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Evaluating the Effectiveness of Continuing Education at Emergency Medical Services

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EVALUATING THE EFFECTIVENESS OF CONTINUING EDUCATION AT EMERGENCY MEDICAL SERVICES

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Abstract

Emergency Medical Services (EMS) require staff to recertify periodically, which involves a significant amount of continuing education. Great effort is given to designing and delivering a continuing education program, but it is also important to know if the training had all of the intended impacts. Nationally, there is no evidence-based system in place for training evaluation at EMS. This research proposes a framework being used at East Baton Rouge Parish Emergency Medical Services (EBRP-EMS) to evaluate a course, generate reports to indicate the performance of staff, and identify areas of improvement.

The Kirkpatrick Model, which is a 4-level evaluation, is used in this research. The evaluation at multiple levels enables this model to create a holistic picture of the impact of a training, incorporating different types of data as opposed to simply looking at post-training feedback. The National Competency Course (NCC) is selected for the pilot study for this research. Reaction (Level 1) of trainees is measured using questionnaires that ask trainees to rate the quality of course content and instruction. The level of learning (Level 2) is evaluated using written post-tests which ask questions related to the course content. Evaluation of behavior (Level 3) and results (Level 4) are measured through Key Performance Indicators (KPIs) identified by stakeholders. These KPIs are indicative of critical behavior of Paramedics in the field and the targeted outcomes of the organization. An example of a KPI is “was End Tidal Carbon dioxide measured for cases of endotracheal intubation?”. This is recorded for individual Paramedics at Level 3. However, at Level 4, the same KPI is measured for the entire organization. The measurements are done using the data system in place for patient care reporting.

Data was collected for Paramedics that took the National Competency training and Clinical Guidelines exams during 2019. A stakeholder report is created to display the results found from this research. Descriptive statistics and Wilcoxon Signed-Rank tests are utilized for Levels 1(n=41, 38, 41, and 17), and 2(n=35 and 58). Test of proportions is utilized for Level 3 and 4. At Level 3, 25 KPIs are measured and tracked for 19 Paramedics, who took the NCC class in February 2019, over a period of 32 months. Additionally, at Level 4, 15 KPIs are measured and tracked for the entire agency over the same time period. Results from the statistical analysis indicate areas of improvement at each level.

The successful application of this framework has generated avenues of improvement for the training program at EBRP-EMS and has also created a link between the content taught in the NCC class to patient care in the field and the overall higher-level goals of the organization. Validation of this framework provides an evidence-based pathway for its use to other courses and potential for its national adoption for all Emergency Medical Services continuing education evaluations.

Chapter 1. Introduction

Typically, within the healthcare industry, continuing medical and nursing education are evaluated using reaction questionnaires and pre- or post-training assessments. Although this method can evaluate a trainee's reaction and level of learning, it does not evaluate changes in a trainee's behavior or the effects on an organization's targeted outcomes (1). There is a need within the healthcare continuing education realm to identify clinical outcomes or measures that can be used to evaluate the effects of training on trainee behavior and organizational targeted outcomes (2, 3). In 2000, Emergency Medical Services (EMS) published an Education Agenda which also identified the evaluation of continuing education as a gap and states the need to develop performance and outcome indicators (4). Continuing education and competency assurance are vital parts of EMS education, and so a procedure needs to be developed that uses a systems approach to evaluate the effectiveness of continuing education.

The lack of an evidence-based training evaluation is a nationwide problem for the healthcare industry, including EMS, and needs to be addressed. There is a great opportunity to address this gap in the healthcare industry, in particular with EMS, given the detailed record keeping associated with their activities. East Baton Rouge Parish Emergency Medical Services (EBRP-EMS) has a data system in place where patient and case information are stored. However, there is no system for identification of deviation from protocol in the reporting, especially the effectiveness of current and previous training. The data system in place can also be used to track field data from emergency calls, including potential Key Performance Indicators (KPIs). However, KPI's have not been identified in relation to the training program.

Given the nature of the job, where employees have to rely heavily on their training to conduct their duties, and the emphasis that EMS is placing on evidence-based systems, it is critical to address this gap. East Baton Rouge Parish Emergency Medical Services (EBRP-EMS) has been used as a test bed to implement and validate the proposed framework to evaluate the effectiveness of EMS training. However, this framework can also be used throughout the healthcare industry. Based on the research gap identified, the following objectives have been set for this research:

1. Develop and validate a framework to determine the effectiveness of continuing education at EMS
2. Create a pilot study to ensure that the framework is applicable
3. Determine a proper reporting format that will periodically report results to stakeholders
4. Document guidelines to implement the framework developed

Chapter 2. A Framework to Evaluate the Effectiveness of a Training Program at Emergency Medical Services

2.1. Introduction

There is a need within Emergency Medical Services for an evidence-based system to evaluate continuing education (4). EMS personnel rely heavily on their training to provide critical emergency medical care but there is no system in place to determine if they are retaining information from training or if they are adhering to protocol. However, the detailed record keeping mandated by the National Emergency Medical Services Information Systems (NEMSIS) provides an opportunity for the researchers to create a framework that EMS agencies can use to evaluate their continuing education program and identify gaps in training. A framework is introduced in this chapter, which is based on an established training evaluation methodology called the Kirkpatrick Model. The guidelines to adapt this framework by an EMS agency are also documented in Chapter 5.

2.1.1. The Kirkpatrick Model

A training evaluation can show the level of learning and changes in behavior along with the impact a business can have with the improved performance of employees (5). The Kirkpatrick Model is predominantly used for the evaluation of training programs. This model was originally created by Don Kirkpatrick in 1954 and has been adapted and widely used by training professionals in a variety of industries (6). There are four levels to the model:

1. Evaluation of Reaction: The degree to which trainees find the training favorable, engaging, and relevant to their jobs.
2. Evaluation of Learning: The degree to which trainees acquire relevant knowledge and skills from the training.
3. Evaluation of Behavior: The degree to which trainees apply the knowledge gained from training back on the job.
4. Evaluation of Results: The degree to which targeted outcomes of the organization are affected as a result of the training.

Levels 3 and 4 measure the degree to which the knowledge and skills gained from the training can affect performance measures and targeted outcomes(7). These measures are called the organizations' Key Performance Indicators (KPIs) (8).

Although there are publications available on the evaluation of training programs in different types of organizations, literature is scarce for the evaluation of training in EMS, including the application of the Kirkpatrick model. Additionally, literature is scarce for

the development of Key Performance Indicators (KPI) specifically for EMS training programs, although the National Highway Traffic Safety Administration (NHTSA) has published a list of recommended measures for EMS system and service performance (9). Also, several EMS organizations have developed systemwide KPIs (10-12). The proposed research will be addressing this particular gap.

2.1.2. KPIs in EMS

KPIs are not new to the world of EMS. Salonish et al. (2018) points out that every EMS organization is unique and can expect varying standards of performance. EMS organizations can have different levels of staffing, serve populations of different sizes, have varying levels of call volume, etc. This is why every EMS organization should identify the right KPIs based on their own priorities (13).

The data systems used by EMS can be a critical tool in measuring KPIs (12). The National Emergency Medical Services Information System (NEMSIS) requires EMS organizations to report their Electronic Health Records (EHR). Data from these EHRs can be aggregated to collect information such as response time, scene time, procedures performed, etc. Therefore, the framework proposed in this research should allow for an EMS organization to create their own KPIs and measure them by utilizing their in-house data system.

2.1.3. 6-stage KPI Methodology

Although the importance of KPIs and the ability to measure them using EHR is established, a methodology that outlines the steps to do so is needed. David Parmenter outlines a 6-stage KPI methodology in his book that is intended to be used for identifying KPIs (14). Additionally, this methodology incorporates steps to engage and get buy in from stakeholders. The stages are as follows:

1. Getting the senior management/stakeholders committed to the change.
2. Assign in-house staff members to work together and manage the KPI project.
3. Leading and selling the change to members of the organization.
4. Finding the organization's operational critical success factors (CSF). The CSFs are operational issues that need to be done well by members of the organization and can lead to the KPIs of the organization.
5. Determining KPIs that are appropriate for the organization and are defined clearly.
6. Measure the KPIs and create a reporting format that will be used periodically.

2.1.4. Continuing Education and the Data System at East Baton Rouge Parish EMS

The East Baton Rouge Parish Emergency Medical Service (EBRP-EMS) is the primary Advanced Life Support (ALS) provider for the parish of East Baton Rouge and currently employs 42 Emergency Medical Technicians (EMT), 2 Advanced EMTs, and 174 Paramedics (15). EMS personnel have 4 different certification levels: Emergency Medical Responder (EMR), Emergency Medical Technician (EMT), Advanced Emergency Medical Technician (AEMT), and Paramedic, with EMR being the lowest certification level and Paramedic being the highest. These certification levels differ based on factors like skills, practice environment, qualifications, risk, autonomy, etc. (16).

An EMS personnel is only allowed to perform a skill when they are educated, certified, licensed, and credentialed for that skill. Each level of EMS personnel has its own set of requirements to complete certification. This involves completion of education, as well as cognitive and psychomotor examination (17). In general, each recertification process involves a National component, a Local or State component, and an Individual component.

EBRP-EMS provides several trainings throughout the year for its personnel, including the National Competency Course (NCC). The NCC training satisfies the National component for recertification. This course is designed by the National Registry of Emergency Medical Technicians (NREMT) and covers a wide variety of topics shown in Appendix B.

EBRP-EMS offers the NCC training twice in a single year. A written Clinical Guidelines exam and psychomotor skills check off based on the contents of the NCC is scheduled during the Competency Evaluation. The Competency Evaluation takes up to 8 hours to complete. Due to time constraints, this evaluation does not take place immediately after the NCC training. In 2019, EBRP-EMS offered the NCC training in February and September, followed by the Competency Evaluation in October and December.

EBRP-EMS handles tens of thousands of calls in a year and it is crucial to store that data. When a 911 call is made, patient information is stored by creating Patient Care Reports. EBRP-EMS utilizes software created by a company named ESO for data entry and management. Data is collected by EMS personnel using a tablet and is recorded in the system, which can later be pulled up by logging into the ESO suite. ESO also allows the creation of reports, which can be programmed in a way to aggregate and report specific data. This feature has been utilized extensively in this research to measure all KPIs.

2.2. Methodology

Based on the needs of EMS, the literature review, and the literature gap identified, the following EMS Training Evaluation Framework is being proposed. This framework is designed based on the integration of the Kirkpatrick model and the 6 stage KPI methodology. A visual representation of the EMS Training Evaluation Framework is shown in Figure 1 below. Each level of the framework is completed using a primary tool i.e. a questionnaire for Level 1, a written assessment for Level 2, and KPIs for Level 3 and 4. The overall procedure of the framework is based on Parmenter's 6-stage KPI methodology.

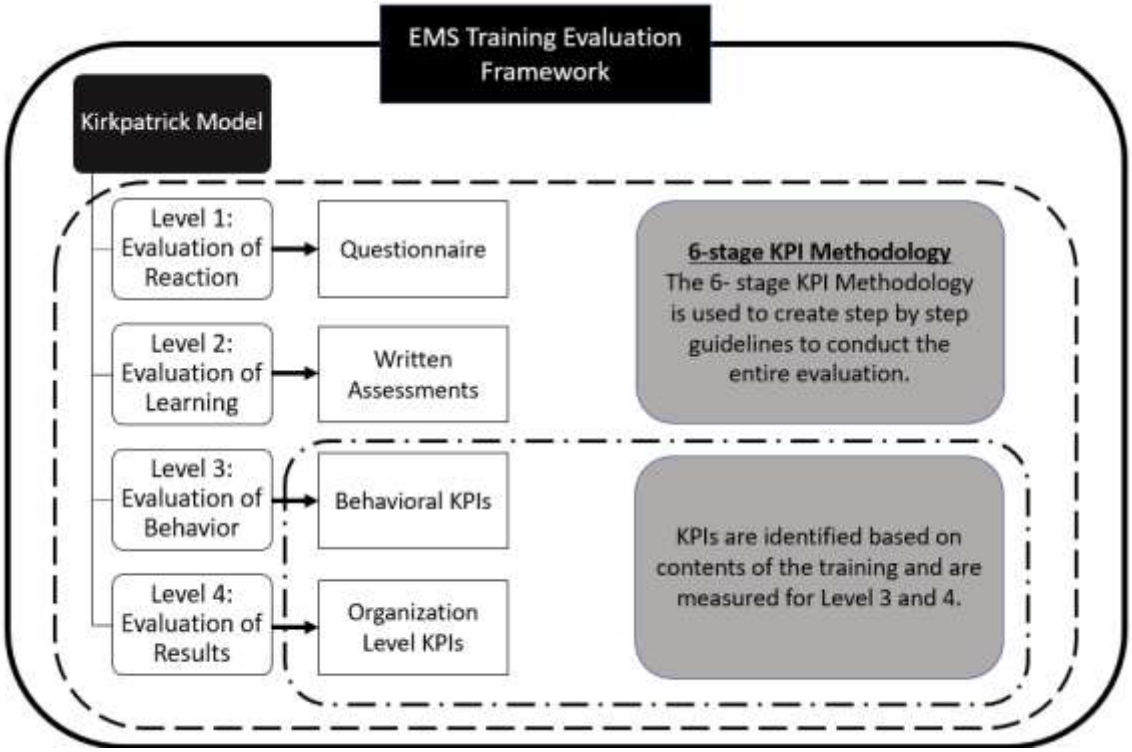


Figure 1. EMS Training Evaluation Framework

The sample for this study is a group of trainees taking the training at the same time. Here is how the EMS Training Evaluation Framework can be applied for any EMS training:

2.2.1. Stage 1. Get EMS Leadership on Board

Once an EMS agency decides to implement the EMS Training Evaluation Framework, senior leadership/stakeholders at the EMS organization are informed about the study and approval is gathered. The stakeholders can be the Chief of Operations, Medical

Director, Training Supervisor, Data System Expert and other relevant senior leadership members. One staff member is assigned as a facilitator for the project.

2.2.2. Stage 2. Involve In-house Staff to Create a KPI Team

A KPI team is formed with the Chief of Operations, Training Supervisor, Data Expert, and Medical Director and other relevant senior leadership members. Members of this group are the stakeholders of this study. They are consulted throughout the project to develop questionnaires, identify KPIs, review results, and make recommendations.

2.2.3. Stage 3. Lead and Sell the Changes

A proposal is presented to the stakeholders at the EMS organization to explain how this framework can utilize the data collected to identify areas of improvement. Once approval is gathered, the study can be continued.

2.2.4. Stage 4. Find the Critical Success Factors

Critical Success Factors (CSF) are operational duties that need to be done well by EMS personnel on a day-to-day basis. A brainstorming session can be arranged for the KPI team to review the contents of a training and identify the CSFs.

2.2.5. Stage 5. Determine KPIs

Once the CSFs are identified, the KPI team will review them to identify the KPIs of the training. The KPIs that need to be measured for individual EMS personnel are the Level 3 KPIs. The KPIs that need to be measured at an organization level, that is for the entire EMS agency, are the Level 4 KPIs. Each KPI needs to have a specific definition in order to avoid confusion. Additionally, the Data System Expert needs to ensure that the KPIs are measurable from the data system.

Also, at this stage, Level 1 questionnaires need to be developed by the KPI team. If there is no existing Level 2 pre- or post-training assessment, one needs to be developed. Further information on the methodology at each level is available in section 2.2.7. A step-by-step task list is also provided in Table 7.

A database is created to measure the KPIs. The in-house data system is utilized to create reports that can extract the data for each KPI. Additionally, data is collected from Level 1 questionnaires and Level 2 assessments. Analysis will be conducted on the data collected based on the analysis procedure outlined in Chapter 3.

2.2.6. Stage 6. Create a Reporting System

At this stage, a report is created to be presented to the stakeholders according to the reporting format outlined in Table 1. The stakeholders can then make recommendations for improvements. Once those improvements are implemented, the same procedure can be followed to collect data and measure KPIs and see how the report has changed.

2.2.7. Methodology at Each Level

Level 1 Reaction: This level will evaluate the reaction of the trainees who have completed the training. A questionnaire is developed which is handed out after the training. The questionnaire is anonymous and includes questions about the following: demographics of the trainee, quality of the training material presented, facilities available to the trainees, understanding of the facilitator in the subject, and the quality of the facilitator's delivery.

The questionnaire is made in collaboration with the stakeholders. This can be the Medical Director, Training Supervisor and senior leadership at the EMS organization, who will also determine the target scores for each question on the survey. The group will also decide on a suitable Likert scale. Using a Likert scale quantifies the data collected from the questionnaire and allows for descriptive statistics (18, 19). The mean, median, and standard deviation of each question's score can be found for the entire questionnaire. A Shapiro-Wilk test is conducted to determine if the data shows a normal distribution, in which case a t-test is done to see if the mean score is significantly lower than the target. If the data does not follow a normal distribution, Wilcoxon Signed-Rank test results are used to draw conclusions.

Level 2 Learning: This level evaluates the level of learning of the trainees who have completed the training. The evaluation of learning is typically done using pre and/or post-tests. Most of the trainings offered at EBRP-EMS include exams after the training which can be utilized for this level. If a training does not have an existing test, the stakeholders can create one by reviewing the contents of the training and focusing on the key aspects that need to be retained by the trainees.

Descriptive statistics can be conducted to find the mean and standard deviation of the scores for each individual question and the overall written exam. The stakeholders can decide what is an acceptable score and the overall exam score is tested to see if it is significantly lower than that number. Further analysis can be done by breaking up the contents of the test into different sections to see how scores vary throughout. If pre and post-tests are available for a certain training, a comparison can be done with mean scores of the two tests to determine if there has been a significant increase in scores. A Shapiro-Wilk test is conducted to determine if the data shows a normal distribution, in which case a t-test is done to see if the mean score is significantly lower than the target. If the data does not follow a normal distribution, Wilcoxon Signed-Rank test results are used to draw the same conclusion.

Level 3 Behavior: This level evaluates the changes in behavior of the trainees who have completed the training. Based on the literature review, the Level 3 evaluation requires the development of KPIs based on the contents of the training.

It is important to involve the stakeholders while developing the KPIs. The Training Supervisor, Medical Director and senior leadership at the EMS organization can identify the KPIs for the training by reviewing the contents of the course. The team members will also provide the target value for each of the KPIs. The Data System Expert, who can be a member of the organization that is most familiar with the system, can ensure that the KPIs are measurable and that the data for each KPI is available. The data system is utilized to measure the KPIs for each individual trainee. Test of proportions are done on the measures to see if the compliance of each KPI is significantly lower than the target value. A complete list of Level 3 KPIs identified by EBRP-EMS is available in Appendix H.

Level 4 Results: This level evaluates if the training is supporting the mission and goals of the organization. The stakeholders at the EMS organization identify the targeted outcomes or the organization level KPIs. These KPIs are in connection to the training and represent how the training is affecting the bottom line of the organization. The stakeholders also set the targets for the KPIs.

The Data System Expert ensures that the KPIs are measurable and that the data is available in the system. The data system is utilized to measure the KPIs for the organization through a significant period of time to identify any trends. Test of proportions are conducted to see if the measures are significantly lower than the target values. A complete list of Level 4 KPIs identified by EBRP-EMS is available in Appendix J.

2.3. Case Study at East Baton Rouge Parish EMS (EBRP-EMS)

To ensure that the EMS Training Evaluation Framework is applicable, a pilot study needs to be conducted at an EMS organization. Once the applicability is proven for the framework, it can be adapted at other EMS organizations.

The application of the framework proposed in this research needs to be tailored based on the needs of EBRP-EMS, and the capabilities of their data system. For this research, the framework is applied on the National Competency Course (NCC) as a pilot. The NCC is required for all EMS personnel to take every 2 years and covers a wide variety of topics. The NCC is also required for the completion of the National Component for recertification, which counts towards 30 hours out of a total of 60 hours for Paramedics. Since this training has a significant weight in the recertification process, it is a good test case for the framework.

EBRP-EMS is the primary ALS provider for the parish of East Baton Rouge, serving a population over 440,000. EBRP-EMS currently employs a total of 218 EMS personnel,

174 of whom are Paramedics. The Paramedics cover all the content of the NCC training while EMTs do not. Conducting the study on both EMTs and Paramedics would require the researchers to work with separate sets of metrics, surveys, tests, etc. and so for simplicity, this study is conducted on the field Paramedics working full time at EBRP-EMS. Data was collected during the NCC trainings and Clinical Guidelines exams conducted in 2019, shown in Figure 2.

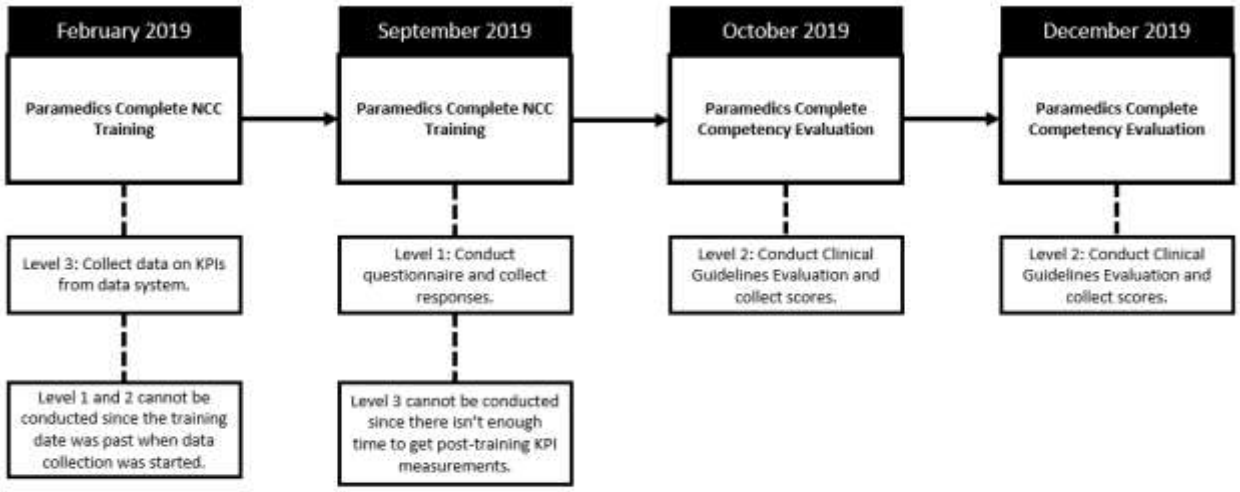


Figure 2. 2019 NCC trainings timeline and data collection

In order to collect data for the implementation of the EMS Training Evaluation Framework, data is collected at different points of the 2019 NCC trainings timeline (Figure 2). For Level 1, questionnaires were completed after each training day for the September 2019 NCC training, with the overall questionnaire being filled out at the end of day 3 (day 1 n=41, day 2 n=38, day 3 n=41, and overall n=17). For Level 2, data was collected from the October and December 2019 Clinical Guidelines exams (n=35 and n=58, respectively). 19 full time field Paramedics participated in the February 2019 NCC training, and their individual performance on the 25 KPIs from Level 3 were collected from January of 2017 to August 2019. Finally, the overall performance on the 15 KPIs from Level 4 were collected for the entire EMS organization from January 2017 to August 2019.

A limitation of this study is that the researchers had no control over the sample size. Paramedics are free to choose when they would like to attend training and complete their Competency Evaluation based on their preferences. Another limitation is that there is no way to create a control group in this study, since all EMS personnel have to complete the training.
The stages of the study, according to the 6-stage KPI methodology, are outlined below.

2.3.1. Stage 1. Get EMS Leadership on Board

A need was identified by staff members at EBRP-EMS to create a systematic procedure that can identify gaps in training based on the performance of Paramedics and the targeted outcomes of the organization. Researchers at Louisiana State University were asked to conduct the study and senior leadership/stakeholders at EBRP-EMS were informed about the research and approval was gathered. A graduate student was assigned as the facilitator for the research.

2.3.2. Stage 2. Involve In-House Staff

A KPI team was formed with the Training Supervisor, Data Expert, and Medical Director. Additionally, other senior leadership members were consulted throughout this research for input. Members of this group are the stakeholders of this study. This KPI team developed the Level 1 questionnaires, approved the use of the Clinical Guidelines exam as the Level 2 assessment, and identified the KPIs at Level 3 and Level 4. Taking into consideration the priorities of the organization, the KPI team identified target values that were used in the data analysis to generate reports. They also reviewed the results from the analysis to make recommendations for the future.

2.3.3. Stage 3. Lead and Sell the Changes

A proposal was presented to the stakeholders at EBRP-EMS to show how this framework can utilize data collected from questionnaires, assessments, and KPIs to identify areas of improvement. The research was continued once approval was gathered.

2.3.4. Stage 4. Find the Critical Success Factors and Stage 5. Determine KPIs

A series of brainstorming sessions were conducted to finalize the Level 1 questionnaires, and Level 2 pre- and/or post-training assessments. Additionally, the contents of the training were reviewed in order to determine the Level 3 and Level 4 KPIs. In the meetings, stakeholders also decided the target values for the questionnaires, assessments, and KPIs based on the priorities and goals of the organization.

Level 1 Reaction. This level evaluates the reaction of the trainees who have completed the NCC training. A 4-part questionnaire was developed for the September 2019 NCC training. A questionnaire was handed out at the end of each of the 3 days of training in addition to an overall questionnaire given at the end of day 3. The questionnaires were anonymous and included questions about quality of the course material presented, facilities available to the trainees, understanding of the instructor in the subject, and the quality of the facilitator’s delivery. The number of responses for each questionnaire are

as follows: 41 for Day 1, 38 for Day 2, 41 for Day 3 and 17 for the Overall questionnaire. The complete questionnaires are available in Appendix C.

The questionnaire was made in collaboration with the senior leadership at EBRP-EMS. A 5-point Likert scale was used to quantify the data collected and the target score for each question was set to be 3. Shapiro-Wilk tests were conducted to see if responses for each question followed a normal distribution, and Wilcoxon Signed-Rank tests were conducted to test the following hypothesis: $H_0: \mu = \mu_0$ and $H_a: \mu \neq \mu_0$. If the null was rejected, it was concluded that the actual responses from the questionnaire was not equal to the target score. The actual score is then observed to see if it is lower or higher than the target. If lower, it is concluded that the actual score is significantly below the target score and this is identified as an area of improvement. If the null could not be rejected, it indicated that the actual responses for a particular question was equal to the target.

Level 2 Learning. This level evaluates how well trainees are retaining information after completing the NCC training. This level is typically completed using pre and/or post-tests. During the Competency Evaluation, a written Clinical Guidelines exam is completed by the trainees which test them on material from the NCC training. The exams in 2019 had 100 multiple choice questions. There were 35 participants in October 2019 and 58 in December 2019. Scores from these exams were collected and analyzed according to sections of the NCC training. The breakdown of questions according to sections on the test are provided in Appendix F and the stakeholders have set target scores for each of these sections. Shapiro-Wilk tests were conducted to see if scores for each section followed a normal distribution, and t-tests or Wilcoxon Signed-Rank tests were conducted to test the following hypothesis: $H_0: \mu = \mu_0$ and $H_a: \mu \neq \mu_0$. If the null was rejected, it was concluded that the actual scores for a section was not equal to the target score. The actual score was then observed to see if it is lower or higher than the target. If lower, it is concluded that the actual score is significantly below the target score and this is identified as an area of improvement. If the null could not be rejected, it indicated that the actual responses for a particular question was equal to the target.
A limitation at this level is that the expertise level of the Paramedics can have an effect on their performance on the test. However, the methodology used in this research cannot limit this external factor.

Level 3 Behavior. This level will evaluate the behavior of the trainees who have completed the training. 25 KPIs based on the contents of the NCC training were identified with the collaboration of the KPI team, who also set the target compliance percentage for each KPI. Reports were created via the ESO suite to measure these KPIs. A complete list of all Level 3 KPIs and their respective targets is provided in Appendix H. The February 2019 NCC training had 19 full time Paramedics as participants, and this class was selected as the sample for this level. The 25 KPIs were

measured for each of these Paramedics starting from January of 2017 to August of 2019.

A limitation at this level is that the researchers had no control over how many data points can be collected for each Paramedic, since the occurrence of a particular incident is completely random. Some incidents occur more often than others, which also affects the number of data points available for a particular KPI. Additionally, the data system at EBRP-EMS has data available for certain KPIs starting only from January of 2018.

Since the KPIs are set up in a way to either measure success or failure in any particular incident, the most appropriate test in this case is a test of proportions. The number of successes that a Paramedic achieves for a particular KPI within the given timeline was recorded. The proportion of success (p) was calculated by dividing the number of successes to the total number of incidents. Test of proportions were conducted with the Hypothesis $H_0: p = p_0$ and $H_a: p < p_0$, where p_0 is the target proportion for a particular KPI. If p-value is small, the null is rejected. This indicates that actual proportion is significantly lower than hypothesized or target proportion. If the null is rejected, it indicates an area of improvement that needs an intervention.

Level 4 Results. This level evaluates how well the training is supporting the targeted outcomes of the organization. The KPI team at EBRP-EMS have identified 15 KPIs based on the contents of the NCC training which represent higher level targeted outcomes of the organization. Reports were created via the ESO suite to measure these KPIs. These KPIs were measured for all EMS personnel from January of 2017 to August of 2019. Test of proportions were conducted with the Hypothesis $H_0: p = p_0$ and $H_a: p < p_0$, where p_0 is the target proportion for a particular KPI. If p-value is small, reject the null. This indicates that actual proportion is significantly lower than hypothesized or target proportion. If the null is rejected, it indicates an area of improvement that needs an intervention.

Limitations at this level are similar to that of Level 3. Researchers had no control over how many data points can be collected since the occurrence of a particular incident is completely random. Some incidents occur more often than others. Additionally, the data system at EBRP-EMS has data available for certain KPIs starting only from January 2018. A complete list of Level 4 KPIs is available in Appendix J.

2.3.5. Stage 6. Measure the KPIs and create a reporting system

Once the data is analyzed, an additional reporting session with the stakeholders was conducted where analysis results were presented and areas of improvements were pointed out. Using a 5-Why's approach, the cause of each area of improvement was determined, and recommendations were made for improvements. Based on feedback gathered from senior leadership, the reporting format shown in Table 1 has been finalized to display the results of the training evaluation.

The researchers collaborated with the Medical Director, Training Supervisor, Data System Expert, and the senior leadership of EBRP-EMS to determine a reporting format. An iterative approach was taken in developing the report, until the final version was determined using the stakeholders' feedback. The frequency of the reporting will be once a year, which will allow the organization to collect and analyze data from a year of training. The report will be sent to all senior leadership members of the organization, including the Medical Director, Training Supervisor, and Data System Expert. These considerations are based on Stephen Few's Dashboard Design Questionnaire (20). Table 1 below shows what information will be made available in the report at each level of the Kirkpatrick model.

Table 1. Reporting Format

Level	Reporting Information
1. Evaluation of Reaction	Table showing descriptive statistics and t-test/ Wilcoxon signed rank test results.
	Table illustrating the scores given by participants in percentage.
2. Evaluation of Learning	Table showing the breakdown of questions on the written assessment according to topics of the NCC training.
	Table showing descriptive statistics and t-test/ Wilcoxon signed rank test results.
3. Evaluation of Behavior	Table listing all KPIs with respective target compliance percentages.
	Matrix showing the compliance percentages each KPI according to Paramedics.
4. Evaluation of Results	Table listing all KPIs with respective target compliance percentages.
	Matrix showing the compliance percentages of each KPI with respect to time.

2.4. Validity

The Kirkpatrick Model and the 6-stage KPI methodology are both well-established concepts, which adds to the construct validity of this work. Additionally, NEMSIS mandates have ensured that all EMS agencies collect the same set of data and uses a standardized format for patient care reporting. This means that the framework proposed in this research can easily be applied to any EMS agency and provides a systematic continuing education assessment process. Furthermore, the stakeholders of the project evaluated the tools and processes of the EMS Training Evaluation Framework and validated that the it can be applied to an EMS organization, providing face validity.

The responses from the questionnaires administered in Level 1 in this study has been analyzed to determine the following Cronbach's Alpha values: Day 1 – 0.98236, Day 2 – 0.97752, Day 3 – 0.95385, and Overall – 0.90661. This indicates high reliability for the responses collected from the questionnaire and adds to the content validity of the study.

The common KPIs measured in both Level 3 and 4 have a correlation coefficient of 0.9893, showing high positive correlation. This indicates high concurrent validity for the study.

Finally, factors like expertise level, partnership assignments, natural ability, etc. can have an effect on their performance on the field, and this framework cannot control this confounding factor. This can negatively impact the internal validity of the framework.

Chapter 3. Analysis

Data collected at each level of the EMS Training Evaluation Framework needs to be analyzed to identify areas of improvement. Table 2 below outlines the procedure to identify areas of improvement based on the data collected. The researchers utilized a statistical software called JMP for this research.

Table 2. Analysis procedure to identify areas of improvement at each level

Level	Procedure
Level 1: Evaluation of Reaction	Conduct descriptive statistics on responses for each question on the questionnaire. Conduct Shapiro Wilk test to determine if the scores for a certain question follows a normal distribution. Conduct a Hypothesis test with $H_0: \mu = \mu_0$ and $H_a: \mu \neq \mu_0$. If data follows a normal distribution, use t-test results to draw conclusion, otherwise use Wilcoxon Signed-Rank test results. If p-value is small, reject the null. This indicates that there is insufficient evidence that the actual score is equal to the hypothesized score (target). Observe to see if the actual score is less than the hypothesized score and if so, conclude that it is significantly below the target. If the actual score is higher than the hypothesized score, conclude that the actual score is significantly above the target.

Level	Procedure
Level 2: Evaluation of Learning	Organize the questions on the written assessment according to sections of the NCC training. Conduct descriptive statistics on scores achieved on each section of the assessment. Conduct Shapiro Wilk test to determine if the scores for a certain section follows a normal distribution. Conduct a Hypothesis test with $H_0: \mu = \mu_0$ and $H_a: \mu \neq \mu_0$. If data follows a normal distribution, use t-test results to draw conclusion, otherwise use Wilcoxon Signed-Rank test results. If p-value is small, reject the null. This indicates that there is insufficient evidence that the actual score is equal to the hypothesized score (target). Observe to see if the actual score is higher than the hypothesized score and if so, conclude that it is significantly below the target. If the actual score is higher than the hypothesized score, conclude that the actual score is significantly above the target.

Level	Procedure
Level 3: Evaluation of Behavior	The data system at EMS organizations can be utilized to measure the KPIs for each individual trainee for a particular class of NCC training over a period of time. Each KPI should be set up as a Yes or No question, so a Paramedic either succeeds or fails to perform a particular task in a specific situation. The proportion of success to total number of incidents (p) can be calculated and a matrix can be created to display the proportion of success for each KPI for every Paramedic. Test of proportions can be conducted with the Hypothesis $H_0: p = p_0$ and $H_a: p < p_0$. If p-value is small, reject the null. This indicates that there is insufficient evidence that actual proportion is equal to the hypothesized or target proportion. If the null is rejected, it indicates an area of improvement that needs an intervention.
Level 4: Evaluation of Results	The data system at EMS organizations can be utilized to measure the KPIs for all EMS personnel at an organization over a period of time. Each KPI should be set up as a Yes or No question, so a Paramedic either succeeds or fails to perform a particular task in a specific situation. The proportion of success to total number of incidents (p) can be calculated over a time increment (for example, 3 months) and a matrix can be created to display the proportion of success for each KPI with respect to time. Test of proportions can be conducted with the Hypothesis $H_0: p = p_0$ and $H_a: p < p_0$. If p-value is small, reject the null. This indicates that there is insufficient evidence that actual proportion is equal to the hypothesized or target proportion. If the null is rejected, it indicates an area of improvement that needs an intervention.

Chapter 4. Results

4.1. Level 1 Evaluation of Reaction

A total of 4 questionnaires were conducted during the 3 days of the September 2019 NCC training. A 5-point Likert scale was used to rate each question, with 1 being the most negative and 5 being the most positive response. The target score for every question was set as 3 by the stakeholders, who had determined that scores below a 3(neutral) were unacceptable. Wilcoxon Signed-Rank test results showed that none of the responses of all questions in all 4 questionnaires were significantly below the target score and no area of improvement was determined. Table 3 below shows the responses gathered for the Overall questionnaire and shows the percentage of participants that gave an item a particular score.

Table 3. Score breakdown for the overall questionnaire

	Score of 1	Score of 2	Score of 3	Score of 4	Score of 5	Total
This course is relevant to my day-to-day job requirements.	0%	12%	6%	6%	76%	100%
This course contributed to my understanding of medical training.	0%	6%	12%	24%	59%	100%
This course contributed to my understanding of clinical evaluation.	0%	6%	18%	18%	59%	100%
The instructor was prepared and organized for each class.	0%	6%	12%	12%	71%	100%
Questions were encouraged and answered. Clear and complete answers were given.	0%	0%	12%	18%	71%	100%
How would you rate the overall quality of the course?	0%	0%	29%	35%	35%	100%

4.1.1. Improvements

From Table 3 above, although scores are skewed towards positive scores (e.g. 4 and 5), some more investigation is warranted to evaluate reasons some participants scored neutral or negatively some items on the questionnaire. For example, from Table 3, 24% of participants rated the contribution of the course to their understanding of clinical evaluation as 3 or below. Also, 29% of participants rated the overall quality of the course as a 3. Although a majority of participants rated everything with high scores, there is a large number of people that did not. Senior leadership members believe that this is the case because the NCC training has remained the same for several years and is in need of being updated. Although the syllabus of the training is determined by the

NREMT, EMS agencies are free to choose how they would like to teach the material. EBRP-EMS intends to update the course with more hands-on learning opportunities and psychomotor demonstrations. Another improvement they have proposed is reducing the size of the class so that the instructor can be more accessible to the trainees. These improvements will be rolled out in the upcoming trainings in 2020.

4.2. Level 2. Evaluation of Learning

Identical multiple-choice assessments (Clinical Guidelines Exam) with 100 questions were handed out to 35 trainees in October 2019 and 58 trainees in December 2019. A complete breakdown of the questions according to the topics of the NCC training is provided in Appendix F. The topics with the highest number of questions on the test are Medication Delivery (16 questions), Ventilation/Oxygenation (14 questions), and Adult/Pediatric Cardiac Arrest (12 questions). T-tests and Wilcoxon Signed-Rank tests were conducted to conclude that the score achieved in Medication Delivery and Ventilation/Oxygenation were significantly lower than the target score, both in October and December. A Bonferroni adjustment was conducted to change the alpha level to 0.0125. The results in Table 4 and 5 indicate that Paramedics are not retaining information well on 2 major sections on the assessment. However, EBRP-EMS needs to take practical significance into account while making their decisions based on these results. Complete results for all sections of the test are available in Appendix G.

Table 4. Analysis of scores achieved in October 2019 for sections with the most questions on the Clinical Guidelines Exam

	Number of Questions	Target Score	N	Mean	Median	Std Dev	Signed-Rank Prob > |t|	Hypothesis Ho: $\mu = \mu_0$ Ha: $\mu \neq \mu_0$	Conclusion
Overall	100	80	35	76.09	77	11.71	0.0562 (t-test)	Fail to reject null	Actual score is equal to the target
Medication Delivery	16	14.4	35	12.57	13	2.10	<0.0001	Reject null	Actual score is significantly lower than target
Ventilation/ Oxygenation	14	12.6	35	10.51	10	1.72	<0.0001	Reject null	Actual score is significantly lower than target
Adult/Pediatric Cardiac Arrest	12	10.8	35	10.37	11	1.52	0.2757	Fail to reject null	Actual score is equal to the target

Table 5. Analysis of scores achieved in December 2019 for sections with the most questions on the Clinical Guidelines Exam

	Number of Questions	Target Score	N	Mean	Median	Std Dev	Signed Rank Prob > |t|	Hypothesis Ho: $\mu = \mu_0$ Ha: $\mu \neq \mu_0$	Conclusion
Overall	100	80	58	76.26	78	13.39	0.0376 (t-test)	Fail to reject null	Actual score is equal to the target
Medication Delivery	16	14.4	58	12.53	13	2.65	<0.0001	Reject null	Actual score is significantly lower than target
Ventilation/ Oxygenation	14	12.6	58	9.97	10	2.17	<0.0001	Reject null	Actual score is significantly lower than target
Adult/Pediatric Cardiac Arrest	12	10.8	58	10.36	11	1.44	0.1776	Fail to reject null	Actual score is equal to the target

4.2.1. Improvements

A major reason that trainees may not be performing as expected on the written assessment is because their results have no effect on their recertification. This could lead certain trainees to not put in any effort on the assessments. An improvement that has been proposed is to include the trainees' scores as a part of their annual evaluation. Senior leadership also hopes that the changes proposed in Level 1 to add in more psychomotor demonstrations and hands-on learning opportunities to the training can improve their retention of information. Based on the breakdown of the questions according to sections, senior leadership has decided to incorporate more questions for particular topics in the Clinical Guidelines assessment. This would create more questions for sections that have a higher priority for EBRP-EMS. The style of the questions will also be changed to be more scenario based. This will test the trainee's actual understanding of topics and not just their memorization capability.

4.3. Level 3. Evaluation of Behavior

The EBRP-EMS KPI team reviewed the contents of the NCC training and identified 25 KPIs and set targets for each of them based on the priorities and goals of the organization. These 25 KPIs were documented for 19 Paramedics from January of 2017 to August 2019. A matrix was created with the proportion of successes of each KPI, shown in Appendix I. Test of proportions is conducted on each KPI to determine if the proportion of success is significantly lower than the target, which shown in the shaded cells with asterisks. The benefit of completing this level is that it can show which KPIs a Paramedic is underperforming in and stakeholders can then recommend them to focus on improving those specific skills. They can also look to see if an entire class is underperforming in certain areas, and that would indicate areas that need to be emphasized for everyone during training or other venues.

4.3.1. Improvements

The benefit of this level is that an EMS organization can assess if the underperformance on a KPI is simply an individual issue or a group issue. In the current study, certain KPIs had very few data points, which made it difficult to determine any areas of improvement (KPIs 2, 11a, 11b, 15, 16, 17a, 17b, 21a, 21b, and 22).

Results revealed that a majority of Paramedics are underperforming in 3 KPIs: KPI 10 (In cases of stroke, was scene time less than 15 minutes?), KPI 14b (In cases of Acute Coronary Syndrome, was a 12-lead acquired within 5 minutes?), and KPI 18 (In cases of trauma, was scene time less than 10 minutes?). Senior leadership has decided to review and emphasize content related to this area in the next round of training.

In the case of KPIs 13(In cases of ACS, was aspirin administered?), and 20 (In cases of trauma with systolic BP less than 80, was IV fluid warmed?) the compliance rate has been very low because of documentation error. Paramedics typically tend to document these items in the narrative section of their report and not the flowchart, which can lower the compliance rate. However, emphasis will be given on these areas during training to correct the way documentation is done to aligned with the reporting process of their data system.

4.4. Level 4. Evaluation of Results

The EBRP-EMS reviewed the contents of the NCC training and identified 15 KPIs that are representative of the targeted outcomes of the organization, and set targets for each KPI based on the priorities and goals of the organization. 15 KPIs were measured for all EMS personnel from January of 2017 to August of 2019. A matrix was created with the proportion of successes of each KPI, shown in Table 6. Test of proportions was conducted for each KPI to determine if the proportion of success is significantly lower

than the target, which are in the shaded cells with asterisks. The benefit of this level is that it can show which KPIs the entire organization is underperforming in, and senior leadership can then create larger initiatives to focus on improving those areas.

Table 6. Compliance Percentages of Level 4 KPIs.

		2017				2018				2019		
	Target	**Jan to Mar**	**Apr to Jun**	**Jul to Sep**	**Oct to Dec**	**Jan to Mar**	**Apr to Jun**	**Jul to Sep**	**Oct to Dec**	**Jan to Mar**	**Apr to Jun**	**Jul to Aug**
KPI 1	95.00%	x	x	x	x	95.97%	93.86%	93.94%	97.62%	99.21%	98.28%	98.82%
KPI 2	50.00%	100.00%	100.00%	50.00%	0.00%	50.00%	x	100.00%	50.00%	33.33%	100.00%	100.00%
KPI 3a	90.00%	**84.10%***	86.67%	**84.57%***	**78.53%***	**79.26%***	**76.28%***	85.27%	**81.65%***	**84.62%***	**84.71%***	86.49%
KPI 3b	90.00%	98.46%	99.33%	99.38%	100.00%	99.47%	100.00%	100.00%	100.00%	98.90%	100.00%	100.00%
KPI 4	50.00%	**3.31%***	**28.77%***	**36.42%***	45.00%	**38.26%***	55.15%	57.63%	56.03%	61.11%	61.70%	70.48%
KPI 5	90.00%	x	66.67%	**57.14%***	**33.33%***	100.00%	**40.00%***	83.33%	100.00%	85.71%	100.00%	100.00%
KPI 6	95.00%	x	x	x	x	**88.82%***	91.93%	93.25%	91.86%	94.22%	**89.81%***	95.03%
KPI 7	90.00%	x	x	x	x	**46.84%***	**50.32%***	**53.13%***	**47.09%***	**42.94%***	**35.71%***	**43.23%***
KPI 8	95.00%	x	x	x	x	**61.86%***	**70.11%***	**63.86%***	**73.84%***	**73.84%***	**72.05%***	**74.31%***
KPI 9a	95.00%	x	x	x	x	**88.07%***	93.01%	**89.97%***	**89.09%***	**89.01%***	**91.09%***	93.15%
KPI 9b	90.00%	x	x	x	x	**35.00%***	**36.00%***	**37.00%***	**40.00%***	**42.00%***	**41.00%***	**47.00%***
KPI 10	95.00%	x	x	x	x	**15.00%***	**24.00%***	**18.00%***	**12.00%***	**11.00%***	**14.00%***	**14.00%***
KPI 11	95.00%	**58.04%***	**56.44%***	**61.39%***	**63.39%***	**67.88%***	**70.18%***	**69.84%***	**70.30%***	**68.76%***	**73.07%***	**72.94%***
KPI 12	95.00%	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**2.33%***	**11.11%***	**12.90%***	**5.66%***	**13.04%***
KPI 13	95.00%	x	x	x	x	**89.44%***	91.98%	92.64%	91.86%	93.64%	**89.87%***	95.03%
KPI 14	80.00%	89.44%	83.61%	82.21%	82.19%	80.57%	**74.59%***	82.53%	82.81%	86.90%	89.18%	85.16%
KPI 15a	95.00%	**84.55%***	**82.79%***	**86.99%***	**82.48%***	**82.53%***	**78.21%***	**84.40%***	**82.33%***	**86.01%***	**87.64%***	**87.73%***
KPI 15b	95.00%	96.35%	94.54%	94.85%	95.22%	96.08%	96.12%	95.41%	96.24%	96.54%	97.99%	96.18%

*Shaded cells indicate compliance rates that are significantly lower than EBRP-EMS target.

4.4.1. Improvements

The results from this level provides a higher-level view of performance for EBRP-EMS. KPI 4(In cases of endotracheal intubation, was a bougie utilized?) and KPI 5(If Intraosseous Infusion was done, and if the patient was over 8 years old, was the humeral site used?) show an improvement over time. This improvement is credited by the KPI team, to initiatives that were taken in the past specifically to address these areas.

Although EBRP-EMS is underperforming in KPI 3a (Was ETCO2 measured when a bronchodilator was used?), KPI 9a (In case of ACS, was a 12-lead acquired within 12 minutes?), and KPI 15a (If opioids were administered, was ETCO2 monitored?), the compliance rate isn't far off from the target. Senior leadership plans to emphasize these items in the future.

KPI 11(In cases of trauma, was SPO2 monitored?) has low compliance rates because it includes all cases of trauma. Mild cases of trauma may not require SPO2 monitoring. This KPI will be reviewed to include only more severe cases of trauma.

Similar to the results in Level 3, EBRP-EMS has low compliance rates for scene time in cases of stroke, aspirin administration in cases of ACS, acquiring a 12-lead within 12 minutes or within 5 minutes in cases of ACS, and scene time in cases of trauma. This indicates that underperformance in these areas is not just specific to certain Paramedics, but common amongst all EMS personnel. These areas will be addressed and emphasized in the future.

Chapter 5. Conclusions and Discussion

EMS has identified the need to develop an evidence-based approach to evaluate continuing education. A research gap is identified in the development of Key Performance Indicators that are indicative of the effects of training in the behavior of personnel and the targeted outcomes of an EMS organization. Utilizing the established Kirkpatrick Model and 6-Stage KPI Methodology, a tailored EMS Training Evaluation Framework was applied to the National Competency Course at EBRP-EMS. Guidelines from this pilot study were developed, that can be utilized by any EMS agency to evaluate their training program.

An EMS organization can assess the reaction of trainees at Level 1 by utilizing the questionnaires provided in Appendix C. This will provide senior leadership with information on participants' engagement level and their perception on the quality of the course, quality of instruction, and quality of facilities. In turn, the course can be improved based on the findings of this level. For example, EBRP-EMS found the need to add more psychomotor demonstrations and hands-on learning opportunities in their NCC training, which right now contains only PowerPoint presentations.

At Level 2 (Evaluation of Learning), an EMS organization can analyze scores from assessments to see how well trainees are retaining relevant information from the training. This Level also has the capability to narrow down to how well participants are retaining information on particular topics or sections of the test. This enables an organization to improve how content is presented in specific sections where trainees are underperforming. Even at this Level, the stakeholder at EBRP-EMS determined the need to include psychomotor demonstrations and hands-on learning in their training to increase engagement and retention.

The results in Level 3 (Evaluation of Behavior) provides a unique opportunity for stakeholders to identify Paramedics who are underperforming in specific areas. They can also determine if underperformance in certain area is in individual or a group issue. These areas can then be reviewed and emphasized in the next round of training. In the case of aspirin administration and using warmed IV fluids at EBRP-EMS, the compliance rates have been very low because of documentation error (21). Emphasis will be given on these areas during training to correct the way documentation is done.

Finally, the results from Level 4 (Evaluation of Results) provides a higher-level view of performance at an EMS organization. A correlation analysis between Level 3 and 4 can show if the performance of a training class is representative of the entire organization. Areas of improvement identified at this Level can warrant large initiatives from the organization. For example, EBRP-EMS saw a definite increase in bougie utilization during endotracheal intubation and using the humeral site during an intraosseous infusion over time. This can be directly credited to initiatives taken by EBRP-EMS in the

past to specifically address these areas and shows how proper training can affect organization-wide performance.

There is no standardized process available for training evaluation for EMS (4) and there is also a lack of literature for the utilization of the Kirkpatrick framework for EMS. Additionally, although systemwide KPIs have been identified, KPIs have not been developed from a training perspective, which this research addresses (9-13). The benefit of utilizing the EMS Training Evaluation Framework is that it provides a systematic and evidence-based process of measuring quality of training at different levels. Thus, a continuous improvement plan can be put in place to monitor and improve continuing education. Once the improvement recommended in this research are implemented, the same analysis can be conducted to see if performance has improved. Thus, begins a cycle of continuous improvement where data is gathered and analyzed to act as evidence that feeds into changes for an organization.

5.1. Guidelines

1. This training evaluation needs to be conducted with the guidance of subject experts/stakeholders along the way. The Training Supervisor, Data System Expert, Medical Director, and other senior leadership can act as stakeholders. A series of brainstorming sessions should be conducted to finalize the Level 1 questionnaires, and Level 2 pre- and/or post-training assessments. Additionally, the contents of the training need to be reviewed in order to determine the Level 3 and Level 4 KPIs. In this meeting, stakeholders should also decide the target values for the questionnaires, assessments, and KPIs. An additional reporting session with the stakeholders will be conducted where analysis results are presented and areas of improvements are pointed out. Using a 5-Why's approach, the cause of each area of improvement is determined, and recommendations are made for improvement.

2. One training class can be chosen for the pilot study and followed throughout its journey. For example, if the National Competency training is selected at an EMS organization, the following data shown in Figure 3 needs to be collected from the training class for Levels 1 through 3.

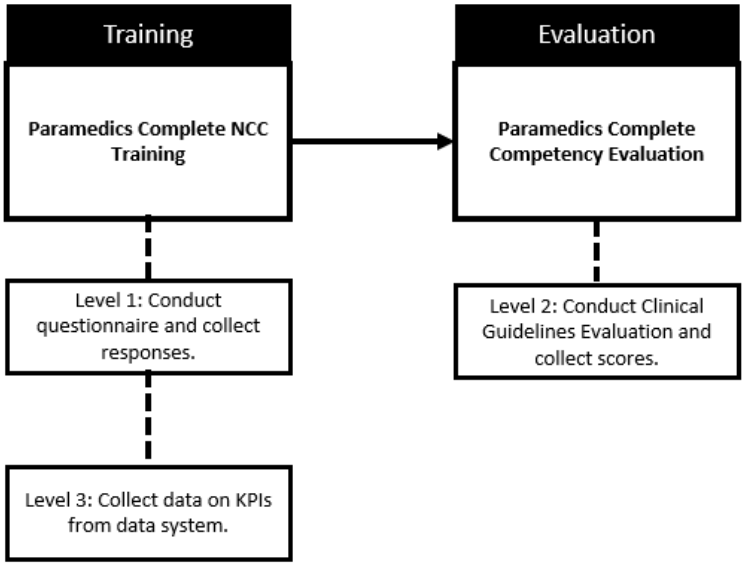


Figure 3. Data Collection for One Training Class

3. For a particular training class, the KPIs need to be measured for each Paramedic over a period of time. An appropriate time period needs to be established for these measurements. Once the data is collected, test of proportions can be done to determine if the proportion of success (p) is significantly lower than the target. In the pilot study, data was collected from January 2017 to August 2019 for 19 Paramedics that took the National Competency Course in February of 2019. Figure 4 below shows how the proportion values (p) can be displayed in a matrix.

	PM 1	PM 2	PM 3	. . .	PM m
KPI 1					
KPI 2					
KPI 3					
. . .					
KPI n					

Figure 4. Proportion of success (p) can be displayed in the matrix above

4. The Level 4 KPIs are also collected for a specified period of time. In the pilot study, these KPIs were also measured from January 2017 to August 2019. However, these KPIs should be measured for all EMS staff altogether, not individual Paramedics. Once the data is collected, test of proportions can be done to determine if the compliance proportion is significantly lower than the target.

Table 7 below relates how each stage of the 6-stage KPI methodology can be broken down into the tasks that need to be completed for a training evaluation. The tasks are then related to their corresponding levels of the Kirkpatrick Framework.

Table 7. Outline of EMS Training Evaluation Framework

Stage (6-Stage KPI methodology)	Tasks	Relation to Kirkpatrick Framework
1. Get EMS leadership on board	Present proposal to EMS leadership to seek approval	
2. Involve in-house staff	Form KPI team with EMS Training Expert, Data Expert, Medical Director, and other stakeholders	
3. Lead and sell the changes	Present proposal and findings to EMS to show the benefits of identifying KPIs	
4. Find the Critical Success Factors (CSF)	Collaborate with stakeholders to review contents of training and identify critical day-to day duties of Paramedics.	Level 3 Evaluation of Behavior and Level 4 Evaluation of Results
5. Determine Key Performance Indicators	Create appropriate survey to be filled out by trainees after training	Level 1 Evaluation of Reaction
	Collect, analyze and report data from survey results	Level 1 Evaluation of Reaction
	Create appropriate written assessment to be taken by trainees after training	Level 2 Evaluation of Learning
	Collect, analyze and report data from assessment scores	Level 2 Evaluation of Learning
	Collaborate with stakeholders/subject experts to identify Level 3 KPIs from the contents of the National Competency training and set their targets based on the priorities and goals of the organization	Level 3 Evaluation of Behavior
	Collaborate with stakeholders/subject experts to identify Level 4 KPIs and set their targets based on the priorities and goals of the organization	Level 4 Evaluation of Results
	Collaborate with Data System Expert to ensure that the KPIs are measurable and use the data system to measure the KPIs	Level 3 and Level 4

Stage (6-Stage KPI methodology)	Tasks	Relation to Kirkpatrick Framework
6. Create reporting system	Collaborate with stakeholders to determine the reporting format	Level 1, 2, 3, and 4
	Create the report according to the format. Make changes to the format as deemed necessary	Level 1, 2, 3, and 4
	Identify areas of improvement and recommend solutions	Level 1, 2, 3, and 4

Chapter 6. Limitations and Future Study

A limitation of this study is that the researchers have no control over the sample size. Paramedics are free to choose when they would like to attend training and complete their Competency Evaluation based on their preferences. Also, the amount of data points that can be collected for a KPI in a given period of time cannot be controlled. This means than an EMS agency needs to take into account the number of data points used in an analysis before making any decisions. Another limitation is that it is difficult to create a control group in this study, since all EMS personnel have to complete the training.

The expertise level of EMS personnel or the Paramedic that they are partnered with can have an effect on their performance on the field. Expertise level can also affect a Paramedics performance on a written assessment. However, the framework used in this research cannot limit this external factor. Future research can address this gap by utilizing more advanced analysis or observational data.

This study looks at the performance of EMS personnel by identifying and measuring specific Key Performance Indicators. However, there are many other factors that can contribute to the care that a patient receives from EMS, such as the procedures a Paramedic follows or how well they can perform certain skills. For example, this study is able to determine whether or not End Tidal Carbon Dioxide is monitored, however, it cannot determine if endotracheal intubation is done properly. This is partly due to the limitations of the data system itself. Further studies can look into this gap by using observational data.

Appendix A. EBRP-EMS Training Schedule for 2019

Month	Dates and Groups	Training	Days
January	Jan 8 - A/C	Advanced Medical Life Support	1 day
January	Jan 10 - B/D	Advanced Medical Life Support	1 day
February	Feb 12, 21, and 26 - B/D	National Competency Course	3 days
February	Feb 14, 19, and 28 - A/C	National Competency Course	3 days
March	Mar 12 and 21 - B/D	Pediatric Advance Life Support	2 day
March	Mar 14 and 19 - A/C	Pediatric Advance Life Support	2 day
April	Apr 2 and 11 - A/C	Tactical Emergency Casualty Care	2 day
April	Apr 4 and 9 - B/D	Tactical Emergency Casualty Care	2 day
May	May 21 - B/D	Prehospital Trauma Life Support	1 day
May	May 23 - A/C	Prehospital Trauma Life Support	1 day
June	June 11 - A/C	Advanced Cardiovascular Life Support/Cardiopulmonary Resuscitation	1 day
June	June 13 - B/D	Advanced Cardiovascular Life Support/Cardiopulmonary Resuscitation	1 day
July	July 23 - A/C	Geriatric EMS	1 day
July	July 25 - B/D	Geriatric EMS	1 day
August	Aug 13 - B/D	EMS Safety	1 day
August	Aug 15 - A/C	EMS Safety	1 day
September	Sep 3, 12, and 17 - A/C	National Competency Course	3 days
September	Sep 5, 10, and 19 - B/D	National Competency Course	3 days
October	Oct 1 or 10 - A/C	Competency Evaluation	Choose 1 day
October	Oct 3 or 8 - B/D	Competency Evaluation	Choose 1 day
November	Open	Open	Open
November	Open	Open	Open
December	Dec 3 or 12 - B/D	Competency Evaluation	Choose 1 day
December	Dec 5 or 10 - A/C	Competency Evaluation	Choose 1 day

Appendix B. EMS NCC Training Topics

Airway/ Respiration/ Ventilation [3.5 Hours]	Cardiovascular [8.5 Hours]	Trauma [3 Hours]	Medical [8.5 Hours]	Operations [6.5 Hours]
Ventilation [2 Hours]	Post-Resuscitation Care [0.5 Hour]	Trauma Triage [1 Hour]	Special Healthcare Needs [2 Hours]	At-risk Populations [1 Hour]
Capnography [1 Hour]	Ventricular Assist Devices [0.5 Hours]	Central Nervous System (CNS) Injury [1 Hour]	OB Emergencies [0.5 Hour]	Ambulance Safety [0.5 Hour]
Oxygenation [0.5 Hours]	Stroke [1.5 Hours]	Hemorrhage Control [0.5 Hour]	Infectious Diseases [0.5 Hour]	Field Triage – Disasters/MCIs [1 Hour]
	Cardiac Arrest [2 Hours]	Fluid Resuscitation [0.5 Hour]	Medication Delivery [1 Hour]	EMS Provider Hygiene, Safety, and Vaccinations [0.5 Hour]
	Pediatric Cardiac Arrest [2.5 Hours]		Pain Management [1 Hour]	EMS Culture of Safety [0.5 Hour]
	Congestive Heart Failure [0.5 Hours]		Psychiatric and Behavioral Emergencies [1 Hour]	Pediatric Transport [0.5 Hour]
	Acute Coronary Syndrome [1 Hour]		Toxicological Emergencies – Opioids [0.5 Hour]	Crew Resource Management [1 Hour]
			Neurological Emergencies – Seizures [0.5 Hour]	EMS Research [1 Hour]
			Endocrine Emergencies – Diabetes [1 Hour]	Evidence Based Guidelines [0.5 Hours]
			Immunological Emergencies [0.5 Hour]	

Appendix C. Level 1 Questionnaire

National Competency Course
Day 1 Questionnaire
East Baton Rouge Parish EMS

1. Age:

2. Years in Service with EMS:

3. Years in Service with Baton Rouge EMS:

4. Name of Position:

5. Circle the type of training you are completing today:

NCC Paramedic / NCC EMT / Other

6. How many times have you taken this course before?

7. Rate the quality of the course material presented:

	Very Poor	Poor	Neutral	Good	Excellent	N/A
Ventilation/Oxygenation						
Capnography						
Acute Coronary Syndromes/CHF						
Adult/Pediatric Cardiac Arrest						
Post Resuscitation Care						
Medication Delivery						
Ventricular Assist Devices						
OB Emergencies/ Immunological Emergencies						

8. Rate the following about the Instructor:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Understood the course material.						
Was prepared and organized.						
Presented the material well.						
Answered your questions clearly.						

9. Rate the following about the Course Content:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Is relevant to your job.						
Improved your understanding of medical treatment.						
Improved your understanding of clinical evaluation.						

10. The quality of equipment/facilities used in this course (projectors, classroom, dummies, etc.) was:

Very Poor Poor Neutral Good Excellent

10. Any general comments on your responses or how this course can be improved:

National Competency Course
Day 2 Questionnaire
East Baton Rouge Parish EMS

1. Age:

2. Years in Service with EMS:

3. Years in Service with Baton Rouge EMS:

4. Name of Position:

5. Circle the type of training you are completing today:

NCC Paramedic / NCC EMT / Other

6. How many times have you taken this course before?

7. Rate the quality of the course material presented:

	Very Poor	Poor	Neutral	Good	Excellent	N/A
Tourniquets						
CNS Injuries						
Pain Management						
Trauma Triage						
Field Triage						
Fluid Resuscitation						
Ambulance Safety/ Culture of Safety						
Crew Resource Management						
Hygiene/Vaccinations						

8. Rate the following about the Instructor:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Understood the course material.						
Was prepared and organized.						
Presented the material well.						
Answered your questions clearly.						

9. Rate the following about the Course Content:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Is relevant to your job.						
Improved your understanding of medical treatment.						
Improved your understanding of clinical evaluation.						

10. The quality of equipment/facilities used in this course (projectors, classroom, dummies, etc.) was:

Very Poor Poor Neutral Good Excellent

10. Any general comments on your responses or how this course can be improved:

National Competency Course
Day 3 Questionnaire
East Baton Rouge Parish EMS

1. Age:

2. Years in Service with EMS:

3. Years in Service with Baton Rouge EMS:

4. Name of Position:

5. Circle the type of training you are completing today:

NCC Paramedic / NCC EMT / Other

6. How many times have you taken this course before?

7. Rate the quality of the course material presented:

	Very Poor	Poor	Neutral	Good	Excellent	N/A
Stroke						
Special Healthcare Needs						
Infectious Disease						
Psychiatric Emergencies						
Toxicological Emergencies/ Opioids						
Neurological Emergencies/ Seizures						
Endocrine Emergencies/ Diabetes						
At-risk Populations						
Research/ Evidence Based Guidelines						

8. Rate the following about the Instructor:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Understood the course material.						
Was prepared and organized.						
Presented the material well.						
Answered your questions clearly.						

9. Rate the following about the Course Content:

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
Is relevant to your job.						
Improved your understanding of medical treatment.						
Improved your understanding of clinical evaluation.						

10. The quality of equipment/facilities used in this course (projectors, classroom, dummies, etc.) was:

Very Poor Poor Neutral Good Excellent

10. Any general comments on your responses or how this course can be improved:

National Competency Course
Day 3 Overall Questionnaire
East Baton Rouge Parish EMS

1. How strongly would you agree/disagree with the following statements?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	N/A
This course is relevant to my day-to-day job requirements.						
This course contributed to my understanding of medical training.						
This course contributed to my understanding of clinical evaluation.						
The instructor was prepared and organized for each class.						
Questions were encouraged and answered clear and complete answers were given.						

2. How would you rate the overall quality of the course? Circle one:

Very Poor Poor Neutral Good Excellent

3. Any general comments on how this course can be improved:

Appendix D. Level 1 Analysis Results (Hypothesized Mean, μ_0 = 3)

Level 1 Day 1 (Cronbach's Alpha = 0.98236)

Descriptive Statistics

	N	Mean	Median	Std Dev
Ventilation/Oxygenation	42	4.3333333333	4	0.7213357077
Capnography	42	4.2857142857	4	0.7741467147
Acute Coronary Syndrome/Congestive Heart Failure	42	4.2857142857	4	0.7741467147
Adult/Pediatric Cardiac Arrest	40	4.325	4.5	0.7970297424
Post Resuscitation Care	41	4.3414634146	5	0.794032622
Medication Delivery	40	4.225	4	0.8002403485
Ventricular Assist Devices	41	4.2682926829	4	0.7079685814
OB/Immunological Emergencies	39	4.2564102564	4	0.7510676162
	N	**Mean**	**Median**	**Std Dev**
Instructor's Understanding of Course Material	42	4.619047619	5	0.7309326135
Instructor's Preparedness and Organization	42	4.5	5	0.8337397383
Instructor's Presentation of Material	42	4.5238095238	5	0.8333914033
Instructor's Clarity of Answering Questions	39	4.5641025641	5	0.7537580163
	N	**Mean**	**Median**	**Std Dev**
Couse Content was Relevant to Job	42	4.4047619048	5	0.8570944624
Course Content Improved Understanding of Medical Treatment	41	4.3414634146	5	0.964617958
Course Content Improved Understanding of Clinical Evaluation	41	4.3170731707	5	0.9601829094
Quality of Equipment/Facilities	41	4.2682926829	4	0.7079685814

Analysis

Level 1 Day 1						
	Shapiro-Wilk W Test		**Hypothesis Test**			
	W	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Quality of Course Material					**Ho: $\mu = \mu_0$** **Ha: $\mu \neq \mu_0$**	
Ventilation	0.767658	<0.0001	441.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Capnography	0.789828	<0.0001	429.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Course Material	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > t**	**Conclusion**	**Interpretation**
ACS/CHF	0.789828	<0.0001	429.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Adult/Pediatric Cardiac Arrest	0.774455	<0.0001	389.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Post Resuscitation Care	0.768006	<0.0001	410.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Medication Delivery	0.807517	<0.0001	384.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Ventricular Assist Devices	0.785349	<0.0001	420.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
OB Emergencies/Immunological Emergencies	0.783658	<0.0001	376.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Quality of Instruction	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Understood the Course Material	0.550415	<0.0001	441.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Was Prepared and Organized	0.642665	<0.0001	431.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Instruction	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > t**	**Conclusion**	**Interpretation**
Presented the Material Well	0.618811	<0.0001	431.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Answered Questions Clearly	0.598518	<0.0001	379.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Other	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > t**	**Conclusion**	**Interpretation**
Course Content is Relevant to Job	0.704401	<0.0001	425.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Medical Treatment	0.691937	<0.0001	388.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Clinical Evaluation	0.711756	<0.0001	387.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Quality of Equipment/Facilities	0.785349	<0.0001	420.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Level 1 Day 2 (Cronbach's Alpha = 0.97752)

Descriptive Statistics

	N	Mean	Median	Std Dev
Tourniquets	38	4.6315789474	5	0.5413223365
CNS Injuries	38	4.6052631579	5	0.5945460991
Pain	38	4.6315789474	5	0.5891382911
Trauma Triage	35	4.6571428571	5	0.481593992
Field Triage	36	4.6111111111	5	0.5491696474
Fluid Resuscitation	37	4.7027027027	5	0.5198752449
Ambulance Safety/Culture of Safety	38	4.5789473684	5	0.6422754712
Crew Resource Management	38	4.5789473684	5	0.5517333349
Hygiene/Vaccination	36	4.5555555556	5	0.7725447539
	N	**Mean**	**Median**	**Std Dev**
Understood the Course Material	38	4.6842105263	5	0.9615658164
Was Prepared and Organized	38	4.6578947368	5	0.9663616857
Presented the Material Well	38	4.6315789474	5	0.9704012163
Answered Your Questions Clearly	38	4.7368421053	5	0.9496574212
	N	**Mean**	**Median**	**Std Dev**
Is Relevant to Your Job	38	4.5789473684	5	0.8893234278
Improved Your Understanding of Medical Treatment	37	4.5405405405	5	0.8690542303
Improved Your Understanding of Clinical Evaluation	37	4.5675675676	5	0.8673247675
Rate the Quality of Equipment/Facilities Used in this Course	37	4.4054054054	4	0.6437502733

Analysis

Level 1 Day 2						
	Shapiro-Wilk W Test		**Hypothesis Test**			
	W	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > t**	**Conclusion**	**Interpretation**
Quality of Course Material					**Ho: $\mu = \mu_0$** **Ha: $\mu \neq \mu_0$**	
Tourniquets	0.648102	<0.0001	370.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
CNS Injuries	0.659037	<0.0001	369.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Course Material	W	Prob < W	Test Statistic	Signed-Rank Prob > |t|	Conclusion	Interpretation
Pain	0.638760	<0.0001	369.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Trauma Triage	0.600757	<0.0001	315.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Field Triage	0.660869	<0.0001	332.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Fluid Resuscitation	0.593390	<0.0001	351.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Ambulance Safety/Culture of Safety	0.661944	<0.0001	367.50000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Crew Resource Management	0.676271	<0.0001	370.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Hygiene/Vaccination	0.561844	<0.0001	308.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Instruction	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Understood the Course Material	0.372983	<0.0001	328.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Was Prepared and Organized	0.405562	<0.0001	327.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Presented the Material Well	0.435911	<0.0001	326.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Answered Questions Clearly	0.300530	<0.0001	330.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Other	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Course Content is Relevant to Job	0.544929	<0.0001	342.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Medical Treatment	0.594201	<0.0001	324.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Clinical Evaluation	0.569022	<0.0001	325.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Quality of Equipment/Facilities	0.750514	<0.0001	348.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Level 1 Day 3 (Cronbach's Alpha = 0.95385)

Descriptive Statistics

	N	Mean	Median	Std Dev
Stroke	41	4.487804878	5	0.637257845
Special Healthcare Needs	41	4.512195122	5	0.7114053422
Infectious Disease	41	4.4390243902	5	0.672635878
Psychiatric Emergencies	39	4.4871794872	5	0.7208107596
Toxicological Emergencies/Opioids	41	4.4634146341	5	0.7449013685
Neurological Emergencies/Seizures	41	4.4390243902	5	0.7432624196
Endocrine Emergencies/Diabetes	41	4.4390243902	5	0.672635878
At-risk Populations	41	4.512195122	5	0.5967391063
Research/Evidence Based Guidelines	40	4.55	5	0.638507876
	N	**Mean**	**Median**	**Std Dev**
Understood the Course Material	41	4.756097561	5	0.7341828044
Was Prepared and Organized	41	4.7073170732	5	0.7497967204
Presented the Material Well	41	4.7073170732	5	0.7497967204
Answered Questions Clearly	41	4.7804878049	5	0.7249894869
	N	**Mean**	**Median**	**Std Dev**
Is Relevant to Your Job	41	4.6585365854	5	0.6931722765
Improved Your Understanding of Medical Treatment	40	4.575	5	0.843907274
Improved Your Understanding of Clinical Evaluation	40	4.6	5	0.8412444994
Quality of Equipment/Facilities	39	4.4358974359	5	0.6405126152

Analysis

Level 1 Day 3						
	Shapiro-Wilk W Test		**Hypothesis Test**			
	W	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Quality of Course Material					**Ho: $\mu = \mu_0$** **Ha: $\mu \neq \mu_0$**	
Stroke	0.720372	<0.0001	427.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Special Healthcare Needs	0.686836	<0.0001	419.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Course Material	W	Prob < W	Test Statistic	Signed-Rank Prob > |t|	Conclusion	Interpretation
Infectious Disease	0.737224	<0.0001	425.5000	<0.0001	Fail to Reject Ho	Actual score is significantly higher than the target.
Psychiatric Emergencies	0.700241	<0.0001	379.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Toxicological Emergencies/Opioids	0.713749	<0.0001	417.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Neurological Emergencies/Seizures	0.727315	<0.0001	416.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Endocrine Emergencies/Diabetes	0.737224	<0.0001	425.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
At-risk Populations	0.710457	<0.0001	429.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Research/Evidence Based Guidelines	0.685078	<0.0001	407.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Quality of Instruction	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Understood the Course Material	0.384010	<0.0001	406.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Was Prepared and Organized	0.448064	<0.0001	405.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Presented the Material Well	0.448064	<0.0001	405.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Answered Questions Clearly	0.348048	<0.0001	407.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Other	**W**	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Course Content is Relevant to Job	0.530769	<0.0001	423.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Medical Treatment	0.571228	<0.0001	381.5000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Course Content Improved Understanding of Clinical Evaluation	0.546230	<0.0001	382.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Quality of Equipment/Facilities	0.740797	<0.0001	387.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.

Level 1 Overall (Cronbach's Alpha = 0.90661)

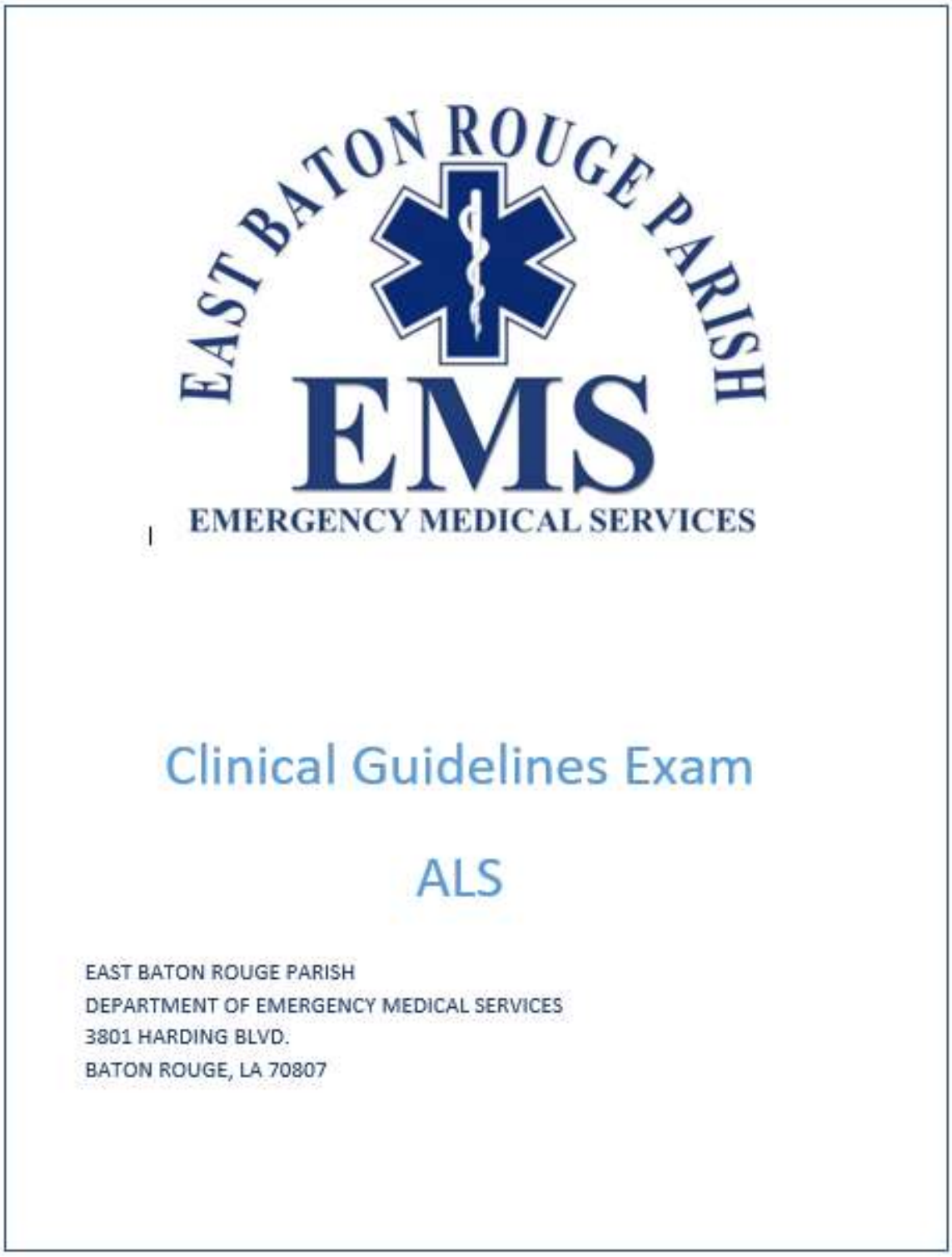
Descriptive Statistics

	N	Mean	Median	Std Dev
Course is Relevant to Day to Day Job Requirements	17	4.4705882353	5	1.0675700831
Course Contributed to Understanding of Medical Training	17	4.3529411765	5	0.9314757425
Course Contributed to Understanding of Clinical Evaluation	17	4.2941176471	5	0.9851843661
Instructor was Prepared and Organized for Each Class	17	4.4705882353	5	0.9432422183
Questions were Engcouraged and Answered. Clear and Complete Answers were Given	17	4.5882352941	5	0.7122871199
How would You Rate the Overall Quality of the Course	17	4.0588235294	4	0.8269362306

Analysis

Level 1 Overall						
	Shapiro-Wilk W Test		**Hypothesis Test**			
	W	**Prob < W**	**Test Statistic**	**Signed-Rank Prob > |t|**	**Conclusion**	**Interpretation**
Quality of Course Material					**Ho: μ = μ_0** **Ha: μ ≠ μ_0**	
Course is Relevant to Day to Day Job Requirements	0.554119	<0.0001	70.0000	0.0002	Reject Ho	Actual score is significantly higher than the target.
Course Contributed to Understanding of Medical Treatment	0.731794	0.0003	70.0000	0.0004	Reject Ho	Actual score is significantly higher than the target.
Course Contributed to Understanding of Clinical Evaluation	0.738282	0.0003	68.0000	0.0006	Reject Ho	Actual score is significantly higher than the target.
Instructor was Prepared and Organized for Each Class	0.633710	<0.0001	71.0000	0.0002	Reject Ho	Actual score is significantly higher than the target.
Questions were Encouraged and Answered. Clear and Complete Answers were Given	0.625573	<0.0001	75.0000	<0.0001	Reject Ho	Actual score is significantly higher than the target.
Rate the Overall Quality of the Course	0.805682	0.0024	69.0000	0.0005	Reject Ho	Actual score is significantly higher than the target.

Appendix E. Level 2 Clinical Guidelines Exam



1) If a patient's condition is alleviated by the clinician's care while following a standing order guideline, the clinician must contact medical control to discontinue the standing order guideline.
   (a) True
   (b) False

2) LERN is utilized by EBRP EMS to recommend transport destinations for which patient(s)
   (a) Trauma patients meeting LERN criteria
   (b) Stroke Patients
   (c) STEMI Patients
   (d) A and B
   (e) All of the above

3) It is the clinician's legal responsibility to report suspected abuse or neglect to a protective service.
   (a) True
   (b) False

4) Fluid boluses are ___ ml/kg for 0-1 months, and ___ ml/kg for 1 month and older
   (a) 10 and 20
   (b) 20 and 40
   (c) 100 and 200
   (d) None of the above

5) What anesthetic agent should be used during EZ-IO administration in patients with awareness
   (a) Amiodarone
   (b) Versed
   (c) Ketamine
   (d) Lidocaine

6) The maximum total dose of fentanyl a patient can receive is:
   (a) 100mcg
   (b) 1.5mcg/kg
   (c) 1mcg/kg
   (d) None of the above

7) Ketorolac is usually given in a single dose of:
   (a) 15mg
   (b) 30mg
   (c) 60mg
   (d) .5mg/kg

8) The Ketamine dose by IV infusion in cases of severe pain is
   (a) 1mg/kg
   (b) 2mg/kg
   (c) 4mg/kg
   (d) .25mg/kg

9) The Ketamine dose by Intramuscular or Intranasal route in cases of severe pain is
   (a) 2mg/kg
   (b) 4mg/kg
   (c) 8mg/kg
   (d) .5mg/kg

10) What route may be preferred in children when managing pain?
   (a) Intravascular
   (b) Intramuscular
   (c) Intranasal
   (d) Rectal

11) Which agent would be the better choice for procedural sedation of a patient that has a blood pressure of 70/40
   (a) Versed
   (b) Fentanyl
   (c) Ketamine
   (d) Etomidate

12) The technique of applying high flow oxygen via nasal cannula during intubation attempts is known as
   (a) Pre-oxygenation
   (b) High flow Nasal bypass
   (c) Elected oxygenation
   (d) Apneic oxygenation

13) What induction agent should be used while treating a hypoxic patient in the Medication Assisted Intubation Guideline?
   (a) Versed
   (b) Fentanyl
   (c) Ketamine
   (d) Etomidate

14) What is the IV/IO dosing range of Succinylcholine given to adults and pediatrics patients?
   (a) 100-300 mg
   (b) 5-10mg/kg
   (c) 2-4mg/kg
   (d) 1-2mg/kg

15) How many advanced airway clinicians need to be present before a neuromuscular blocking agent may be given?
   (a) 1
   (b) 2
   (c) 3

16) During treatment under the Medication Assisted Intubation Guideline, Your patients spO_2 declines to 86 during your attempt at intubation. What guideline should you proceed to?
   (a) Post Advanced Airway Care
   (b) Crash Airway
   (c) Failed Airway
   (d) None of the above

17) How many intubation attempts are allowed in the Medication Assisted Intubation Guideline?
   (a) 1
   (b) 2
   (c) 3
   (d) 4

18) How many intubation attempts are allowed in the Crash Airway Guideline?
   (a) 1
   (b) 2
   (c) 3
   (d) 4

19) How many intubation attempts are allowed in the Failed Airway Guideline?
   (a) 1
   (b) 2
   (c) 3
   (d) 4

20) You have reached the maximum number of intubation attempts allowed in the Failed Airway Guideline. You attempt placing a supraglottic airway without success and now you are unable to oxygenate and/or ventilate with a BVM device and a basic airway. What is your next course of action?
   (a) Continue to ventilate with a BVM despite oxygen desaturation
   (b) Call Medical Control
   (c) Call Dan Godbee and drive fast to the hospital
   (d) Surgical Cricothyroidotomy procedure

21) You have reached the maximum number of attempts allowed in the Failed Airway Guideline, You attempt placing a Supraglottic airway without success but you are able to maintain oxygenation and ventilation with a BVM

device. What is your next course of action?
(a) Continue providing ventilation and oxygenation by BVM and basic airway
(b) Continuously monitor spO_2 and $etCO_2$
(c) Ventilate at a rate of 10-12 breaths per minute
(d) All of the above

22) After successfully placing an advanced airway, you have placed a commercial tube restraint, $etCO_2$ and noted tube depth. You noticed the patient is starting to breathe some on their own and tears are starting to be excreted (Lacrimation). What medicine(s) should be considered?
(a) Atropine
(b) Lidocaine
(c) Ketamine and morphine
(d) Fentanyl and Versed

23) $etCO_2$ monitoring can identify main-stem intubation
(a) True
(b) False

24) A patient in cardiac arrest that has a catastrophic brain injury meets the obvious signs of death criteria and resuscitation is considered futile.
(a) True
(b) False

25) A goal of Cardio-Cerebral Resuscitation(CCR) is to limit pauses in CPR to _____ seconds or less
(a) 15
(b) 10
(c) 20
(d) 30

26) The goal of ventilation in CCR is targeted to _____ breaths per minute
(a) 8
(b) 10
(c) 12
(d) 20

27) Pit Crew CPR suggests that the team members providing chest compressions change every _____ minutes.
(a) 5
(b) 2
(c) 4
(d) 10

28) In cases of refractory V-fib where a patient has been shocked at least 5 times, what treatment should be considered **next** if available?
(a) Mechanical CPR
(b) Heads Up CPR
(c) Transport to a cath Lab
(d) Dual Sequential Defibrillation

29) Mechanical CPR may be considered when:
(a) Rescuers are fatigued
(b) Patient requires transport
(c) Heads Up CPR technique is used
(d) When manual High quality compressions are compromised
(e) All of the above

30) In cases of patients who receive high quality chest compressions resulting in improved blood flow to the brain and attain awareness, what medication(s) can be used for sedation?
(a) Fentanyl
(b) Versed

(c) Etomidate
(d) Ketamine
(e) A and D

31) Heads Up CPR promotes:
(a) Coronary Artery Perfusion
(b) Decreased Preload
(c) Decreased Afterload
(d) Cerebral perfusion

32) The interruption in chest compressions prior to and following defibrillator shock is called?
(a) Compression pause
(b) 2 minute cycle
(c) Peri-shock pause
(d) Quick look

33) What medication can be considered if Torsades de Pointes is identified?
(a) Magnesium sulfate
(b) Lidocaine
(c) Sodium Bicarbonate
(d) Calcium Chloride

34) What is the leading cause of cardiac arrest in children
(a) Dehydration
(b) Sepsis
(c) Respiratory Failure
(d) Heart Disease

35) A newborn that presents with a sustained HR of less than 60 despite initial attempts of stimulation with suctioning, drying and warming requires:
(a) BVM ventilations only
(b) BVM ventilations then CPR with advanced airway then Epinephrine
(c) Atropine IV push
(d) Epinephrine infusion and transcutaneous pacing

36) Newborns should be given dextrose (D_{10}) if they have a measured CBG of less than:
(a) 100
(b) 80
(c) 60
(d) 40

37) After ROSC is obtained, fluid administration, Epinephrine and/or Levophed infusion(s) may need to be given if the patients MAP is less than:
(a) 80
(b) 100
(c) 70
(d) 65

38) You have just shocked a patient that you witnessed a V-Fib arrest, the patient was successfully defibrillated and ROSC was achieved. You have concern there is a risk of V-fib returning and decide to administer Amiodarone. What is the dosage?
(a) 300mg IV push
(b) 150mg IV push
(c) 150mg over 10 minute infusion
(d) 1mg/min infusion

39) What GCS score must a patient have in order to initiate Targeted Temperature Management?
(a) 15
(b) 3
(c) 5 or less
(d) None of the above

40) What medication may be used for a patient requiring sedation after ROSC?
(a) Versed
(b) Etomidate
(c) Fentanyl
(d) Ketamine

41) What is the target spO_2 of a patient after ROSC?
   (a) 85-90%
   (b) 90-95%
   (c) 95-99%
   (d) 100%

42) Which of the following is not included as one of the four rules for a paramedic to be allowed to termination resuscitation?
   (a) A Healthcare Provider must not have witnessed the arrest
   (b) Bystander CPR must not have been performed
   (c) No shocks must have been delivered
   (d) The patient must be in asystole

43) Full resuscitative effort is defined as definitive airway, vascular access, defibrillation and at least _____ minutes of treatment following ACLS or CCR guideline
   (a) 10-20
   (b) 20-30
   (c) 40-50
   (d) 50-60

44) The Termination Guideline should not be attempted in what circumstance?
   (a) Pediatrics
   (b) Pregnancy
   (c) Hypothermia
   (d) All of the above

45) It may not be appropriate to terminate resuscitation when in view of:
   (a) The family
   (b) The attending medical staff
   (c) Law enforcement
   (d) The general public

46) What medication and dose is used in the management of chest pain while treating for ACS
   (a) Morphine 2mg every 5 minutes
   (b) Nitroglycerin 400mg
   (c) Fentanyl 1mcg/kg repeated every 5-10 minutes at .5mcg/kg
   (d) Heparin 5000mg

47) What is the dose of Heparin while treating a STEMI patient that is suspected to have PCI?
   (a) 5mg/kg IV
   (b) 5000mg IV
   (c) 500units IV
   (d) 5000units IV

48) When would it be reasonable to withhold Nitroglycerin while treating a STEMI patient?
   (a) When inferior wall MI is present
   (b) When anterior wall MI is present
   (c) Any time there is hypotension or relative hypotension
   (d) None of the above

49) Epinephrine can be used to increase heart rate in symptomatic bradycardia
   (a) True
   (b) False

50) You have decided to treat a bradycardic patient that is near death with transcutaneous pacing. What is the correct location of pad placement?
   (a) Anterior/Anterior
   (b) Anterior/Posterior
   (c) Posterior/Posterior
   (d) All of the above

51) What is the most common cause of bradycardia in children?
   (a) Poisoning/overdose
   (b) Head trauma

(c) Heart disease
(d) Hypoxia

52) You are treating a 2 year old that has cardio respiratory compromise and a heart rate of 48. You have established oxygenation and ventilation with a BVM, despite your treatment, the patient's heart rate remains unchanged. What is your next course of action?
(a) Administer Atropine IV
(b) Administer Epinephrine IV
(c) Start CPR
(d) Start transcutaneous pacing

53) You are treating a patient that called 911 for difficulty breathing. You have determined the patient is suffering from CHF with pulmonary edema. CPAP has been placed and an IV is established, their blood pressure is 240/130. What choice of medication and route should be considered to achieve blood pressure reduction?
(a) Labetalol IV
(b) Furosemide IV
(c) Nitroglycerin IV
(d) Metoprolol IV

54) A cardiogenic shock patient with pulmonary edema that has a blood pressure of 70/30 could receive which two medications?
(a) Dopamine and Epinephrine
(b) Epinephrine and Dobutamine
(c) Dopamine and Levophed
(d) Levophed and Dobutamine

55) You are treating a hemodynamically stable wide complex tachycardia but is symptomatic. The 12-lead EKG interpretation is Wolff-Parkinson-White (WPW) and the patient tells you he has a history of WPW. What should be your first line treatment?
(a) 20mg IV Cardizem over 2minutes
(b) 12 mg of Adenosine rapid IV push
(c) Mag Sulfate 2 grams over 10 minutes
(d) Modified Valsalva

56) What is the initial dose of adenosine for adults in SVT?
(a) 12mg
(b) 18mg
(c) 6mg
(d) 150mg

57) What is the initial treatment for a two year old with SVT at a heart rate of 220? They are awake with pink skin and a blood pressure of 140/90.
(a) Apply ice over the patients face
(b) Synchronized cardioversion at 1J/kg
(c) Adenosine 0.1mg/kg rapid IV push
(d) Amiodarone 5mg/kg over 20-60 minutes

58) A patient that presents with diffuse abdominal/flank pain suspected of kidney stones should be directed to the Pain management guideline for treatment?
(a) True
(b) False

59) Females that are of child bearing years that present with acute abdominal pain should be suspected of_____?
(a) Uterine rupture
(b) Ovarian Cyst
(c) Ectopic pregnancy
(d) None of the above

60) A patient with a history of adrenal insufficiency may have what medication prescribed to them and on hand for injection during crisis?
   (a) Solu-Cortef (Hydrocortisone)
   (b) Valium
   (c) EPI-Pen
   (d) Insulin

61) Diphenhydramine and Famotidine are examples of _____?
   (a) Antiemetic's
   (b) Vasopressor's
   (c) Corticosteroids
   (d) Antihistamines

62) Famotidine (Pepcid) is given in conjunction with Diphenhydramine in allergic reactions. What is the dose given IV?
   (a) 60mg
   (b) 20mg
   (c) 25-50mg
   (d) 2mg

63) You a treating a patient suffering from an allergic reaction to peanuts, the patient complains of itching all over and severe nausea, they have obvious urticaria upon examination. Should Epi 1:1,000 (0.3mg-0.5mg) be given by IM injection?
   (a) Yes
   (b) No

64) What medication and route should be considered when a patient presents with Anaphylaxis after taking a new antibiotic for the first time, the patient complains of severe weakness and nausea only. Their skin is cool and pale with very weak pulses. The patients' Blood pressure is 60 by palpation.
   (a) DuoNeb Inhaled
   (b) Norepinephrine IV infusion
   (c) Epinephrine IV
   (d) Solu-Medrol IV

65) What Medication, dose and route would be preferred in the excited delirium patient without IV access, to achieve chemical restraint and sedation?
   (a) Midazolam 5mg IN
   (b) Geodon 20mg IM
   (c) Ketamine 4mg/kg IM

66) In severe asthma CPAP can be initiated at _____cmH2O
   (a) 5
   (b) 7.5
   (c) 10
   (d) 15

67) 2 grams of Magnesium Sulfate can be given to severe asthma over _____ minutes.
   (a) 2
   (b) 5
   (c) 10
   (d) 15-20

68) What medication and route should be considered first line in severe cases of asthma with poor tidal volume?
   (a) Epi 1:10,000 IV
   (b) EPI 1:1,000 nebulized
   (c) Albuterol nebulized
   (d) EPI 1:1,000 IM

69) Wheezing can be a sign of pulmonary edema in CHF.
   (a) True
   (b) False

70) What medication can be given to the Pre-Eclampsia patient with the following signs and symptoms; Hypertension, Headache, Blurred Vision and Nausea?

(a) Nitroglycerin
(b) Nicardipine
(c) Midazolam
(d) Magnesium Sulfate

71) While Treating a pregnant patient in cardiac arrest greater than 20 weeks gestation, a single rescuer should be dedicated to perform_____
(a) Emergency Cesarean section
(b) Uterine displacement
(c) Chest compressions

72) Anaphylactic, Neurogenic and Septic shock are caused by problems with the patients
(a) Blood vessels (container)
(b) Heart (pump)
(c) Heart (rate)
(d) Blood (volume)

73) What concentration of dextrose can safely be administered to children under the age of 8 years?
(a) D_{50}
(b) D_{25}
(c) D_{10}
(d) None of the above

74) What concentration of dextrose can safely be administered to an adult?
(a) D_{50}
(b) D_{25}
(c) D_{10}
(d) All of the above

75) What medication should be considered before administration of dextrose to the hypoglycemic patient with a history of gastric bypass?
(a) Insulin
(b) Magnesium sulfate
(c) Glucagon
(d) Thiamine

76) Patients suspected of DKA/HHNK (HHS) should be evaluated and treated for?
(a) Hypoglycemia
(b) Pulmonary edema
(c) Severe dehydration
(d) Metabolic alkalosis

77) One of the goals when treating hypertensive crisis should be to reduce the patients mean arterial pressure by_____%
(a) 50-60
(b) 5-10
(c) 10-20
(d) None of the above

78) A blood pressure of 185/110 results in a MAP of _____?
(a) 150
(b) 98
(c) 110
(d) 135

79) Nicardipine is given by infusion at a range of _____mg/hr.
(a) 5-10
(b) 10-20
(c) 5-15
(d) 20-25

80) What position should you place a patient for transport with a Hypertensive crisis?
(a) Prone
(b) Supine
(c) Semi fowlers
(d) Left Lateral recumbent

81) The max dose for Ondansetron in an adult is_____?
(a) 20mg
(b) 32mg
(c) 8mg
(d) 4mg

82) Ondansetron at high doses can cause what EKG change?
(a) ST elevation
(b) ST depression
(c) Prolonged QT
(d) Pathological Q waves

83) The choice of vasopressor for neurogenic shock is?
(a) Dopamine
(b) Norepinephrine
(c) Dobutamine
(d) Epinephrine

84) What medication should be given by nebulizer in pediatrics with severe croup?
(a) Albuterol 2.5mg
(b) Normal saline 3cc
(c) Epinephrine 3mg
(d) Atrovent .5mg

85) In septic shock, MAP is targeted above _____mmHg to regain end organ perfusion.
(a) 55
(b) 65
(c) 80
(d) 100

86) Two or more SIRS criteria combined with consecutive $etCO_2$ readings of less than _____mmHg meet sepsis alert criteria.
(a) 10
(b) 18
(c) 26
(d) 32

87) To reduce time to tPA in strokes, blood pressure should be targeted below_____.
(a) 200/120
(b) 185/110
(c) 165/100
(d) 140/90

88) V.A.N assessment in stroke helps identify_____
(a) Large vessel occlusion
(b) Sub arachnoid hemorrhage
(c) TIA
(d) Pontine Hemorrhage

89) V.A.N assessment should be performed on any stroke patient with_____
(a) Facial drooping
(b) Arm weakness
(c) Speech difficulties
(d) Seizure activity

90) What medication is used to lower heart rate when treating a patient suspected of aortic dissection?
(a) Adenosine
(b) Amiodarone
(c) Metoprolol
(d) Nicardipine

91) Patients with Crush syndrome from traumatic rhabdomyolysis can develop hyperkalemia when muscle tissue breaks down, what medication(s) should be given to return potassium back into the cell.
(a) Sodium Bicarbonate, Albuterol and Calcium Chloride
(b) Atropine, Solu-Medrol and Calcium
(c) Calcium and TXA
(d) Calcium

92) Traumatic head/brain injured patients with increased intracranial pressure cannot tolerate _____and_____ even for a short period.
(a) Hypertension, hypercapnia
(b) Hypoxia, hypotension
(c) Ventilation, perfusion

(d) Bradycardia, hypoglycemia

93) Traumatic injury less than 3 hours old and significant bleeding should receive TXA at what dose?
(a) 1 gram IV push
(b) 1 gram IV over 10 minutes
(c) 2 grams over 2 hours
(d) 2 grams IV over 20 minutes

94) What are the three components of traumatic injury that lead to increased mortality and make up the "Trauma Triad of Death"?
(a) Hypoxia, Hypotension, Hypovolemia
(b) Metabolic Acidosis, Hypothermia, Coagulopathy
(c) Hypoperfusion, Hypoventilation, Hypovolemia

95) Back Boards should be used as therapeutic or precautionary measures in the patient with blunt trauma.
(a) True
(b) False

96) Patients with penetrating trauma to the head, neck or torso and no evidence of spinal injury should receive spinal motion restriction.
(a) True
(b) False

97) Treatment of a patient with flail chest who is becoming fatigued should include
(a) Bulky dressings placed over the site
(b) Sand bag placed over the site
(c) Chest decompression
(d) Positive pressure ventilation

98) Springing/Rocking the pelvis is a safe and reliable way to evaluate a patient for pelvic fractures.
(a) True
(b) False

99) A patient that presents in cardiac arrest with a single stab wound to the center of the chest may benefit most from
(a) Chest decompression
(b) Chest compressions
(c) Pericardiocentesis
(d) Advanced airway

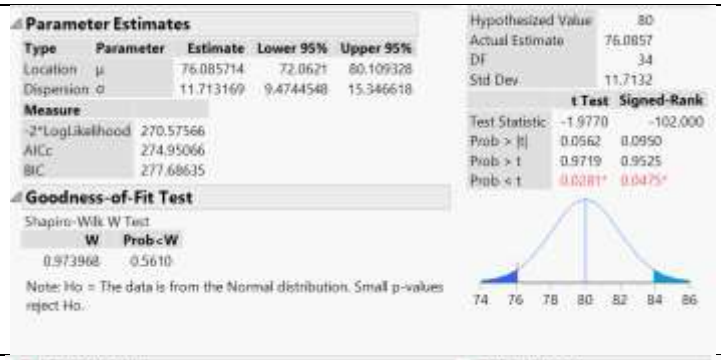
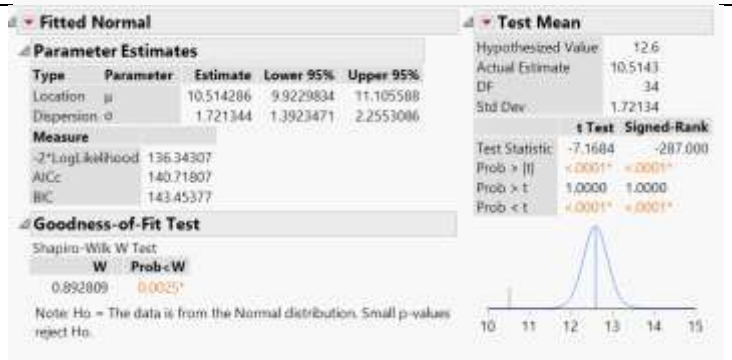
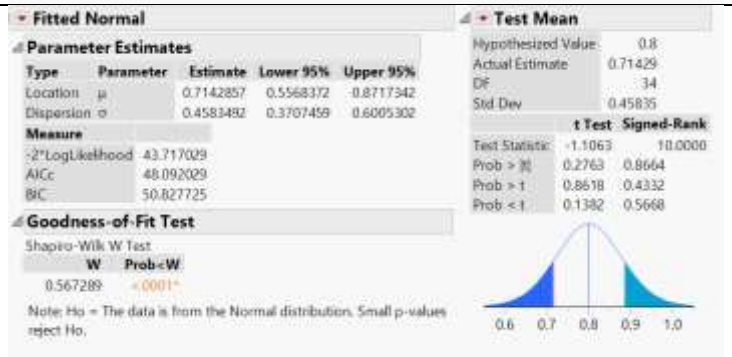
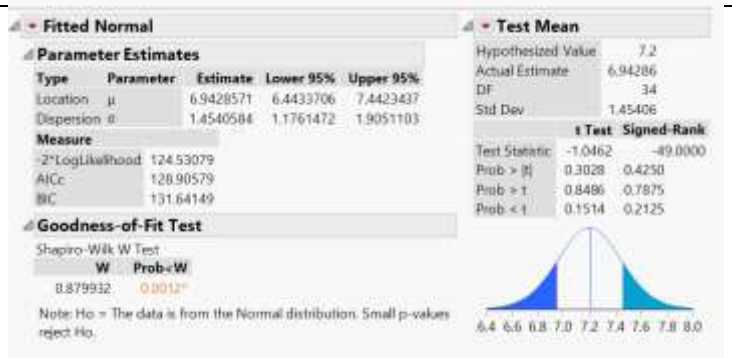
100) You have elected to intubate a patient that received blunt trauma, after confirmation of tube placement you notice the bag valve device is getting increasingly more difficult to squeeze and the patients vital signs are deteriorating. What is your next course of action?
(a) Extubate the patient and attempt intubation again
(b) Assess for and Perform a simple or needle thoracostomy
(c) Call medical control
(d) Load and Go

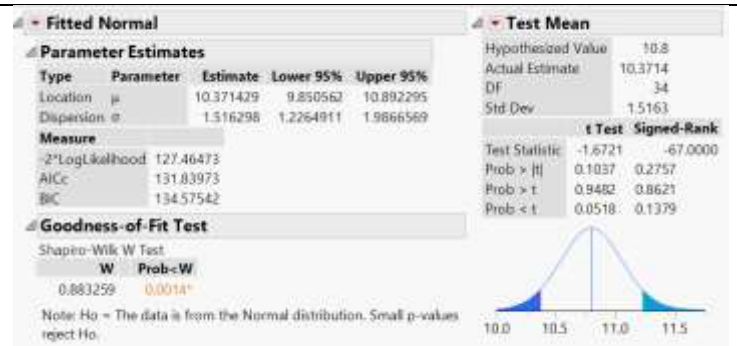
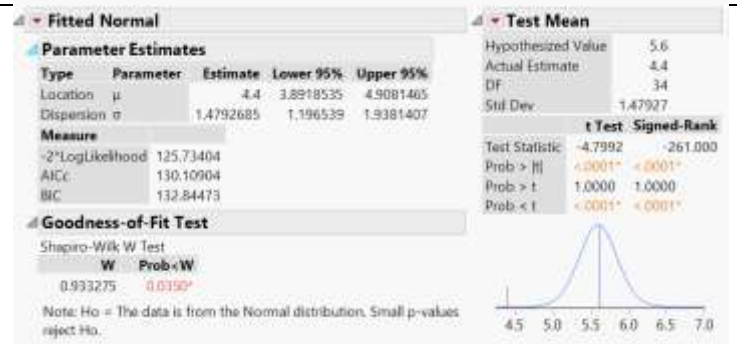
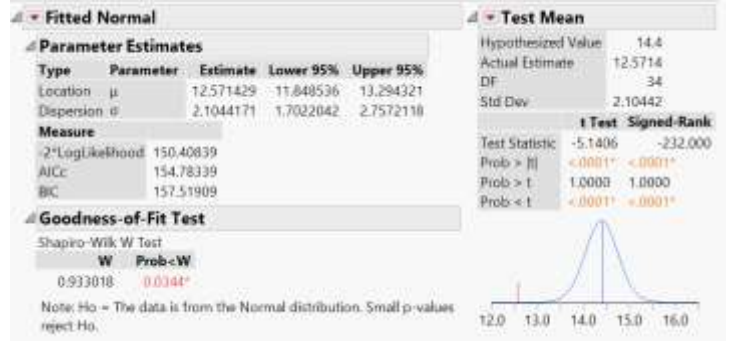
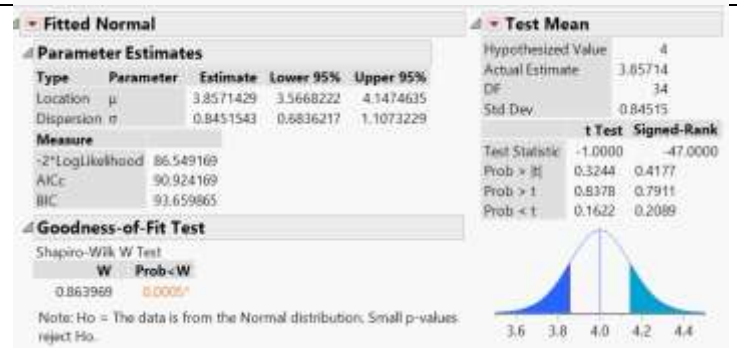
Appendix F. Level 2 Question Breakdown

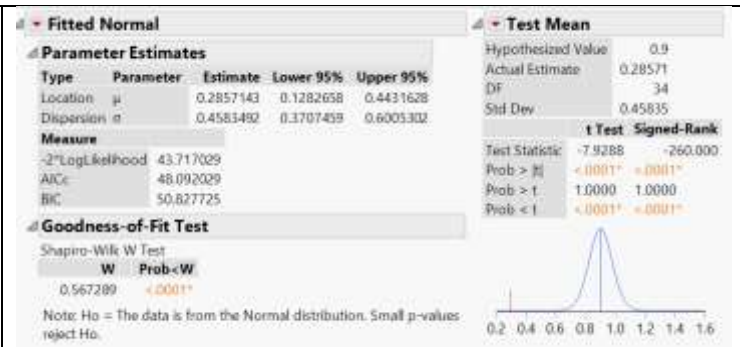
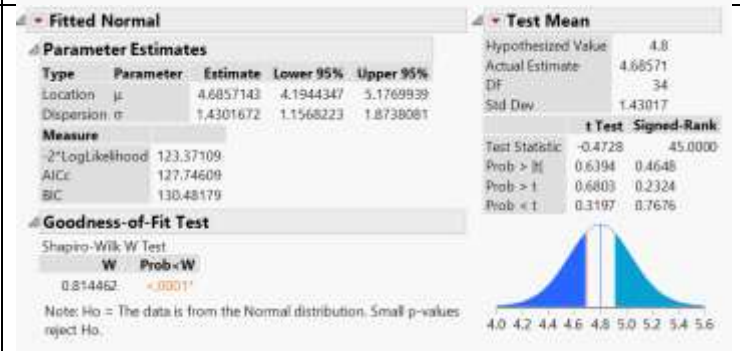
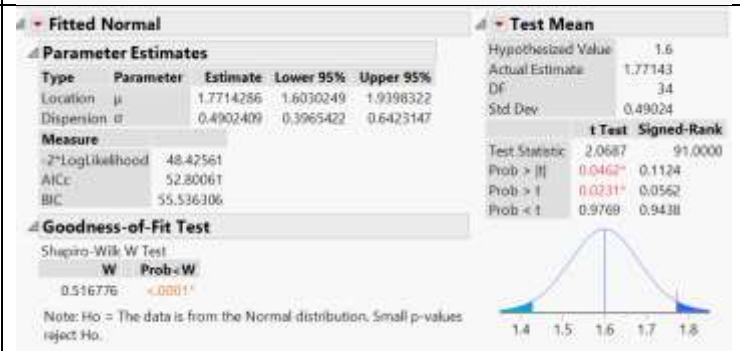
Topic	No. of Questions on Exam	Target Score (%)	Target Score
Overall Exam	100	80	80
Ventilation/Oxygenation	14	90	12.6
Capnography	1	80	0.8
ACS/CHF	9	80	7.2
Adult/Pediatric Cardiac Arrest	12	90	10.8
Post-Resuscitation Care	7	80	5.6
Medication Delivery	16	90	14.4
OB Emergencies/ Immunological Emergencies	5	80	4
CNS Injuries	1	90	0.9
Pain Management	6	80	4.8
Trauma Triage	7	80	5.6
Fluid Resuscitation	2	80	1.6
Crew Resource Management	1	80	0.8
Stroke	6	90	5.4
Special Healthcare Needs	5	80	4
Infectious Disease	2	80	1.6
Psychiatric Emergencies	1	80	0.8
Neurological Emergencies/ Seizures	2	90	1.8
Endocrine Emergencies/Diabetes	3	80	2.4
At-risk Populations	0	80	0
Research/Evidence Based Guidelines	0	80	0
Ventricular Assist Devices	0	80	0
Tourniquets	0	90	0
Field Triage	0	80	0
Ambulance Safety/Culture of Safety	0	80	0
Hygiene/Vaccination	0	80	0
Toxicological Emergencies/ Opioids	0	90	0

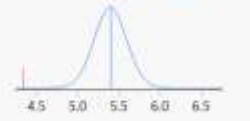
Appendix G. Level 2 Analysis Results (Alpha = 0.05, Bonferroni Adjustment: 0.05/19 = 0.00263)

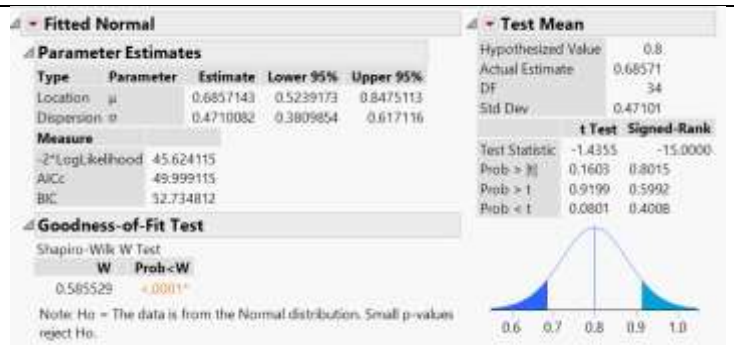
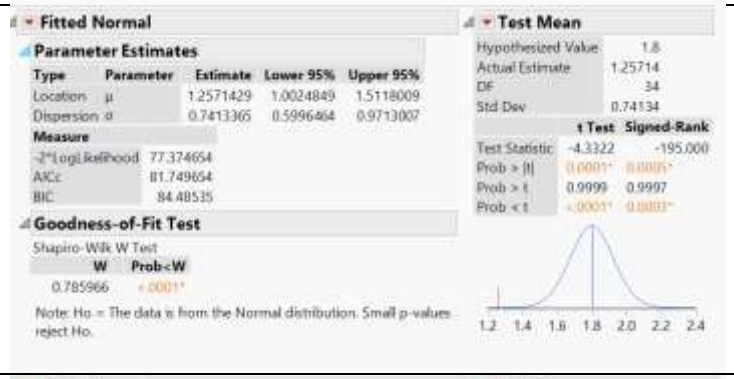
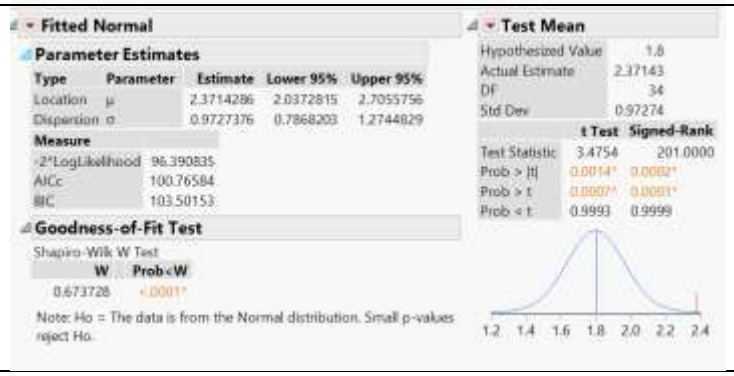
Level 2 October 2019 Analysis

Level 2		
		Conclusion
Overall		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Ventilation/Oxygenation		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Capnography		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
ACS/CHF		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

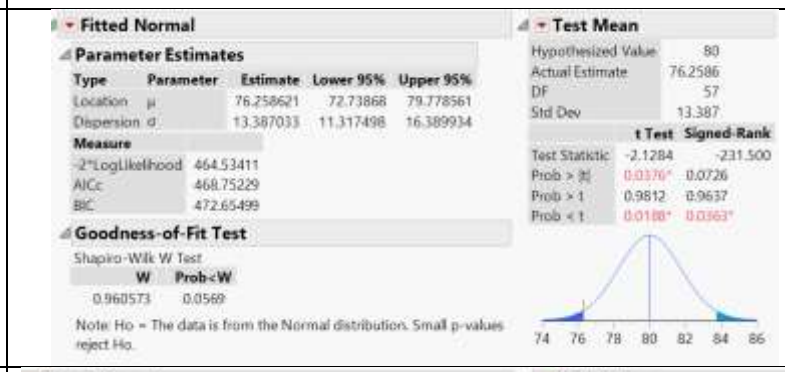
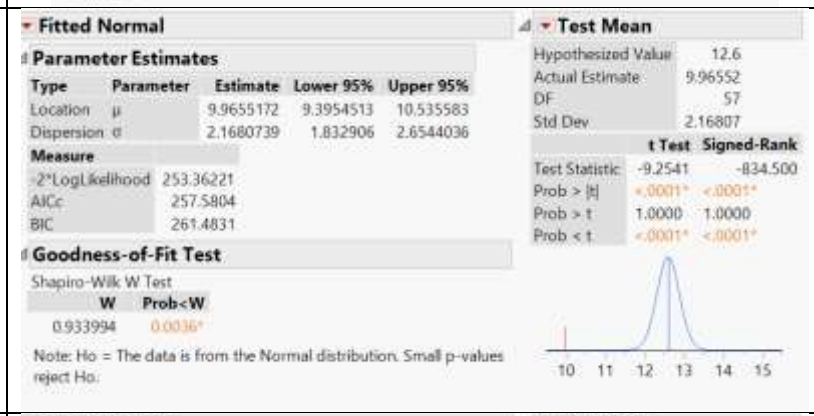
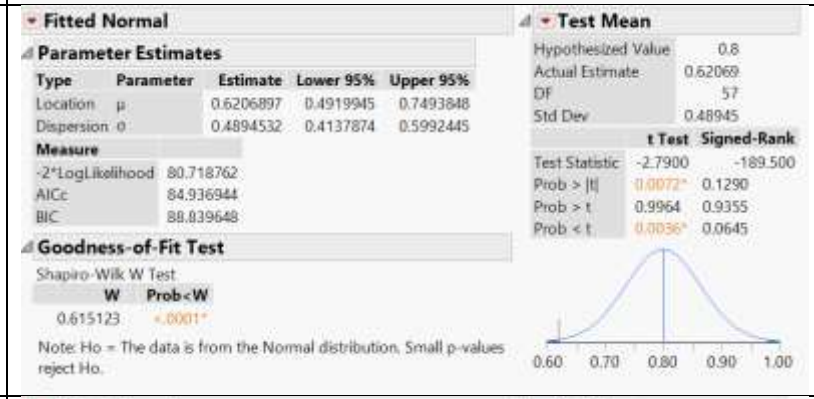
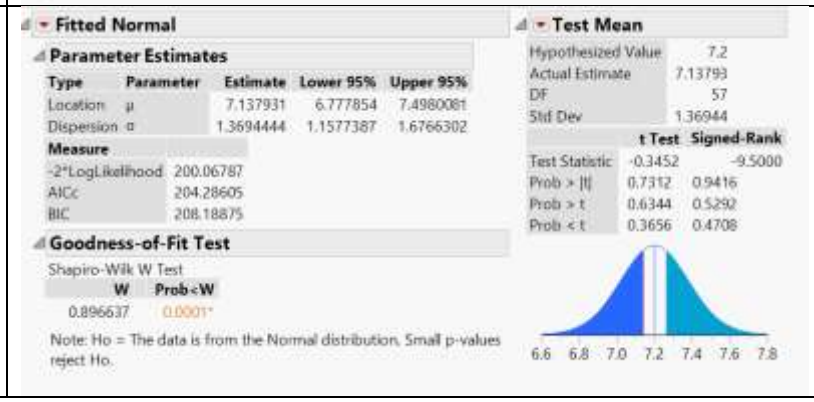
Adult/Pediatric Cardiac Arrest		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Post Resuscitation Care		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Medication Delivery		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
OB Emergencies/Immunological Emergencies		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

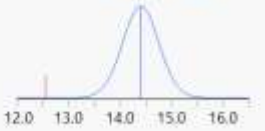
CNS Injuries		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Pain Management		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Trauma Triage		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Fluid Resuscitation		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly above the target.**

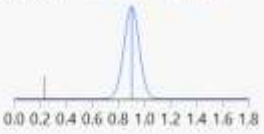
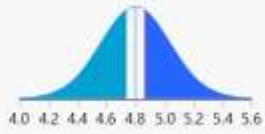
Crew Resource Management	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 0.9428571 0.8619587 1.0237556 Dispersion σ 0.2355041 0.1904927 0.308558 **Measure** -2*LogLikelihood -2.896187 AICc 1.4788128 BIC 4.2145089 **Goodness-of-Fit Test** Shapiro-Wilk W Test W Prob<W 0.249962 <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 0.8 Actual Estimate 0.94286 DF 34 Std Dev 0.2355 t Test Signed-Rank Test Statistic 3.5887 246.0000 Prob > |t| 0.0010* <.0001* Prob > t 0.0005* <.0001* Prob < t 0.9995 1.0000  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly above the target.**
Stroke	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 4.3428571 3.9437944 4.7419199 Dispersion σ 1.1617142 0.9396781 1.5220804 **Measure** -2*LogLikelihood 108.81846 AICc 113.19346 BIC 115.92916 **Goodness-of-Fit Test** Shapiro-Wilk W Test W Prob<W 0.888992 0.0020* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 5.4 Actual Estimate 4.34286 DF 34 Std Dev 1.16171 t Test Signed-Rank Test Statistic -5.3835 -238.000 Prob > |t| <.0001* <.0001* Prob > t 1.0000 1.0000 Prob < t <.0001* <.0001*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Special Healthcare Needs	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 3.7142857 3.4073621 4.0212093 Dispersion σ 0.8934872 0.7227168 1.1706488 **Measure** -2*LogLikelihood 90.442066 AICc 94.817066 BIC 97.552762 **Goodness-of-Fit Test** Shapiro-Wilk W Test W Prob<W 0.876910 0.0010* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 4 Actual Estimate 3.71429 DF 34 Std Dev 0.89349 t Test Signed-Rank Test Statistic -1.8918 -98.0000 Prob > |t| 0.0671 0.0907 Prob > t 0.9665 0.9546 Prob < t 0.0335* 0.0454*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Infectious Disease	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 1.4857143 1.2595139 1.7119147 Dispersion σ 0.6584933 0.5326368 0.8627593 **Measure** -2*LogLikelihood 69.079634 AICc 73.454634 BIC 76.19033 **Goodness-of-Fit Test** Shapiro-Wilk W Test W Prob<W 0.719275 <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 1.6 Actual Estimate 1.48571 DF 34 Std Dev 0.65849 t Test Signed-Rank Test Statistic -1.0268 -105.000 Prob > |t| 0.3118 0.0766 Prob > t 0.8441 0.9617 Prob < t 0.1559 0.0383*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

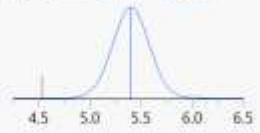
Psychiatric Emergencies		Ho: μ = μ_0 Ha: μ ≠ μ_0 Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.
Neurological Emergencies		Ho: μ = μ_0 Ha: μ ≠ μ_0 Reject the null. Actual score is significantly below the target.
Endocrine Emergencies		Ho: μ = μ_0 Ha: μ ≠ μ_0 Reject the null. Actual score is significantly above the target.

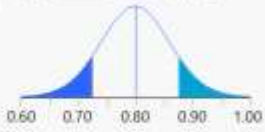
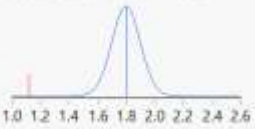
Level 2 December 2019 Analysis

Level 2		
		Conclusion
Overall		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Ventilation/Oxygenation		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Capnography		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
ACS/CHF		**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

Adult/Pediatric Cardiac Arrest	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 10.362069 9.9847216 10.739416 Dispersion σ 1.4351267 1.2132669 1.7570459 **Measure** -2*LogLikelihood 205.50223 AICc 209.72042 BIC 213.62312 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.845705 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 10.8 Actual Estimate 10.3621 DF 57 Std Dev 1.43513 t Test / Signed-Rank Test Statistic -2.3240 -173.500 Prob > |t| 0.0237* 0.1776 Prob > t 0.9881 0.9112 Prob < t 0.0119* 0.0888  10.2 10.4 10.6 10.8 11.0 11.2 11.4	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Post Resuscitation Care	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 4.9655172 4.5594734 5.3715611 Dispersion σ 1.5442652 1.3055334 1.8906658 **Measure** -2*LogLikelihood 214.00446 AICc 218.22264 BIC 222.12535 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.910598 Prob<W 0.0004* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 5.6 Actual Estimate 4.96552 DF 57 Std Dev 1.54427 t Test / Signed-Rank Test Statistic -3.1290 -405.500 Prob > |t| 0.0028* 0.0011* Prob > t 0.9986 0.9995 Prob < t 0.0014* 0.0005*  4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Medication Delivery	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 12.534483 11.837572 13.231394 Dispersion σ 2.6504916 2.2407456 3.2450344 **Measure** -2*LogLikelihood 276.66731 AICc 280.88549 BIC 284.78819 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.934502 Prob<W 0.0038* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 14.4 Actual Estimate 12.5345 DF 57 Std Dev 2.65049 t Test / Signed-Rank Test Statistic -5.3603 -531.500 Prob > |t| <.0001* <.0001* Prob > t 1.0000 1.0000 Prob < t <.0001* <.0001*  12.0 13.0 14.0 15.0 16.0	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
OB Emergencies/Immunological Emergencies	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 3.9310345 3.6757653 4.1863036 Dispersion σ 0.9708392 0.8207548 1.1886122 **Measure** -2*LogLikelihood 160.16392 AICc 164.3821 BIC 168.2848 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.849584 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 4 Actual Estimate 3.93103 DF 57 Std Dev 0.97084 t Test / Signed-Rank Test Statistic -0.5410 -30.5000 Prob > |t| 0.5906 0.8073 Prob > t 0.7047 0.5963 Prob < t 0.2953 0.4037  3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

CNS Injuries	**Fitted Normal** **Parameter Estimates** Type: Location, Dispersion; Parameter: μ, σ; Estimate: 0.2241379, 0.4206554; Lower 95%: 0.1135322, 0.3556253; Upper 95%: 0.3347436, 0.5150144 **Measure** -2*LogLikelihood 63.147689 AICc 67.365871 BIC 71.268575 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.515154; Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 0.9 Actual Estimate 0.22414 DF 57 Std Dev 0.42066 t Test / Signed-Rank Test Statistic -12.236 / -764.500 Prob > |t| <.0001* / <.0001* Prob > t 1.0000 / 1.0000 Prob < t <.0001* / <.0001*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Pain Management	**Fitted Normal** **Parameter Estimates** Type: Location, Dispersion; Parameter: μ, σ; Estimate: 4.862069, 1.8204325; Lower 95%: 4.3834106, 1.5390074; Upper 95%: 5.3407273, 2.2287813 **Measure** -2*LogLikelihood 233.08947 AICc 237.30765 BIC 241.21035 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.762411; Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 4.8 Actual Estimate 4.86207 DF 57 Std Dev 1.82043 t Test / Signed-Rank Test Statistic 0.2597 / 66.5000 Prob > |t| 0.7961 / 0.6076 Prob > t 0.3980 / 0.3038 Prob < t 0.6020 / 0.6962  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly above the target.**
Trauma Triage	**Fitted Normal** **Parameter Estimates** Type: Location, Dispersion; Parameter: μ, σ; Estimate: 4.9137931, 1.4177383; Lower 95%: 4.5410178, 1.1985666; Upper 95%: 5.2865684, 1.7357571 **Measure** -2*LogLikelihood 204.08816 AICc 208.30634 BIC 212.20905 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.922728; Prob<W 0.0012* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 5.6 Actual Estimate 4.91379 DF 57 Std Dev 1.41774 t Test / Signed-Rank Test Statistic -3.6862 / -481.500 Prob > |t| 0.0005* / <.0001* Prob > t 0.9997 / 1.0000 Prob < t 0.0003* / <.0001*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Fluid Resuscitation	**Fitted Normal** **Parameter Estimates** Type: Location, Dispersion; Parameter: μ, σ; Estimate: 1.8275862, 0.4245919; Lower 95%: 1.7159455, 0.3589532; Upper 95%: 1.939227, 0.5198339 **Measure** -2*LogLikelihood 64.22816 AICc 68.446342 BIC 72.349046 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.449769; Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 1.6 Actual Estimate 1.82759 DF 57 Std Dev 0.42459 t Test / Signed-Rank Test Statistic 4.0821 / 369.5000 Prob > |t| <.0001* / 0.0014* Prob > t <.0001* / 0.0007* Prob < t 0.9999 / 0.9993  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly above the target.**

Crew Resource Management	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 0.8965517 0.8157767 0.9773267 Dispersion σ 0.3072033 0.259712 0.3761133 **Measure** -2*LogLikelihood 26.688387 AICc 30.906568 BIC 34.809273 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.349990 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 0.8 Actual Estimate 0.89655 DF 57 Std Dev 0.3072 t Test / Signed-Rank Test Statistic 2.3936 522.5000 Prob > |t| 0.0200* <.0001* Prob > t 0.0100* <.0001* Prob < t 0.9900 1.0000  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly above the target.**
Stroke	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 4.5172414 4.1681337 4.866349 Dispersion σ 1.3277257 1.1224693 1.6255533 **Measure** -2*LogLikelihood 196.47909 AICc 200.69728 BIC 204.59998 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.854916 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 5.4 Actual Estimate 4.51724 DF 57 Std Dev 1.32773 t Test / Signed-Rank Test Statistic -5.0635 -420.500 Prob > |t| <.0001* 0.0007* Prob > t 1.0000 0.9997 Prob < t <.0001* 0.0003*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Special Healthcare Needs	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 4 3.7910392 4.2089608 Dispersion σ 0.7947194 0.6718618 0.9729862 **Measure** -2*LogLikelihood 136.94399 AICc 141.16218 BIC 145.06488 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.843023 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 4 Actual Estimate 4 DF 57 Std Dev 0.79472 t Test / Signed-Rank Test Statistic 0.0000 27.5000 Prob > |t| 1.0000 0.8204 Prob > t 0.5000 0.4102 Prob < t 0.5000 0.5898  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly above the target.**
Infectious Disease	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 1.3275862 1.134381 1.5207914 Dispersion σ 0.7347975 0.6212034 0.899623 **Measure** -2*LogLikelihood 127.85028 AICc 132.06846 BIC 135.97116 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.765125 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 1.6 Actual Estimate 1.32759 DF 57 Std Dev 0.7348 t Test / Signed-Rank Test Statistic -2.8234 -449.500 Prob > |t| 0.0065* 0.0002* Prob > t 0.9967 0.9999 Prob < t 0.0033* <.0001*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**

Psychiatric Emergencies	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 0.7241379 0.6055927 0.8426832 Dispersion σ 0.4508512 0.381153 0.5519835 **Measure** -2*LogLikelihood 71.189185 AICc 75.407367 BIC 79.310071 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.559143 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 0.8 Actual Estimate 0.72414 DF 57 Std Dev 0.45085 t Test / Signed-Rank Test Statistic -1.2815 47.5000 Prob > |t| 0.2052 0.7022 Prob > t 0.8974 0.3511 Prob < t 0.1026 0.6489  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**
Neurological Emergencies	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 1.1206897 0.9232024 1.3181769 Dispersion σ 0.7510831 0.6349713 0.9195617 **Measure** -2*LogLikelihood 130.39315 AICc 134.61133 BIC 138.51403 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.804128 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 1.8 Actual Estimate 1.12069 DF 57 Std Dev 0.75108 t Test / Signed-Rank Test Statistic -6.8880 -645.500 Prob > |t| <.0001* <.0001* Prob > t 1.0000 1.0000 Prob < t <.0001* <.0001*  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Reject the null. Actual score is significantly below the target.**
Endocrine Emergencies	**Fitted Normal** **Parameter Estimates** Type / Parameter / Estimate / Lower 95% / Upper 95% Location μ 2.3275862 2.0745799 2.5805925 Dispersion σ 0.962233 0.813479 1.1780755 **Measure** -2*LogLikelihood 159.13102 AICc 163.34921 BIC 167.25191 **Goodness-of-Fit Test** Shapiro-Wilk W Test W 0.711170 Prob<W <.0001* Note: Ho = The data is from the Normal distribution. Small p-values reject Ho. **Test Mean** Hypothesized Value 2.4 Actual Estimate 2.32759 DF 57 Std Dev 0.96223 t Test / Signed-Rank Test Statistic -0.5731 159.5000 Prob > |t| 0.5688 0.2065 Prob > t 0.7156 0.1032 Prob < t 0.2844 0.8968  	**Ho: μ = μ_0** **Ha: μ ≠ μ_0** **Fail to reject the null. Insufficient evidence to say that actual score is significantly below the target.**

Appendix H. Level 3 KPI List

The data input method of the KPI indicates how a data point is recorded into the data system. Example: For the KPI “Was ETCO2 measured in cases of Asthma and/or COPD with SPO2<90?”, the ETCO2 is automatically measured by the data system. However, for the KPI “Was preoxygenation done in cases of endotracheal intubation?” the preoxygenation would only be noted in the system when the Paramedic manually documents that information.

KPI	Target	Data Input Method
1. Was ETCO2 measured in cases of endotracheal intubation?	95%	Automatic
2. Was ETCO2 measured in cases of Asthma and/or COPD with SPO2 <90%	50%	Automatic
3a. Was ETCO2 measured when a bronchodilator was administered?	90%	Automatic
3b. Was SPO2 measured when a bronchodilator was administered?	90%	Automatic
4. Was preoxygenation done in cases of endotracheal intubation?	90%	Manual
5. Was the bougie utilized in cases of endotracheal intubation?	50%	Manual
6. Was CPAP used in cases of CHF or COPD with SPO2<90%	50%	Manual
7. Was epinephrine administered within 10 minutes of patient contact?	95%	Automatic
8. If Intraosseous Infusion (IO) is used, and the patient is over 8 years old, was the humeral site used?	90%	Manual
9. In cases of stroke, was CBG (Capillary Blood Glucose) obtained? (Jan 2018 onwards)	95%	Manual
10. In cases of stroke, was scene time <15 min? (Jan 2018 Onwards)	90%	Automatic
11a. In cases of stroke with SPO2<90%, was Oxygen delivered?	95%	Manual
11b. In cases of stroke with SPO2>90%, was Oxygen delivered?	95% No	Manual
12. In cases of pediatric cardiac arrest (Less than 8yr old), was CPR started when heartrate dropped below 60?	90%	Manual
13. In cases of ACS, was aspirin administered? (Jan 2018 onwards)	95%	Manual
14a. In cases of ACS, was 12 lead acquired within 12 min? (Jan 2018 Onwards)	95%	Manual
14b. In cases of ACS, was 12 lead acquired within 5 min? (Jan 2018 Onwards)	90%	Manual
15. In cases of ACS, was Plavix administered?	95%	Manual
16. In cases of ACS, was Heparin administered?	95%	Manual
17a. In cases of ACS with SPO2<90%, was Oxygen administered?	95%	Manual
17b. In cases of ACS with SPO2>90%, was Oxygen administered?	95% No	Manual
18. In cases of trauma, was scene time < 10 mins?	95%	Automatic
19. In cases of trauma, was SPO2 monitored?	95%	Automatic
20. In cases of trauma with systolic BP <80, was IV fluids warmed?	95%	Manual
21a. In cases of trauma where certain advanced procedures are performed (Surgical Cricothyrotomy, Simple Thoracostomy, Pericardiocentesis, and Needle (Pleural) Decompression) was ETCO2 monitored?	95%	Automatic
21a. In cases of trauma where certain advanced procedures are performed (Surgical Cricothyrotomy, Simple Thoracostomy, Pericardiocentesis, and Needle (Pleural) Decompression) was SPO2 monitored?	95%	Automatic

KPI	Target	Data Input Method
22. In cases of trauma, if a tourniquet was used, was a hemorrhage documented?	95%	Manual
23. In cases of seizures, was CBG (Capillary Blood Glucose) obtained?	95%	Manual
24. If benzodiazepine (Midazolam) is administered, was ETCO2 monitored?	80%	Automatic
25a. If opioids (Morphine, Ketamine, and Fentanyl) are administered, was ETCO2 monitored?	95%	Automatic
25b. If opioids (Morphine, Ketamine, and Fentanyl) are administered, was SPO2 monitored?	95%	Automatic

Appendix I. Level 3 KPI Results

	Target	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11	PM12	PM13	PM14	PM15	PM16	PM17	PM18	PM19	Overall
KPI 1	95.00%	83.33%	75.00%	100.00%	95.45%	100.00%	100.00%	84.62%	100.00%	87.50%	88.89%	94.44%	**81.25% ***	82.35%	100.00%	100.00%	100.00%	86.67%	95.24%	100.00%	**92.35%**
KPI 2	50.00%	x	x	x	x	x	100.00%	x	x	x	x	x	x	x	x	0.00%	x	x	100.00%	x	**66.67%**
KPI 3a	90.00%	81.25%	95.83%	83.33%	87.50%	83.33%	87.88%	88.89%	85.70%	79.17%	90.91%	92.00%	100.00%	100.00%	94.12%	66.67%	**58.33%***	**50.00%***	**78.38%***	95.24%	**84.13%**
KPI 3b	90.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	**100.00%**
KPI 4	90.00%	**50.00%***	100.00%	83.33%	91.30%	**38.46%***	100.00%	**56.25%***	100.00%	84.62%	90.00%	91.67%	100.00%	94.44%	**33.33%***	93.33%	100.00%	94.12%	91.30%	85.00%	**83.01%**
KPI 5	50.00%	50.00%	62.50%	83.33%	91.30%	30.77%	53.85%	**12.50%***	33.33%	76.92%	**10.00%***	60.00%	88.24%	55.56%	33.33%	40.00%	46.67%	47.06%	**4.35%***	45.00%	**48.67%**
KPI 6	50.00%	x	x	x	x	x	100.00%	x	x	100.00%	x	100.00%	x	x	100.00%	66.67%	50.00%	x	100.00%	100.00%	**89.58%**
KPI 7	95.00%	**0.00%***	**71.43%***	**60.00%***	81.82%	**73.33%***	75.00%	**60.00%***	100.00%	90.00%	88.89%	100.00%	91.67%	100.00%	83.33%	88.89%	87.50%	100.00%	**71.43%***	100.00%	**80.17%**
KPI 8	90.00%	66.67%	100.00%	66.67%	100.00%	88.89%	75.00%	**0.00%***	71.43%	100.00%	**54.55%***	80.00%	**33.33%***	77.78%	x	94.12%	**0.00%***	**60.00%***	66.67%	**56.25%***	**66.19%**
KPI 9	95.00%	92.31%	83.33%	50.00%	100.00%	94.12%	**33.33%***	100.00%	100.00%	86.67%	100.00%	**85.19%***	100.00%	100.00%	100.00%	100.00%	80.00%	88.89%	100.00%	100.00%	**89.15%**
KPI 10	90.00%	**15.38%***	**0.00%***	50.00%	**37.50%***	**11.76%***	66.67%	**33.33%***	100.00%	80.00%	85.71%	**62.96%***	**66.67%***	**28.57%***	**25.00%***	**53.85%***	50.00%	66.67%	**33.33%***	**47.37%***	**48.15%**
KPI 11a	95.00%	0.00%	x	x	x	x	x	x	0.00%	x	x	100.00%	x	0.00%	x	x	x	x	x	x	**25.00%**
KPI 11b	95.00%	x	x	x	x	x	x	x	x	x	100.00%	x	x	x	x	x	x	x	x	x	**100.00%**
KPI 12	90.00%	x	x	x	x	100.00%	100.00%	x	100.00%	x	100.00%	x	100.00%	x	x	x	x	x	50.00%	x	**91.67%**
KPI 13	95.00%	**63.16%***	82.35%	**72.73%***	**70.00%***	**63.64%***	100.00%	**37.50%***	**55.56%***	87.50%	**80.95%***	**71.43%***	**72.22%***	**62.50%***	100.00%	**83.33%***	**61.90%***	89.47%	**60.00%***	**55.56%***	**72.09%**
KPI 14a	95.00%	94.44%	**62.07%***	93.33%	92.86%	89.19%	86.67%	90.91%	100.00%	92.31%	93.33%	96.77%	**82.61%***	89.29%	90.00%	87.88%	89.13%	96.30%	94.74%	92.86%	**90.25%**
KPI 14b	90.00%	**44.44%***	**13.79%***	**13.33%***	**57.14%***	**24.32%***	**26.67%***	**36.36%***	**61.54%***	**46.15%***	**66.67%***	**54.84%***	**43.48%***	**10.71%***	**40.00%***	**39.39%***	**28.26%***	**29.63%***	**47.37%***	**28.57%***	**37.51%**
KPI 15	95.00%	**0.00%***	x	x	**33.33%***	**0.00%***	x	**0.00%***	0.00%	x	**0.00%***	**14.29%***	x	**0.00%***	**0.00%***	**0.00%***	0.00%	**0.00%***	**0.00%***	**0.00%***	**3.40%**
KPI 16	95.00%	50.00%	x	x	**57.14%***	**25.00%***	x	**0.00%***	x	x	**50.00%***	**42.86%***	x	**0.00%***	50.00%	**0.00%***	100.00%	**50.00%***	66.67%	**0.00%***	**37.82%**
KPI 17a	95.00%	x	x	x	100.00%	**0.00%***	x	100.00%	0.00%	x	x	100.00%	x	x	x	100.00%	100.00%	x	50.00%	x	**68.75%**

KPI 17b	95.00%	50.00%	x	100.00%	**62.50%***	**66.67%***	x	0.00%	x	100.00%	x	0.00%	x	50.00%	50.00%	66.67%	0.00%	100.00%	100.00%	100.00%	**60.42%**
	Target	**PM1**	**PM2**	**PM3**	**PM4**	**PM5**	**PM6**	**PM7**	**PM8**	**PM9**	**PM10**	**PM11**	**PM12**	**PM13**	**PM14**	**PM15**	**PM16**	**PM17**	**PM18**	**PM19**	**Overall**
KPI 18	95.00%	x	**0.00%***	**25.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	50.00%	**25.00%***	**40.00%***	**33.33%***	50.00%	**20.00%***	0.00%	**0.00%***	**0.00%***	0.00%	**0.00%***	**33.33%***	**15.37%**
KPI 19	95.00%	**56.38%***	**61.90%***	**33.71%***	**64.34%***	**62.69%***	**58.90%***	**72.53%***	**51.11%***	**55.95%***	95.67%	**58.44%***	**71.43%***	**88.39%***	**51.76%***	**82.49%***	**62.96%***	**83.75%***	99.24%	**73.87%***	**67.66%**
KPI 20	95.00%	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**12.50%***	**0.00%***	**0.00%***	x	**0.00%***	**0.00%***	**0.00%***	**12.50%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**0.00%***	**1.39%**
KPI 21a	95.00%	**33.33%***	x	x	100.00%	x	x	100.00%	100.00%	100.00%	x	x	**25.00%***	50.00%	x	x	x	50.00%	0.00%	100.00%	**65.83%**
KPI 21b	95.00%	66.67%	x	x	100.00%	x	x	50.00%	100.00%	100.00%	x	x	**25.00%***	100.00%	x	x	x	**0.00%***	100.00%	0.00%	**64.17%**
KPI 22	95.00%	x	x	0.00%	x	0.00%	x	x	x	0.00%	0.00%	0.00%	0.00%	0.00%	x	x	x	x	x	x	**0.00%**
KPI 23	95.00%	92.31%	83.33%	50.00%	100.00%	94.12%	**33.33%***	100.00%	100.00%	86.67%	100.00%	**85.19%***	100.00%	100.00%	100.00%	100.00%	80.00%	88.89%	100.00%	100.00%	**89.15%**
KPI 24	80.00%	80.00%	100.00%	66.67%	95.65%	100.00%	92.31%	92.31%	100.00%	88.24%	92.31%	75.00%	87.23%	96.15%	66.67%	77.14%	64.29%	63.64%	90.00%	80.95%	**84.66%**
KPI 25a	95.00%	**81.82%***	96.55%	88.00%	92.00%	89.83%	**81.97%***	90.54%	90.00%	92.41%	**87.93%***	**76.52%***	**91.24%***	93.55%	91.30%	**83.70%***	**74.29%***	**78.57%***	**81.82%***	**74.63%***	**86.14%**
KPI 25b	95.00%	90.91%	96.55%	92.00%	97.33%	96.61%	96.72%	97.30%	100.00%	100.00%	100.00%	93.91%	97.08%	98.92%	100.00%	97.78%	100.00%	92.86%	98.48%	94.03%	**96.87%**
Overall		**55.93%**	**67.61%**	**62.45%**	**76.29%**	**57.81%**	**71.29%**	**56.12%**	**74.94%**	**77.46%**	**71.49%**	**68.03%**	**70.39%**	**61.47%**	**64.04%**	**64.88%**	**59.72%**	**63.19%**	**67.11%**	**66.51%**	

Appendix J. Level 4 KPI List

The data input method of the KPI indicates how a data point is recorded into the data system. Example: For the KPI “Was ETCO2 measured in cases of Asthma and/or COPD with SPO2<90?”, the ETCO2 is automatically measured by the data system. However, for the KPI “In cases of endotracheal intubation, was the bougie utilized?” the bougie utilization would only be noted in the system when the Paramedic manually documents that information.

KPI	Target	Data Input Method
1. Was ETCO2 measured in cases of endotracheal intubation? (Jan 2018 Onwards)	95%	Automatic
2. Was ETCO2 measured in cases of Asthma and/or COPD with SPO2 <90%	50%	Automatic
3a. Was ETCO2 measured when a bronchodilator was used?	90%	Automatic
3b. Was SPO2 measured when a bronchodilator was used?	90%	Automatic
4. In cases of endotracheal intubation, was the bougie utilized?	50%	Manual
5. If Intraosseous infusion (IO) was done, and if the patient was over 8 years old, was the humeral site used?	90%	Manual
6. In cases of stroke, was CBG(Capillary Blood Glucose) obtained? (Jan 2018 Onwards)	95%	Manual
7. In cases of stroke, was scene time <15 min(900s)? (Jan 2018 Onwards)	90%	Automatic
8. In case of ACS, was aspirin administered with no allergy?	95%	Manual
9a. In case of ACS, was 12 lead acquired within 12 mins?(Jan 2018 Onwards)	95%	Manual
9b. In case of ACS, was 12 lead acquired within 5 mins?(Jan 2018 Onwards)	90%	Manual
10. In cases of trauma, was scene time <10 mins(600s)?	95%	Automatic
11. In cases of trauma, was SPO2 monitored?	95%	Automatic
12. In cases of trauma, with systolic BP< 80, were IV fluids warmed?	95%	Manual
13. In cases of seizures, was CBG obtained?	95%	Manual
14. If Benzodiazepines (Midazolam) were administered, was ETCO2 monitored?	80%	Automatic

KPI	Target	Data Input Method
15a. If Opioids (Morphine, Ketamine, Fentanyl) were administered, was ETCO2 monitored?	95%	Automatic
15b. If Opioids (Morphine, Ketamine, Fentanyl) were administered, was SPO2 monitored?	95%	Automatic

Appendix K. IRB Approval and Consent Form

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/research

TO: Isabelina Nahmens
Mechanical and Industrial Engineering

FROM: Dennis Landin
Kinesiology

DATE: October 25, 2019

RE: **IRB#** 4286

TITLE: Developing a Framework to Evaluate the Effectiveness of Continuing Education at Emergency Medical Services

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited _X_ **Review date:** 10/23/2019

Risk Factor: Minimal ___X___ Uncertain _____ Greater Than Minimal_____

Approved_____X_____ **Disapproved**_____

Approval Date: 10/25/2019 **Approval Expiration Date:** 10/24/2020

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: N/A

LSU Proposal Number (if applicable):

By: Dennis Landin, Chairman _____

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

Consent Form

1. Study Title: Developing a Framework to Evaluate the Effectiveness of Continuing Education at Emergency Medical Services

2. Performance Site: East Baton Rouge Parish Emergency Medical Services Headquarters

3. Investigators: The following investigators are available for questions about this study,

Dr. Isabelina Nahmens, Ph.D Email: nahmens@lsu.edu
Tasmia Mustaquim, Graduate Student Email: tmusta4@lsu.edu

4. Purpose of the Study: to evaluate the effectiveness of training at EMS by analyzing data collected from EMS from surveys, tests, observations, and the ESO data suite.

5. Subject Inclusion: Paramedics currently employed by East Baton Rouge EMS.

6. Number of Subjects: Approximately 50 paramedics.

7. Study Procedures: The study will be conducted in 4 levels.

Level 1. Reaction: Survey data collected during training will be analyzed (means, standard deviation, t-test, hypothesis testing, etc.) to understand overall reaction to training content, instructor quality, facilities quality, etc.

Level 2. Learning: Test results collected during competency evaluations will be analyzed (mean, standard deviation, t-test, hypothesis testing, etc.) to understand how well the participants have retained the information from the training.

Level 3. Behavior: Key Performance Indicators will be measured from the ESO data suite and observation data will be collected from ambulances and analyzed (t-test, hypothesis testing, etc.) to evaluate if there are any changes in behavior after taking a training.

Level 4. Results: Key Performance Indicators will be measured from the ESO data suite and analyzed (t-test, hypothesis testing, etc.) to evaluate if the training has had any effects on targeted outcomes of EMS.

8. Benefits: This study may yield valuable information about how effective the training program at EMS is and how it can be improved to better serve EMTs and paramedics.

9. Risks: There are no physical or mental risks associated with the study.

10. Right to Refuse: Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.

11. Privacy: Results of the study will be published, but no names or identifying information will be included in the publication. Only aggregated data will be reported.

12. Signatures: The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators. If I have questions about subjects' rights or other concerns, I can contact Dennis Landin, Institutional Review Board, (225) 578-8692, irb@lsu.edu, www.lsu.edu/irb. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Subject Signature: **Date:**

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Vita

Tasmia Mustaquim was born in Sylhet, Bangladesh in 1994. She received her Bachelor's degree in Mechanical Engineering from Missouri University of Science and Technology in December 2017. In August 2018, she started her work towards a Master's degree in Industrial Engineering at Louisiana State University. As a Master's student, Tasmia also worked as a Graduate Assistant in the Department of Mechanical and Industrial Engineering. Tasmia plans to earn her Master's in May 2020.