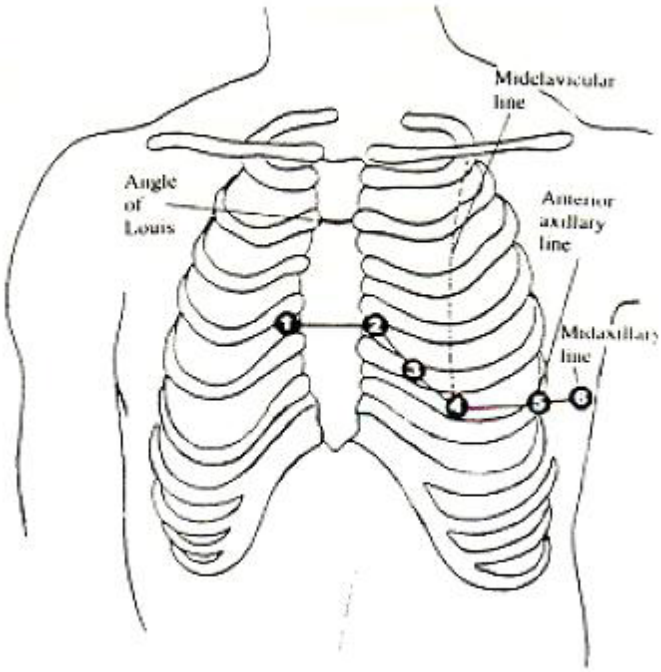
10. **12-lead ECG and Interpretation** (from CJCFPD Procedural Protocol, 12 Lead ECG, (operation of MRL PIC not included), P 9.0)

- **Indication:**

Any and all patients presenting with typical or atypical chest pain, or any associated symptoms when an Acute Coronary Syndrome (ACS) is suspected. Signs and symptoms of suspected ACS patients include Classic Angina (dull substernal discomfort described as pressure or tightness, with or without radiation), Anginal equivalent (no specific chest pain or discomfort, but presents with **dyspnea, palpitations, presyncope, or syncope)**, and Atypical chest pain (discomfort that is localized to the precordial area but has musculoskeletal, positional, or pleuritic features). The 12 lead should be done within 10 minutes of arrival.

- **Procedure: (Zoll E Series)**
  - Advise the patient of the need for a 12 lead ECG.
  - If the patient is a female, ensure privacy.
  - Remove any clothing covering the thorax (this includes the bra for a female).
  - Patient should be positioned in a position of comfort (supine is preferred).
  - Prepare the skin:
    - Shave the chest using the surgical razor.
    - Wipe the sites with a alcohol wipe.
    - Dry the skin using a 4X4 using a firm wiping motion (this removes the top layer of dead skin cells).
  - Place the electrodes (See figure):
    - LA- Left arm preferably on the shoulder area.
    - RA- Right arm preferably on the shoulder area.
    - LL- Left side below the diaphragm.
    - RL- Right side below the diaphragm.
    - V1- 4th intercostal space, Right of the sternum.
    - V2- 4th intercostal space, Left of the sternum.
    - V4- 5th intercostal space, midclavicular line.
    - V3- between V2 and V4.
    - V5- anterior axillary line, level of V4.
    - V6- mid-axillary line, level of V4.
  - Attach the precordial cables to the main ECG cable at the port.
  - Turn the Zoll E Series to “Monitor” mode
  - Enter patient information.
  - Advise the patient to remain as still as possible.
  - Depress the “ACQUIRE” button to begin the acquisition. The Zoll E Series will begin to print out your 12 lead with measurements.
  - Sending the 12 lead to medical control:
    - ((omitted))
  - Follow the ACS Protocol (AM 1.0).

- Proper placement of the Precordial Leads:



Appendix E

Perceived Procedure Times, experience comparison

Proc. Num	5 yr plus	1-4 yrs	Proc. Num	5 yr plus	1-4 yrs
1	170	130	31	30	30
2	70	80	32	40	170
3	160	260	33	240	230
4	110	190	34	140	80
5	120	130	35	90	90
6	130	100	36	90	90
7	80	50	37	180	190
8	60	40	38	120	120
9	200	210	39	100	130
10	50	60	40	60	70
11	60	60	41	60	110
12	70	70	42	40	40
13	280	540	43	70	100
14	110	110	44	140	230
15	100	200	45	50	60
16	160	130	46	70	90
17	70	90	47	190	180
18	50	40	48	210	220
19	60	40	49	90	150
20	140	110	50	60	50
21	100	170	51	180	240
22	110	90	52	90	110
23	80	50	53	40	40
24	110	90	54	120	110
25	150	80	55	230	230
26	160	90	56	120	130
27	300	220	57	250	390
28	200	150	58	440	730
29	60	60	59	110	170
30	180	140	60	120	150

(Portz, 2010, Appendix F)