NEONATAL RESUSCITATION: INTERACTIVE FLASH CARDS FOR PEDIATRIC HEALTH PROFESSIONALS

APPROVED BY SUPERVISORY COMMITTEE

Kenneth Coulter, M.F.A.

Lewis Calver, M.S.

Gregory Jackson, M.D., M.B.A.

DEDICATION

I would like to thank the members of my Graduate Committee, Kenneth Coulter, Lewis Calver and Dr. Gregory Jackson, for all your support and guidance throughout this entire process.

I would also like to thank Kim Hoggatt Krumwiede, Angela Diehl, Dr. Laura McClendon and especially my classmates, for your encouragement and support throughout this journey.

To my family, I would not be where I am today without your love and support throughout my life. Thank you.

NEONATAL RESUSCITATION: INTERACTIVE FLASH CARDS FOR PEDIATRIC HEALTH PROFESSIONALS

by

SUZANNE M. GHUZZI

DISSERTATION / THESIS

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Southwestern Medical Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

The University of Texas Southwestern Medical Center at Dallas

Dallas, Texas

August, 2010

Copyright

by

SUZANNE M. GHUZZI, 2010

All Rights Reserved

NEONATAL RESUSCITATION: INTERACTIVE FLASHCARDS FOR PEDIATRIC HEALTH PROFESSIONALS

SUZANNE M. GHUZZI, M.A.

The University of Texas Southwestern Medical Center at Dallas, 2010

KENNETH COULTER, M.F.A.

The goal of this thesis project was to create a supplementary educational tool to the American Heart Association and American Academy of Pediatrics' Neonatal Resuscitation Program (NRP). It was designed for pediatric health professionals, specifically those in the Newborn Nursery Department to train, study and practice neonatal resuscitation on an interactive application consisting of ten multiple choice and interactive questions. The application featured 3D animation in an interactive setting. Users received a cumulative score following completion of all ten cards based on performance. The application was evaluated by Gregory Jackson, MD, MBA and Laura McClendon, MD of the University of Texas Southwestern Medical Center Department of Pediatrics and was reviewed to be a successful, intriguing educational tool for use in

formal training, practice, continuing education and as a variable in a long-term study of delivery room performance.

TABLE OF CONTENTS

ABSTRACT i

CHAPTER ONE: INTRODUCTION 1

GOALS 1

PROGRAM 1

OBJECTIVES 2

BACKGROUND 3

SIGNIFICANCE 5

LIMITATIONS 6

PRODUCTION METHODS 8

CHAPTER TWO: REVIEW OF THE LITERATURE 10

ANALYSIS OF AVAILABLE RESOURCES FOR LEARNING NRP 10

ANALYSIS OF PREVIOUS TESTING ON PERFORMANCE AND RETENTION OF NRP 12

THE VALUE OF INTERACTIVE LEARNING 14

CONCLUSIONS 15

CHAPTER THREE: METHODOLOGY 16

CONCEPT DEVELOPMENT 16

TARGET AUDIENCE 17

PRE-PROJECT PLANNING 17

FLOWCHARTS 18

FLASH CARDS 20

CARD 1: DIAPHRAGMATIC HERNIA 20

CARD 2: PULSE OXIMETER 21

CARD 3: MISSING TOOL 22
CARD 4: PRONE POSITION PLACEMENT 23
CARD 5: SHOULDER ROLL 24
CARD 6: GRUNTING BABY 25
CARD 7: SUCTION FOR MECONIUM 26
CARD 8: PROPER BAGGING TECHNIQUE 27
CARD 9: UNPREPARED RADIANT WARMER 28
CARD 10: INEFFECTIVE BAGGING 29
PROGRAMMING 30
MODELING 31
ANIMATION 31
FINAL PROGRAMMING 32
CHAPTER FOUR: RESULTS 33
PHYSICIAN EVALUATIONS 33
EVALUATION DISTRIBUTION 33
SUMMARY OF EVALUATION RESULTS 34
EVALUATION OF EVALUATION RESPONSES 34
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS 38
PROJECT SUMMARY 38
SUCCESSES 40
SUGGESTED AREAS FOR FURTHER RESEARCH 40

LIST OF FIGURES

FIGURE 1-1: MEGACODE CHECKLIST ASSESSMENT FORM 42

FIGURE 1-2: FLASH CARD INTRODUCTION SCREEN 43

FIGURE 2-1: TEXTBOOK OF NEONATAL RESUSCITATION 44

FIGURE 3-1: FLOWCHART OF CARD 7: PULSE OXIMETER 20

FIGURE 3-2: CARD 1: DIAPHRAGMATIC HERNIA 21

FIGURE 3-3: CARD 2: PULSE OXIMETER 22

FIGURE 3-4: CARD 3: MISSING TOOL 23

FIGURE 3-5: CARD 4: PRONE POSITION PLACEMENT 24

FIGURE 3-6: CARD 5: SHOULDER ROLL 25

FIGURE 3-7: CARD 6: GRUNTING BABY 26

FIGURE 3-8: CARD 7: SUCTION FOR MECONIUM..... 27

FIGURE 3-9: CARD 8: PROPER BAGGING TECHNIQUES..... 28

FIGURE 3-10: CARD 9: UNPREPARED RADIANT WARMER..... 29

FIGURE 3-11: CARD 10: INEFFECTIVE BAGGING..... 31

FIGURE 3-12: SCREEN SHOT FROM ADOBE® FLASH® PROGRAMMING..... 45

FIGURE 3-13: SCREEN SHOT FROM AUTODESK® MAYA® MODELING 45

FIGURE 3-14: SCREEN SHOT FROM AUTODESK® MAYA® ANIMATION 46

FIGURE 3-15: SCREEN SHOT FROM ADOBE® AFTEREFFECTS® 46

LIST OF APPENDICES

APPENDIX A - FIGURES 42

APPENDIX B - FLOWCHARTS 47

APPENDIX C - PHYSICIAN EVALUATIONS 52

CHAPTER ONE
Introduction

Goals

Neonatal Resuscitation: Interactive Flash Cards for Pediatric Health Professionals was developed as an online application supplementary to the American Heart Association and American Academy of Pediatrics' Neonatal Resuscitation Program for pediatric residents, fellows and nurse practitioners. The application presents residents with interactive decision-making scenarios to facilitate the timely application of acquired knowledge in a clinical setting, and increased comprehension and reinforced clinical knowledge of the content.

Program

The scenarios presented in the application reflect events with which residents, fellows and nurse practitioners will be faced as interactive flash cards, with each "card" featuring a multiple choice question, systematic list ranking, or a clinical situation to which treatment should be properly administered as indicated by the user. The user provides their name prior to initializing the application and their performance is continuously tracked, including the number of attempts required to answer a card correctly and their final cumulative score. Once all of the cards, presented in random order with each use, the final evaluation page immediately informs the user of their performance on each question, and can then be printed, or saved, as a Portable Document File (PDF) and handed in or emailed to the program administrator, Gregory Jackson, M.D., M.B.A., Professor of Pediatrics at the University of Texas Southwestern Medical Center at Dallas

and Clinical Co-Director of the Parkland Memorial Hospital Newborn Nursery, for analysis and record-keeping. The application was evaluated by Dr. Jackson and Dr. McClendon as a legitimate and useful supplementary tool to be used during the didactic learning period first-year residents experience, in preparation for the Megacode delivery room assessment and for use in a long term delivery room performance study being implemented at Parkland Memorial Hospital.

Objectives

The initial objective was to work with Dr. Jackson to identify a topic where the greatest need for health professional education was needed. It was determined that the American Heart Association's Neonatal Resuscitation Program was of great importance to pediatrics because of the numerous cases of birth asphyxia pediatric residents and nurse practitioners at Parkland Memorial Hospital encounter on a daily basis. The next objective was to establish the appropriate content presented to the target audience. There are a number of groups of pediatric health care professionals that learn and practice NRP including first-year residents learning the resuscitation procedures, third-year residents learning more in-depth treatments to neonatal asphyxia such as administering intravenous drugs, pediatric attendings and fellows, and pediatric nurse practitioners who spend more time in the delivery room than any other group. The next objective was to create the application by programming each flash card scenario, and designing the user GUI (Graphical User Interface) in Adobe Flash®. Modeling, texturing and animating of the 3D assets in Autodesk® Maya® occurred simultaneously.

A major component of the Neonatal Resuscitation Application is reinforcing the completion of the initial clinical procedures in a systematic order to ensure proper assessment of the newborn immediately following birth. The four initial steps a pediatrician should perform on an asphyxiated infant are 1) position the infant on the radiant warmer so that larynx is in the optimal position for air to travel to the lungs; 2) suctioning the mouth and nose to remove any fluids; 3) drying the infant with blankets to remove fluids; 4) tactilely stimulate the infant and reduce heat loss from evaporation; by rubbing its back or flicking its foot (Kattwinkel). Each flash card begins with a delivery history and informs the user which procedures have been completed prior to the point at which they must intervene. Unless the infant was treated immediately following delivery, and no clinical procedures were performed, the delivery history lists the initial treatment steps in the proper order to further reinforce the initial steps of the Neonatal Resuscitation Program.

Background

The Neonatal Resuscitation Program (NRP) was established in 1987 by the American Heart Association and the American Academy of Pediatrics as the standard course for instructing pediatric caregivers on proper methods and techniques of newborn resuscitation. Neonatal asphyxia results from oxygen deprivation in a newborn infant and can last long enough to cause harm or fatalities. Left untreated or given failed treatment, asphyxia at birth accounts for 19% of annual neonatal mortalities (Kattwinkel

2005). At Dallas' Parkland Memorial Hospital, first year residents are required to complete a four-week rotation in the Newborn Nursery. In these few weeks they must become competent in the NRP as outlined by the American Heart Association and American Academy of Pediatrics to prepare for the delivery of a newborn in any given situation.

Currently, the most common course of instruction in NRP teaches pediatric residents, nurse practitioners and fellows the proper methods to resuscitate an infant who is showing signs of partial or complete asphyxia. The training consists of a textbook with limited monochromatic illustrations as well as an accompanying DVD that restates the methodology of the procedure with actors playing the parts of delivery room healthcare professionals while a narrator reiterates the major concepts discussed in the corresponding chapter of text. After studying these materials, residents complete a standard 9-part online examination administered by the American Heart Association. However, some residents do not pass the test on their first attempt, and must retake either a section or the entire test .

A performance review is also given towards the middle of the rotation called the *Megacode Checklist Assessment Form* (*see Appendix A, figure 1-1*). First-year residents must be evaluated by an Attending Pediatric Physician trained in NRP using the checklist's guidelines and criteria. The resident's performance is also evaluated using a resuscitation scenario incorporating a plastic newborn mannequin, and they must ask the evaluator questions regarding the infant's responses to treatment and their appearance. Residents must achieve a minimum score of 85%, and perform all tasks and procedures

according to the Megacode Checklist Assessment Form. Once the resident passes, he or she may go to deliveries and perform neonatal resuscitation on asphyxiated infants.

Significance

According to the Newborn Nursery section of its website, Dallas' Parkland Memorial Hospital delivers approximately 15,000 - 16,000 infants each year and is the second largest neonatal center in the country. Of the forty-two infants birthed on a daily basis, 1-3 newborns must be resuscitated at the time of birth by pediatricians. A first year resident spends only four weeks on rotation in the Newborn Nursery, but in that time, he or she will encounter 10-15 deliveries that require some sort of breathing assistance. Therefore, it is imperative that residents be extremely familiar and competent with the neonatal resuscitation procedure.

Currently, the resuscitation-training program utilizes the *Textbook of Neonatal Resuscitation, 5th Edition* text book, accompanied by a supplemental DVD. There is a substantial volume of written information for the resident to study in a short period of time with minimal interactivity to assist in the learning process. Dr. Jackson and Laura McClendon, M.D., Coordinator of the Newborn Nursery Neonatal Resuscitation Program at Parkland Memorial Hospital, have identified problems with residents correlating the static textual information with dynamic clinical situations, and retaining the information as well as instances of experienced pediatric nurse practitioners and pediatric fellows following incorrect protocol.

To date there are no other supplemental, interactive learning tools to assist pediatric health professionals in achieving higher scores on their Megacode Checklist Assessment Form for the Neonatal Resuscitation Program. Therefore, an interactive application has the potential to enhance both learning and performance in a clinical environment in the long run through mental recall of acquired skills and additional practice of potential delivery room situations.

Dr. Jackson is implementing a new method of delivery room performance and evaluation at Parkland Memorial Hospital in the near future and will use the interactive program as a supplementary tool to evaluate residents in the test group of his study.

Limitations

The *Textbook of Neonatal Resuscitation, 5th Edition*, published by the American Heart Association, encompasses all aspects of the Neonatal Resuscitation Program, including the procedural steps and concepts as well as the physiology of neonatal pulmonology. The online application was limited to the resident's knowledge of the resuscitation procedure to reinforce its clinical application. The application did not include step-by-step teaching of the Neonatal Resuscitation Program. Instead, it acted as a method of practice and repetition of clinical procedure. Therefore, it was imperative the user had prior knowledge of the program from his or her studies of the *Textbook of Neonatal Resuscitation*.

Upon opening the application, the user was given a brief introduction to the program (*see Appendix A, figure 1-2*). The user clicked a start button to begin the flash cards. The flash cards ran in a randomized fashion and the user had to complete all ten cards. If the user quit the program before completing all ten flash cards, the score would be invalid and the attempt void. Each flash card began with a background information page that contained a list of information regarding the delivery and infant featured in the scenario including gestational age, estimated fetal weight, fetal heart rate, the presence of meconium during delivery, the age of life at the time of the flash card, the infants muscle tone appearance, color and whether or not the infant was responsive. This information is given to the pediatrician or nurse practitioner in the delivery room at the time of birth so it was relevant and necessary to give to the user before their performance. In reality, certain information is presented to the pediatrician by reading the mother's chart, therefore it is important for the user to read and remember the information given to them in the background history. To mimic a real life delivery situation, the user was not allowed to return to the background information page at any time during the flash card. After completing the flash card correctly, an "advance" button appeared to prompt the user to the next flash card.

The program featured numerous multiple-choice questions. A correct response allowed the user to progress either within the flash card or to the "advance" button. An incorrect response triggered a popup to inform the user of the incorrect response, briefly explained why it was incorrect and prompted them to try again. The tracking system recoded all attempts and allowed the user to obtain points by answering correctly. The user was only allowed as many response attempts as were responses to a certain question to receive

points. If he or she failed to answer correctly within the number of answer choices, no points would be awarded for that particular flash card. For example, answering a question correctly on the second attempt when there were eight answer choices would earn the user a total of seven out of eight points. If the user answered correctly on the eighth attempt, he or she would be awarded no points.

After the user completed all ten flash cards, a feedback page showed a list of the ten flash cards and the user's score for each card as well as their final, cumulative score given as a percentage out of one hundred. This page could be printed and given to Dr. Jackson or saved as a Portable Document Format (PDF) and emailed to Dr. Jackson. If the user did not send the results page to Dr. Jackson immediately following their completion of the flash cards, the score would not count and the user would not receive credit for completing the program.

Production Methods

Research was conducted via the UT Southwestern Library, and the American Heart Association's *Textbook of Neonatal Resuscitation, 5th Edition,* and the Internet because these are the primary outlets for residents to quickly find any information they may need regarding the Neonatal Resuscitation Program.

The final product was a web-based application that combined animated Autodesk® Maya® 3D models with post-production modifications done in Adobe® AfterEffects®.

The final images were then incorporated into an Adobe® Flash® interactive application. Additional delivery room supplies and equipment were created and animated in Autodesk® Maya®. The 3D infant model was purchased online from TurboSquid.com and manually jointed and rigged to animate. Adobe® AfterEffects® served to apply any post-production animation work that needed to be done. Adobe® Flash® was used to create and deign the application's interface, introduction page, and help menu. The Flash® platform served as a means to create the interactivity of the program as well as the scoring and points system.

CHAPTER TWO
Review of the Literature

Analysis of available resources for learning NRP

One possible reason why pediatric residents, fellows, and nurse practitioners may find the Neonatal Resuscitation Program difficult to learn and retain is due to the limited amount of supplemental resources available to them for extra study. An Internet and UT Southwestern Medical Center Library search was conducted to find other materials similar to this Flash® application available to residents. The results only yielded numerous self-made "how to" videos on the home video uploading website, www.youtube.com, such as how to intubate or perform chest compressions. Quality of many of these videos was poor and no interactive programs were available.

Currently, the *Textbook of Neonatal Resuscitation*, *5th Edition*, published by the American Heart Association, is the primary textbook pediatric residents and nurse practitioners use to study while preparing for the American Heart Association's standardized exam. The text contains hundreds of simple, procedural line drawings that illustrate the resuscitation procedure. The end of each chapter contains a short quiz with both short answer and multiple-choice responses to allow the reader to review what was read. Although the text caters directly to the final examination, it relies heavily on didactic material and does not give the reader a strong sense of the clinical environment or its pressures. The images featured in the book are monochromatic, two dimensional outlines (*see Appendix A, figure 2-1*). The images fail to convey a sense of dimension to

the reader, which is important in the neonatal resuscitation procedure where position of the infant and instruments is crucial.

Another limitation of the textbook is that it advises readers to use 100% oxygen in cases of cyanosis and positive pressure ventilation (Kattwinkel 2006, 8-8). However, a study conducted by neonatologists at the University of California, San Diego, found that resuscitating term infants (<37 weeks) using room air, 21% oxygen, was more beneficial than using 100% oxygen due to findings of elevated cardiac enzymes in certain infants (Wang et al. 2008, 1084). Another study, administered by neonatologists at the University Hospital La Fe in Valencia, Spain, University Hospital San Carlos in Madrid, and Vanderbilt University, found that hyperoxia, or the use of 100% oxygen in resuscitation, has been associated with injury to the development of vital organs such as the brain, lungs, myocardium of the heart and kidneys. Resuscitating with room air was found to decrease resuscitation time, while increasing oxidative stress and inflammation (Vento et al. 2009, e440).

The Textbook of Neonatal Resuscitation, 5th Edition Multimedia DVD-ROM accompanies the American Heart Association's *Textbook of Neonatal Resuscitation, 5th Edition*. The main menu features links to each chapter in the book and reviews the featured scenarios from the text in live-action video as well as key points mentioned in the text. There are also six other scenarios featured in the main menu, different from those in the book. These scenarios give the user a prompt background of the birth and give them 2-3 clinical treatments from which to choose. If the user answers incorrectly, the program lets them try again for the correct answer. The chapter scenarios

featured in the DVD are the same as the corresponding ones in the text book. However, these scenarios feature movie clips of people acting out the scenario in a delivery room. The infant undergoing the resuscitation procedure is a plastic mannequin that does not move or respond in any way. Because of this limitation, the user cannot visualize muscle tone, lung activity, cyanosis, or the effect of stimulation. The DVD was distributed four years ago (2006) and is extremely slow to load each video clip and successive page in the program. Modern advances in digital technology allow for streaming of online content as it becomes available, and could perform better than a DVD for loading purposes.

Analysis of previous testing on performance and retention of NRP

A number of studies have been conducted to test different methods of observing and evaluating pediatric caregivers' neonatal resuscitation performance. Researchers at the University of Texas Medical School at Houston assembled two groups of non-certified first year pediatric interns to test the effect of a teamwork training workshop intervention on neonatal resuscitation performance. Identical resuscitation simulations on SimBaby™ (Laerdal Medical Corp., Stavanger, Norway) mannequins revealed that the teamwork-training group completed simulations an average of 2.6 minutes faster than the control group (Thomas et al. 2009, 544). The teamwork group was also observed to ask more questions and suggest new strategies during simulations. Although the test group completed the simulations in less time and showed greater communication with teammates, there was no significant difference in NRP megacode scores between the groups (Thomas et al. 2009, 545). There is no evidence that indicates teamwork training

increases NRP performance; however, simulating another caregiver present in the online application's delivery room setting to offer advice and different care tactics may facilitate learning the proper methods of newborn resuscitation.

Another method of observing pediatric caregivers' newborn resuscitation performance is to video record them in the delivery room. Neonatologists at the University of California, San Diego, set up a video camera on the radiant warmer to observe caregivers as they attempted to resuscitate newborns. They found that numerous techniques were done improperly or took too much time to complete and that 45% of the observed resuscitations digressed from the standard practice guidelines (Carbine et. al 2000, 654). Whether or not caregivers become careless or simply forget proper protocol following initial training, it is evident there is a need to stress the fundamental elements of NRP to not only those initially learning the program, but to residents, fellows, and nurse practitioners as a means of preliminary and continuing education to assure the proper treatment of newborns.

There appears to be a correlation between the amount of time following completion of NRP training and standardized test scores. Pediatricians at McMaster University, Hamilton, Ontario administered the NRP written examination to family medicine residents 6-8 months after the initial examination was give. On the follow-up assessment, only 59% of residents had scores above the acceptable passing level of 191/239 (80%) (Kaczorowski 1998, 708). Other studies, such as one conducted at the Center for Clinical Education, Rigshospitalet, Copenhagen University Hospital, found testing skills as a final activity, rather than time spent practicing clinical skills, in a course

increases learning. The study indicates that the testing effect, or memory enhancement due to the act of retrieving knowledge, will not only intensify knowledge retention, but will also increase the outcome of skills learning (Kromann 2009, 26). Allery also finds this notion to be true in her commentary paper, *Educational games and structured experiences*, and insists there is a need to move the learner from the testing phase and into clinical application practice via the insights and experiences they receive from the act of testing itself (2004, 505).

The value of interactive learning

After reviewing the material available to pediatricians and nurse practitioners, it was evident that most of the information available was in the form of didactic textbooks, or homemade, online videos that are audibly difficult to understand. Because the Neonatal Resuscitation Program is of clinical relevance, it is evident there is need for an interactive learning application for health care professionals to use as a supplement to the didactic reading materials as well as passive visuals in the form of online videos.

Interactive, online games have been shown to have a significant impact on the ability of users to retain presented information. Pediatricians at the University of Utah School of Medicine observed this same notion when they divided medical students into two groups: one group would receive supplementary intervention from an online pediatric game and the other would self-study the material. Although the students in the self-study group scored higher in both the follow-up written examination and posttest examination, the

overall reaction to the game was positive. An evaluation revealed the mean score of game's overall reaction to be a 6.5 out of a possible 9 with both agreeing they would prefer a gaming method of teaching rather than traditional methods. "Active learning methods such as game playing may engage students in the learning activity (Sward et al. 2008, 356)."

In another instance, researchers at Duke University Medical Center tested the effects of a computer-based interactive tool on pediatric resuscitation. Two groups of radiologists performed simulated resuscitations on mannequins with one group receiving intervention from an interactive resource that presented resuscitation algorithms and helped guide users through clinical queries. Those who had access to the tool completed 95% of the tasks to be assessed while the control group was only able to complete 64% of the tasks (Lerner et al. 2009, 707).

Conclusions

According to the research of relevant literature and the opinions of Drs. Jackson and McClendon, there are no interactive tools for pediatric health professionals that supplement the American Heart Association's Neonatal Resuscitation Program. Research on the value of interactive learning which combines didactic text, animations and gives the user instant feedback, as well as providing a performance evaluation for review, is a successful way to achieve the goals of this thesis, *Neonatal Resuscitation: Interactive Flash Cards for Pediatric Health Professionals.*

CHAPTER THREE
Methodology

Concept development

Dr. Jackson expressed his concern about the importance of educating pediatric residents' proper clinical application of the Neonatal Resuscitation Program. Initially, the goal of this thesis was to create an interactive program that would begin with a guided preparation scenario in which the user had to properly set up the radiant warmer bed in the delivery room before a birth and six clinical scenarios in which users would perform the NRP on asphyxiated infant models. The program was to be designed to react to any and all clinical decisions the user made and would end with each infant breathing on its own, having to be put in the neonatal intensive care unit, or in death. After fleshing out each scenario, the scope of the project was revealed to be too large and adjustments were made.

The program was then cut down to contain only the preparation scenario and one NRP scenario. The NRP scenario would involve one of the most complex instances of complete asphyxia, a case of an infant born with shoulder dystocia. This case would require the user to use all tools available to them as well as all clinical applications taught to them in training. Upon mapping out this scenario's level of interactivity, it also proved to be too large for the scope of the thesis.

Finally, the program was set to ten, small-scaled scenarios and multiple choice questions. The multiple choice questions served as a means to test the users' ability to recall vital

information learned during their NRP training as well as to test their ability to use the information presented to them in the patient history page, assess the situation they were presented with and make a conducive clinical assessment as to how they would treat the infant.

Target audience

The target audience for this project was pediatric residents, fellows and nurse practitioners. The online application was designed as a supplementary educational tool to the American Heart Association and American Academy of Pediatrics' Neonatal Resuscitation Program. This group of pediatric healthcare professionals was chosen because NRP training and continuing education is an integral part of the clinical practice in the Newborn Nursery. All the visual elements, including the models and tools, as well as the vocabulary and phrasing of text, were designed to address this audience.

Pre-project planning

During initial meetings with Dr. Jackson, basic content ideas for the project were discussed. Because neonatal resuscitation is a common and critical procedure in the Newborn Nursery, it was decided that a supplemental learning tool would be created to aid pediatric residents, fellows, and nurse practitioners learning the procedure or were already certified and needed to use the program for continuing education credits.

Because a great deal of the learning material was only available to users in the form of text or in-hospital training, the format of the project was determined to be in the form of an online interactive program that users could access at their leisure from the Parkland Memorial Hospital server.

After a topic and format were established, a committee meeting was held with Dr. Jackson, Kenneth Coulter, M.F.A. and Lewis Calver, M.S. The meeting was necessary so that all committee members would be in agreement regarding the content and format of the thesis project.

Drs. Jackson and McClendon determined the final content of the project. Weekly meetings were held to discuss each flash card's content, its significance to NRP, and the correct answers the users should choose for each card. A rough script was also written for immediate feedback to incorrect responses, and was approved for accuracy by Drs. Jackson and McClendon. Photographs of the radiant warmer and resuscitation tools were taken for reference and Dr. Jackson ran through scenarios and procedures in a delivery room whenever questions arose. As the programming and modeling progressed, Drs. Jackson and McClendon gave feedback and changes were made when necessary.

Flowcharts

Before any programming or artwork could be done, each scenario, or flash card, had to be mapped out in the form of a flowchart to visualize the webbing of different pathways of

interaction the user could potentially experience depending on the options they choose (see Appendix B). The scenarios and questions were chosen after meeting with Dr. Jackson, Dr. McClendon, and a number of pediatric nurse practitioners from the Newborn Nursery at Parkland Memorial Hospital. The nurse practitioners perform the NRP more than anyone in the Department of Pediatrics and were able to come up with a list of popular scenarios as well as well as the most common errors in clinical judgment they have witnessed. After finalizing the list of ten flash cards, the optimal treatment pathways were discussed and agreed upon by Drs. Jackson and McClendon (*see figure 3-1*). It was also decided that incorrect responses would give immediate feedback and would not only inform the user their choice was incorrect, but would also give reason as to why it was incorrect as well as offer assistance in choosing the correct response. As a result of their study on the learning effects of a web-based teaching game designed for medical students, Sward et al. concluded that immediate feedback is an essential feature of active learning (2008, 358).

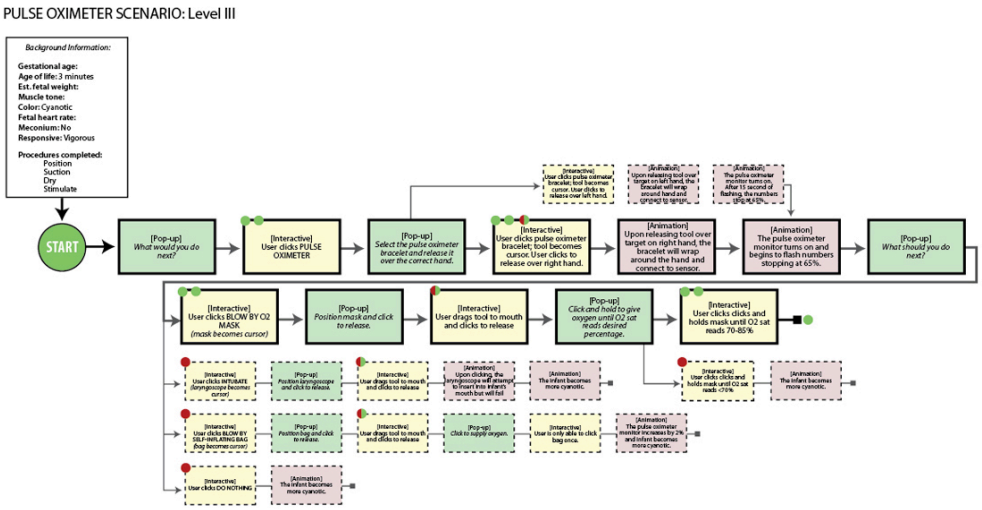


Figure 3-1. Flowchart of *Card 2: Pulse Oximeter.*

Flash cards

From the flowcharts came the development of the actual flash cards. The following are the selected ten flash cards featured in the application:

Card 1: Diaphragmatic hernia (*see figure 3-2*)

Card 1 began with the user being prompted to watch a 30-second animation of an infant being bagged with the self-inflating bag as the infant grows more cyanotic. The user is then asked to choose a possible diagnosis from a list of four pathologies: a diaphragmatic hernia, tracheal atresia, hyaline membrane disease or Potter's sequence. By using the

information about the amniotic fluid volume present in patient history page, the user should conclude that the infant may have been suffering from a diaphragmatic hernia.

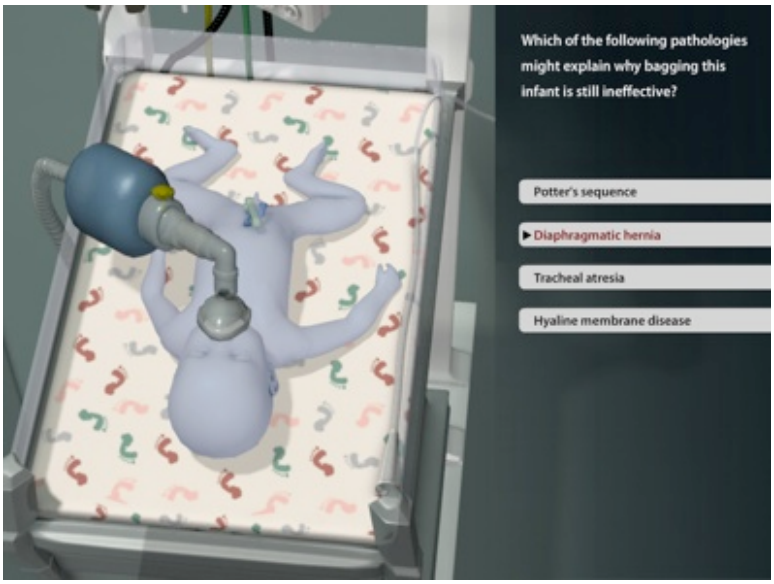


Figure 3-2. Still image of *Card 1: Diaphragmatic hernia.*

Card 2: Pulse oximeter (*see figure 3-3*)

Card 2 began by showing the user an active and responsive infant who is cyanotic. Because the infant was responsive but still cyanotic, the user should choose to administer a pulse oximeter to check the infant's hemoglobin oxygenation. Incorrect choices included using a self-inflating bag, positioning the infant, intubation, using a bulb syringe, drying the infant, checking the heart rate, and stimulating the infant. Because the user was informed in the patient history that the infant is four minutes old, the oxygen

saturation should be at least 75%. This card was significant in testing the user's memorization of the pulse oximetry oxygen saturation chart.

Figure 3-3. Still image of *Card 2: Pulse oximeter.*

Card 3: Missing tool (*see figure 3-4*)

Card 3 showed the user a nearly prepared radiant warmer image. Because the user was informed in the patient history page that the infant was being delivered delivered through meconium-stained fluid, he or she should notice the meconium aspirator tool is missing from the bed. This flash card was significant in making sure the user could recognize a fully-prepared radiant warmer bed following proper preparation before a delivery.

Figure 3-4. Still image of *Card 3: Missing tool.*

Card 4: Prone position placement (*see figure 3-5*)

Card 4 informed the user in the patient history page that the infant was delivered and noticed to have a small, posteriorly-directed jaw. They were then asked to choose from three images depicting possible anatomical placement of the infant on the bed. The user was to choose the prone position image due to the placement of the infant's tongue in an effort to open the airway as much as possible. This card was significant in making sure the user understood this concept because placing the infant in the standard supine position could potentially block the infant's airway.

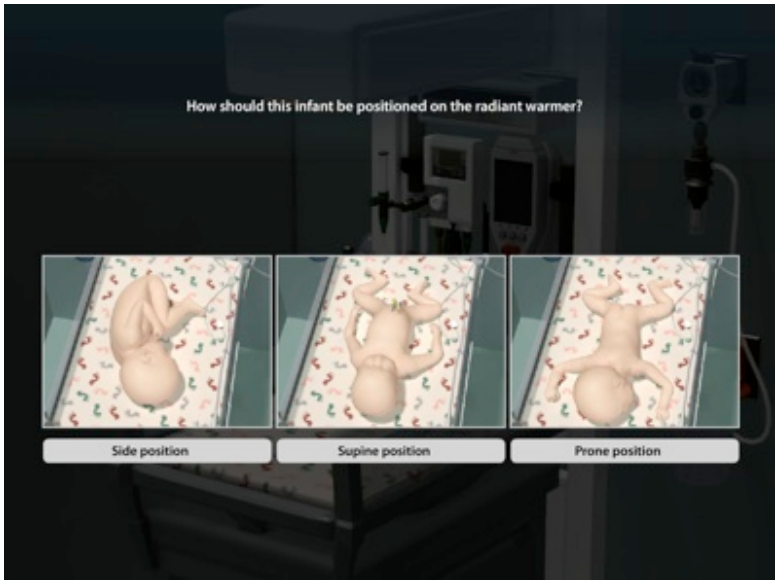


Figure 3-5. Still image of *Card 4: Prone position placement.*

Card 5: Shoulder roll (*see figure 3-6*)

Card 5 presented the user with an unresponsive infant immediately following delivery. The user was to chose to position the infant in the correct manner and then to choose the correct shoulder placement from a series of three images depicting an infant with a flexed neck, extended neck and hyperextended neck. This flash card was significant because the first step in any resuscitation procedure when the infant is unresponsive is to correctly position their shoulders to ensure a clear airway is obtained. Dr. Jackson expressed his concern about numerous cases of health professionals assisting in respiration before correctly positioning the infant.

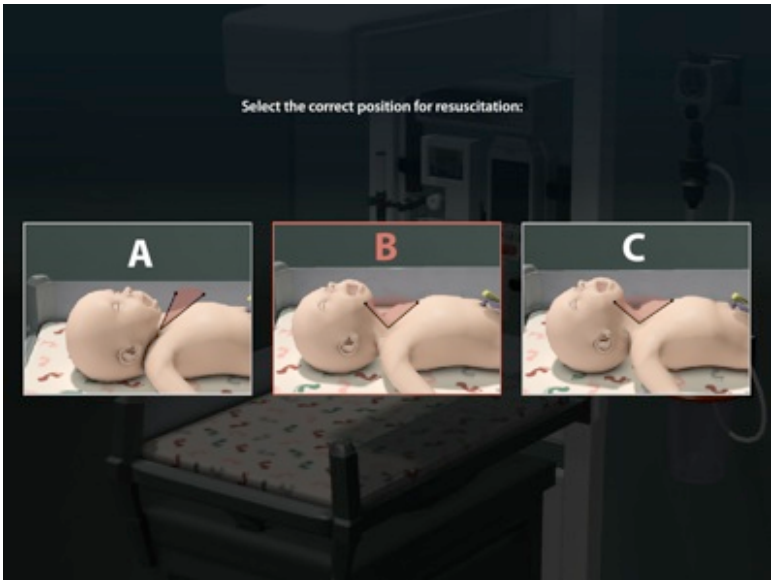


Figure 3-6. Still image of *Card 5: Shoulder roll.*

Card 6: Grunting baby (*see figure 3-7*)

Card 6 showed the user an animation of an infant breathing, but with subcostal chest retractions. The infant was also making grunting noises. The user was then presented with a list of four care management options and was asked to check all that applied. This scenario was significant because it tested the user's ability to choose more than one option from a list of potential care options. It was also important grunting infants are in respiratory distress and need immediate care, especially preterm infants.

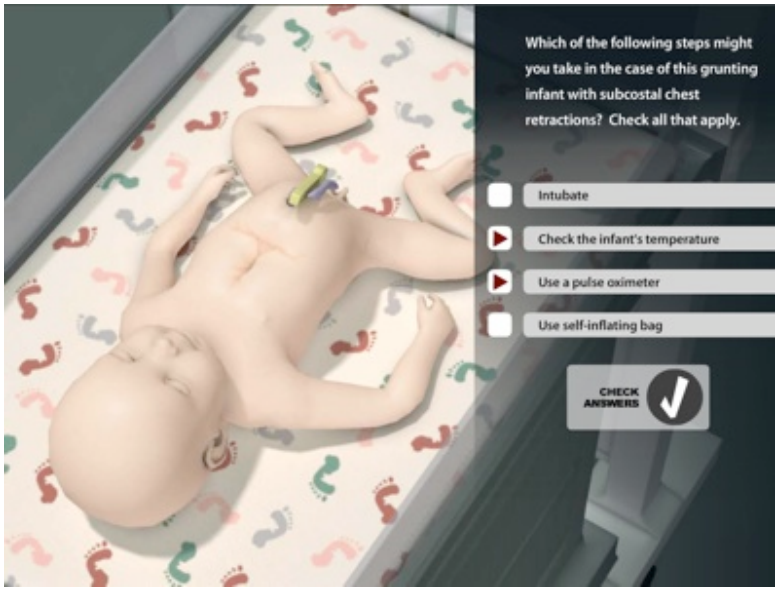


Figure 3-7. Still image of *Card 6: Grunting baby.*

Card 7: Suction for meconium (*see figure 3-8*)

Card 7 presented the user with an infant delivered through meconium-stained fluid that already been positioned. The user was to choose to intubate the infant to suction for meconium and choose the correct location in the infant's larynx to suction meconium from. This flash card was significant because all infant's born through meconium-stained fluid should be intubated for suction to ensure no fluids were aspired during delivery. It was also important to test the user's knowledge of the proper location in the throat to begin suction for meconium because Dr. McClendon expressed concern of newer residents suctioning too early in the superior pharynx instead of at a later point, in the inferior pharynx through the vocal cords where meconium may have entered the trachea during delivery.

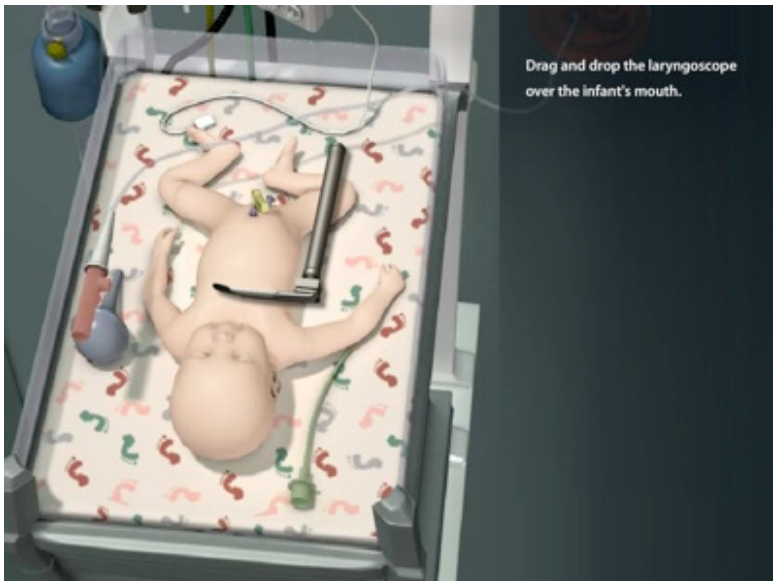


Figure 3-8. Still image of *Card 7: Suction for meconium.*

Card 8: Proper bagging technique (*see figure 3-9*)

Card 8 prompted the user to interactively bag the infant using the self-inflating bag tool for thirty seconds at the proper rate of 40-60 bag squeezes per minute. This card was significant because it reinforced the proper bagging technique. By bagging the infant at the proper rate, the rhythm of clicking and releasing the mouse is significant in training the user to bag the infant at the proper speed.

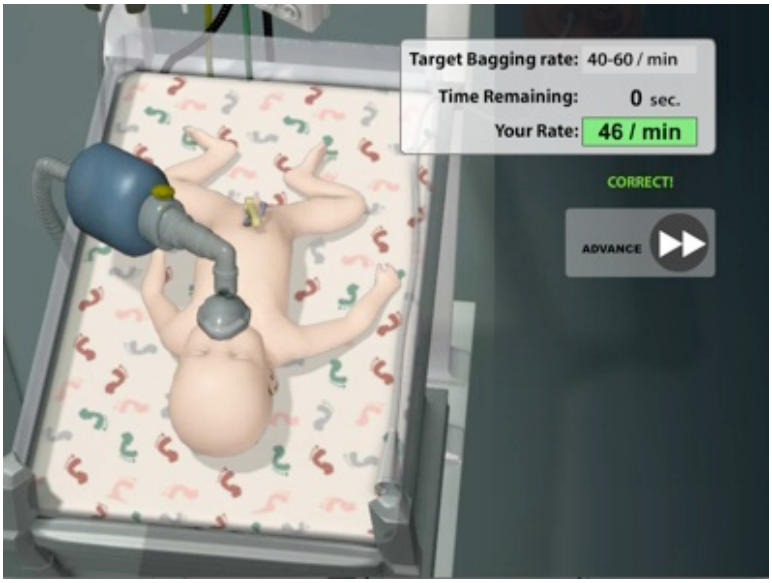


Figure 3-9. Still image of *Card 8: Proper bagging technique.*

Card 9: Unprepared radiant warmer (*see figure 3-10*)

Card 9 prompted the user to rank the top five most important tools to prepare on the radiant warmer for an infant born through meconium-stained fluid. It was significant in testing the user's ability to recognize the differences in tool preparation of a normal delivery versus a meconium-stained delivery.

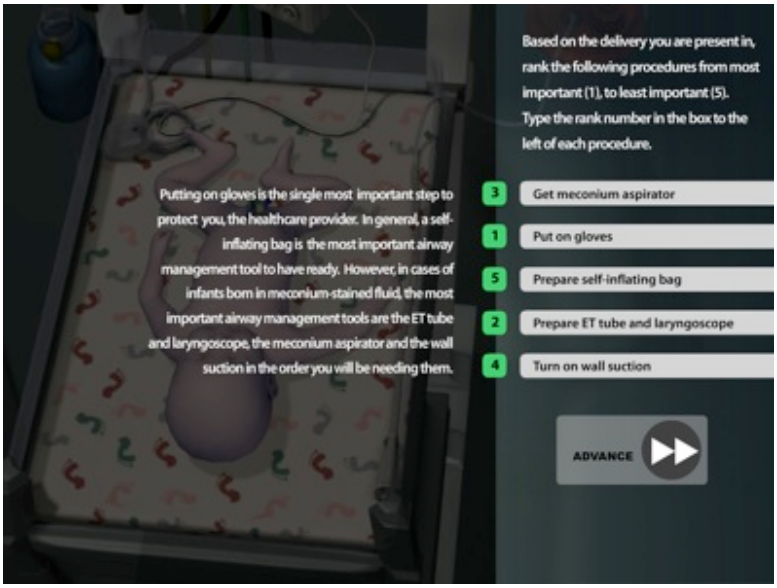


Figure 3-10. Still image of *Card 9: Unprepared radiant warmer.*

Card 10: Ineffective bagging (*see figure 3-11*)

Card 10 prompted the user to number six procedures in the proper order to proceed in the case of ineffective bagging. The flash card is significant because ineffective bagging can be remedied most of the time by correcting human error and it is important for the user to recognize the proper order in which to assess the situation and correct the bagging technique.

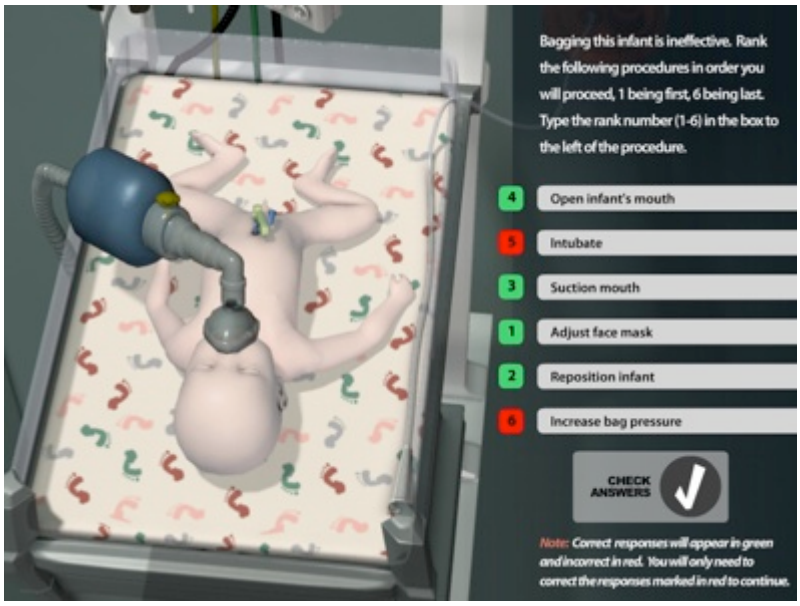


Figure 3-11. Still image of *Card 11: Ineffective bagging.*

Programming

The programming for the supplementary program was completed using Adobe® Flash® ActionScript 2.0 scripting. The preliminary and basic actions were programmed and used to create simple animatic-like flash cards to ensure scripting was complete before completely rendered 3D animations were introduced (*see Appendix A, figure 3-12*). A Flash® programmer, Andrew Sher, M.D., was hired to complete the more complex programming, such as *Card 8: Proper bagging technique*, the randomization of flash cards feature and the scoring system. This was necessary to ensure the program would be complete with the desired level of interactivity and scoring feedback.

Modeling

Following the scripting of Flash® programming, the radiant warmer and resuscitation tools were modeled in the 3D platform, Autodesk® Maya®. The models were normal mapped, textured and manipulated in this program (*see Appendix A, figure 3-13*). Photographs taken in the delivery room were used as references to create accurate resuscitation tools that could be instantly recognized by the user. The infant model was purchased and downloaded from a 3D modeling website, www.turboquid.com to expedite the development process and allow for more time to be spent on programming and interactivity.

Animation

The 3D models were rigged with a joint skeletal system and smooth bound skin to create fluid movement of the models in the same program they were modeled in. Animation clips were timed and rendered to be integrated into the interactive program as movie clips to serve as the bulk of the program's visual content (*see Appendix A, figure 3-14*). Along with rendering animations out of Autodesk® Maya®, still images were also created for certain buttons and background images featured in the program.

The 3D animations and still images were rendered out of Autodesk® Maya® in render layers as Portable Network Graphics (PNG) images. Adobe® AfterEffects® served as the post-production platform to composite render layers into fully developed 3D

animation sequences (*see figure 3-15*). Individual animation clips were then exported out of AfterEffects® as Image Sequences to be imported into Adobe® Flash®.

Still images were composited in Adobe® Photoshop® in the same manner. The images' color and tone were adjusted for visual accuracy and were compressed and exported as JPEG rasterized files.

Final Programming

After the animation sequences and still images were exported from their respective composite programs, they were imported into Adobe® Flash® and replaced the temporary movie clips and images used in the Flash® animatics (*see Appendix A, figure 3-16*). Some minor programming changes were made, such as the incorporation of the "help" menu and the visual layout, typeface and color schemes were altered for a more visually pleasing interface design.

CHAPTER FOUR
Results

Physician evaluation

Following production of *Neonatal Resuscitation: Interactive Flash Cards for Pediatric Health Professionals*, Dr. Jackson and Dr. McClendon were asked to evaluate the application's relevant medical content, visual content and comment on its potential for future use and expansion (*see Appendix C*). They were also asked to comment on whether or not they felt the application's goals and objectives were met.

The purpose of this evaluation survey was to determine whether or not Dr. Jackson and Dr. McClendon felt the interactive application met the original goals and objectives of this project and would be implemented in the Newborn Nursery as a supplemental learning tool to the NRP training program. Each question was worded, "How do you feel.." so as to leave the answer responses entirely open to the evaluators.

Evaluation distribution

Dr. Jackson and Dr. McClendon were asked to complete the completed version of the flash card application. Following completion the interactive application, they were asked to evaluate it for legitimacy. Both physicians completed the evaluation in its entirety and handed them in.

Summary of evaluation results

The physicians evaluation forms were collected and analyzed. Overall, reaction to the interactive application was positive. Both agreed the application exceeded the expectations of the original goals set for the project. They also agreed that the application was appropriate for the target audience and would serve well as a supplementary tool in the future of NRP training.

Evaluation of evaluation responses

The following are responses to the survey questions:

Question 1: Do you feel this application can be used as a relevant supplement for the AHA/AAP's NRP training?

Both participants agreed this application can be used as a relevant supplemental tool for NRP training. Dr. Jackson commented that the new application offers more to participants including instant feedback, interaction, a scoring system and a more real-life sense in the scenarios unlike the *Textbook of Neonatal Resuscitation, 5th Edition's* more theoretical scenarios. Dr. McClendon mentioned the new application is relevant to the most recent updates in NRP. This question is relevant to the application's primary objective: acting as a supplement to pre-existing material.

Question 2: Do you feel the clinical content of this application is appropriate for NRP training?

This question was relevant to the second objective of this application: creating an application with appropriate clinical content. Both evaluators agreed the content accurately reflected concepts presented in NRP training.

Question 3: Do you feel the application is appropriate for the target audience?

This question regarded the third objective of this application: creating an application appropriate for a variety of pediatric healthcare professionals. Both Dr. Jackson and Dr. McClendon agreed the application was appropriate for the audience and could be used by new interns training for NRP as well as those who are looking to refresh their NRP training skills.

Question 4: Do you feel the application is visually pleasing and will enhance the audiences' learning of NRP?

This question was meant for visual and creative feedback. Both agreed the delivery room, tools, and infant closely resembled real life. Dr. McClendon added the interface design was also visually pleasing and was not difficult to navigate.

Question 5: Visually, do you feel the application is an accurate representation of NRP?

This question also served to receive feedback on the creative process. Both physicians again agreed the delivery room setup was accurate an looked close to the real life room. Dr. McClendon added the infant animations were an accurate representation of how the infant would react during NRP. This responses to this question suggest the visuals of the

application served to enhance the feeling of reality within the application and created a near real environment for the user to engage in NRP training.

Question 6: What, if anything, would you change about this application?

Dr. McClendon responded that she would not change anything about the application at the moment. Dr. Jackson suggested the addition of more scenarios and adding a voice-over feature that would describe the case. Both of his suggestions will be considered for future research and development.

Question 7: How do you see this application being used in the future?

Dr. McClendon suggested using the application in the Newborn Nursery's formal NRP training for first-year residents as well as to enhance the continuing education of the pediatric nurse practitioners. She also suggested keeping the scenarios up to date with the newest evidence-based medicine. Dr. Jackson again suggested the addition of more flash cards as well as resenting the application to the AAP-NRP Committee. He also mentioned using it as a variable in a long-term research study. Both evaluators suggestions will be considered for future research.

Question 8: Do you feel the final application met the goals of the original project?

Both evaluators agreed the application met the original goals set in this project. Dr. Jackson continued to say the application exceeded expectation.

Question 9: Comments about this application:

Dr. Jackson commented, “The expandability of the program is quite nice and ease of use for the user is excellent.”

The evaluations given by Dr. Jackson and Dr. McClendon were quite positive. Both agreed the application met, and exceeded, the original goals and objectives.

CHAPTER FIVE
Conclusions and Recommendations

Project Summary

The intended purpose of this thesis project was to create a supplemental interactive program for pediatric residents and nurse practitioners to used in conjunction with study of the American Heart Association and American Academy of Pediatrics' Neonatal Resuscitation Program. The Adobe® Flash® application featured 3D animations, 3D still images, didactic text, multiple choice questions and conceptual hierarchy questions arranged in the form of ten randomized interactive flash cards.

Pediatric healthcare professionals who perform neonatal resuscitation must first become certified by the American Heart Association. To do so, completion of a 9-part didactic written examination and a score of at least 85% on the Megacode Checklist Assessment Form is necessary. The interactive application acted as a supplementary learning tool that was able to combine the didactic and informative portions of the certification examination as well as the clinical and interactive portions the user might experience in the Megacode evaluation.

In order to meet the goal of this thesis, a number of objectives had to be met. The first was to meet with Dr. Jackson and discuss creating an interactive application for a topic where the greatest need for health professional education was needed. It was determined that the American Heart Association's Neonatal Resuscitation Program was of great importance to pediatrics due to the number of asphyxiated infants born at Parkland

Memorial Hospital each day and the need for the pediatric healthcare professionals to practice the procedures correctly and with confidence.

The next objective was to establish the appropriate content presented to the target audience. This objective was met by holding consistent meetings with Dr. Jackson in the Newborn Nursery department at Parkland Memorial Hospital. Meeting in this location made it easier for Dr. Jackson to answer questions, discuss potential ideas and issues with colleagues and have access to delivery rooms for both references and observing deliveries. A meeting with a group of pediatric nurse practitioners was successful in determining the final ten flash cards that would be featured in the application. The nurses in the Newborn Nursery practice and observe others performing neonatal resuscitation more than anyone else and were aware of some of the more common mistakes and misconceptions made by pediatric healthcare professionals in the delivery room. Their opinions were taken into consideration and the remaining content was determined by Dr. Jackson.

The next objective was to create the application itself. This was done in stages that ranged from basic, draft-quality interactive programming up to the final stages of 3D animation and intricate interactivity scripted in Adobe® Flash®. A great deal of the initial production work went into programming each individual flash card in Adobe® Flash® to assure the interactivity was fully functional. Delivery room models and clinical animations were simultaneously created and rendered into PNG sequences in Autodesk® Maya®. Post-production work was done in Adobe® AfterEffects® and image sequences were rendered and prepared for Adobe® Flash®. After Dr. Sher

completed the final programming and randomization feature, the final artwork, interface design, and animation sequences were reimported into the interactive platform to create the final application. Dr. Jackson was available to see the application through all stages of production and provided feedback throughout the process.

Successes

Based on the evaluations completed by Dr. Jackson and Dr. McClendon, the goals of this thesis project were met successfully. Both physicians agreed the application exceeded the expectations, goals and objective of the project. The usage of the application may expand in the future to a regional or national level. Dr. Jackson suggested presenting the application to the AAP-NRP Committee to apply for a research grant to continue the growth of the application and use it as a variable in a controlled delivery room performance assessment.

Suggested Areas for Further Research

Evaluation process

One limitation of this thesis project was the number of residents available in the Newborn Nursery for evaluation. Because there the first-year residents only spend a month in the nursery, there was a very small window of opportunity to have them evaluate the

application during production. A larger audience of residents, fellows, attendings and nurse practitioners could have evaluated the application had there been more time.

The interactive application will be used as part of a greater future study conducted by Dr. Jackson and Dr. McClendon. Starting in the near future, attending pediatric physicians will monitor and assess colleagues in the delivery room as they provide care to asphyxiated infants. The interactive application will serve as the variable in the study and will only be available to those in the test group of the study. Dr. Jackson and Dr. McClendon hypothesize the use of use of the interactive application will enhance delivery room performance and confidence.

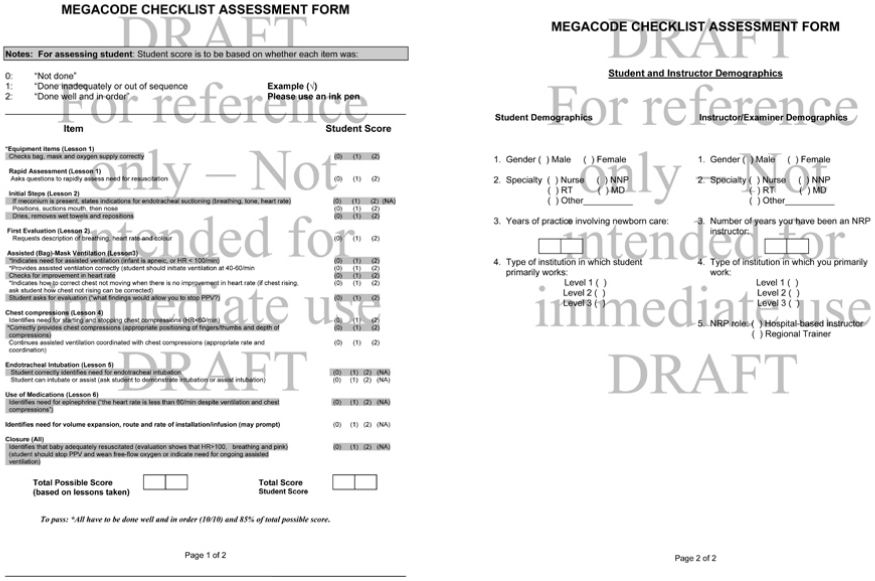
Addition of voice-over

Dr. Jackson suggested adding voice-over audio to describe the case presented in the flash card. Audio could also simulate the delivery room setting by adding machine sound effects as well as other peoples' voices trying to help or distract the user in the delivery room.

Addition of more flash cards

More flash cards can be programmed and added to the interactive application as a way to expand the scope of learning as well as keep the application up to date with current neonatal resuscitation techniques. The randomization scripting within the Adobe® Flash® program will allow for more cards to be added to the randomization queue along with the current flash cards.

APPENDIX A
Figures



MEGACODE CHECKLIST ASSESSMENT FORM

Notes: For assessing student: Student score is to be based on whether each item was:

0: "Not done"
1: "Done inadequately or out of sequence"
2: "Done well and in order"

Example (√)
Please use an ink pen

Item	Student Score
*Equipment items (Lesson 1) Checks bag, mask and oxygen supply correctly	(0) (1) (2)
Rapid Assessment (Lesson 1) Asks questions to rapidly assess need for resuscitation	(0) (1) (2)
Initial Steps (Lesson 2) If meconium is present, states indications for endotracheal suctioning (breathing, tone, heart rate)	(0) (1) (2) (NA)
Positions, suctions mouth, then nose	(0) (1) (2)
Dries, removes wet towels and repositions	(0) (1) (2)
First Evaluation (Lesson 2) Requests description of breathing, heart rate and colour	(0) (1) (2)
Assisted (Bag)-Mask Ventilation (Lesson3) *Indicates need for assisted ventilation (infant is apneic, or HR < 100/min)	(0) (1) (2)
*Provides assisted ventilation correctly (student should initiate ventilation at 40-60/min	(0) (1) (2)
Checks for improvement in heart rate	(0) (1) (2)
*Indicates how to correct chest not moving when there is no improvement in heart rate (if chest rising, ask student how chest not rising can be corrected)	(0) (1) (2)
Student asks for evaluation ("what findings would allow you to stop PPV?)	(0) (1) (2)
Chest compressions (Lesson 4) Identifies need for starting and stopping chest compressions (HR<60/min)	(0) (1) (2)
*Correctly provides chest compressions (appropriate positioning of fingers/thumbs and depth of compressions)	(0) (1) (2)
Continues assisted ventilation coordinated with chest compressions (appropriate rate and coordination)	(0) (1) (2)
Endotracheal Intubation (Lesson 5) Student correctly identifies need for endotracheal intubation	(0) (1) (2) (NA)
Student can intubate or assist (ask student to demonstrate intubation or assist intubation)	(0) (1) (2) (NA)
Use of Medications (Lesson 6) Identifies need for epinephrine ("the heart rate is less than 60/min despite ventilation and chest compressions")	(0) (1) (2) (NA)
Identifies need for volume expansion, route and rate of installation/infusion (may prompt)	(0) (1) (2) (NA)
Closure (All) Identifies that baby adequately resuscitated (evaluation shows that HR>100, breathing and pink) (student should stop PPV and wean free-flow oxygen or indicate need for ongoing assisted ventilation)	(0) (1) (2) (NA)

Total Possible Score (based on lessons taken) ☐☐

Total Score Student Score ☐☐

*To pass: *All have to be done well and in order (10/10) and 85% of total possible score.*

Page 1 of 2

MEGACODE CHECKLIST ASSESSMENT FORM

Student and Instructor Demographics

Student Demographics	Instructor/Examiner Demographics
1. Gender ( ) Male ( ) Female	1. Gender ( ) Male ( ) Female
2. Specialty ( ) Nurse ( ) NNP ( ) RT ( ) MD ( ) Other_____	2. Specialty ( ) Nurse ( ) NNP ( ) RT ( ) MD ( ) Other_____
3. Years of practice involving newborn care: ☐☐	3. Number of years you have been an NRP instructor: ☐☐
4. Type of institution in which student primarily works: Level 1 ( ) Level 2 ( ) Level 3 ( )	4. Type of institution in which you primarily work: Level 1 ( ) Level 2 ( ) Level 3 ( )
	5. NRP role: ( ) Hospital-based instructor ( ) Regional Trainer

Page 2 of 2

DRAFT For reference only – Not intended for immediate use DRAFT

Figure 1-1. Megacode Checklist Assessment Form.

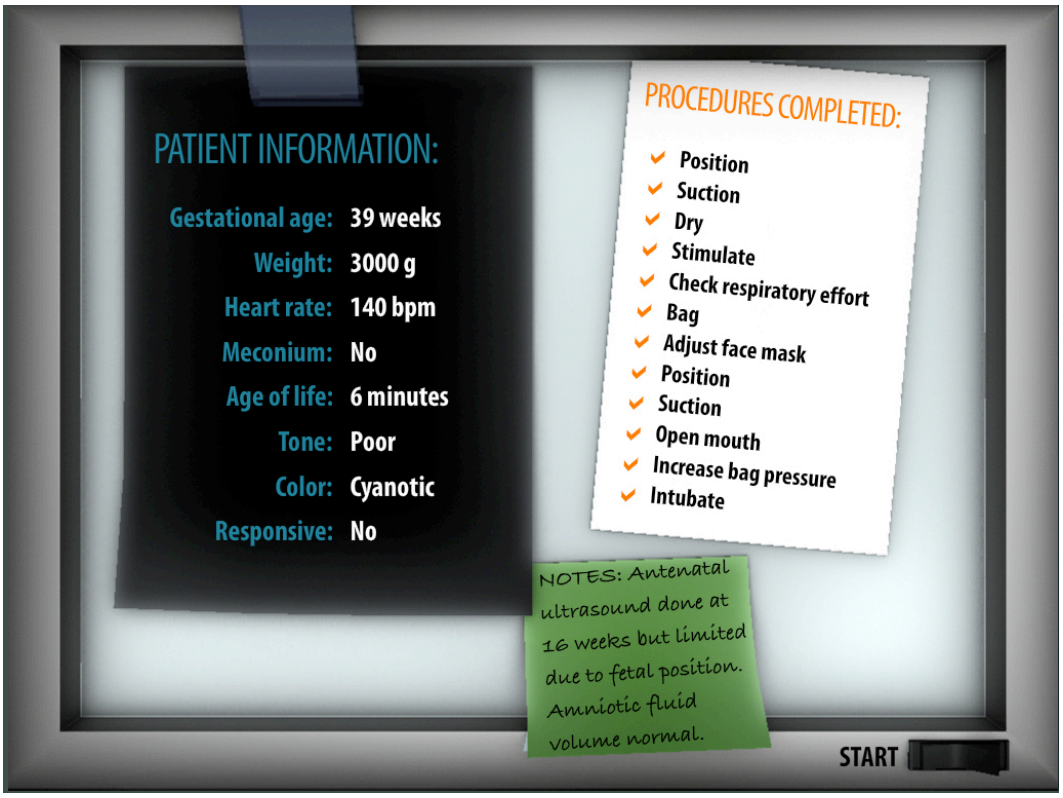


Figure 1-2. Flash card introduction screen.

What are the initial steps and how are they administered?

If the baby is term and vigorous, the initial steps may be provided in modified form, as described in Lesson 1 (page 1-18 under "Routine Care").

Initial Steps
- Provide warmth
- Position; clear airway (as necessary)
- Dry, stimulate, reposition

Once you decide that resuscitation is required, all of the initial steps should be initiated within a few seconds. Although they are listed as "initial" and are given in a particular order, they should be applied throughout the resuscitation process.

• ***Provide warmth***

The baby should be placed under a radiant warmer so that the resuscitation team has easy access to the baby and the radiant heat helps reduce heat loss (Figure 2.1). The baby should not be covered with blankets or towels. Leave the baby uncovered to allow full visualization and to permit the radiant heat to reach the baby.

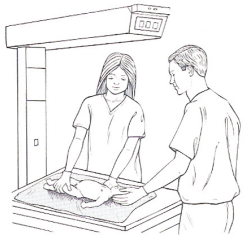


Figure 2.1. Radiant warmer for resuscitating newborns

• ***Position by slightly extending the neck***

The baby should be **positioned** on the back or side, with the neck slightly extended in the "sniffing" position. This will bring the posterior pharynx, larynx, and trachea in line and facilitate unrestricted air entry. This alignment in the supine position is also the best position for assisted ventilation with a bag and mask and/or the placement of an endotracheal tube. The goal is to move the baby's nose as far anterior as possible, thus creating the "sniffing" position.

Care should be taken to prevent hyperextension or flexion of the neck, since either may restrict air entry (Figure 2.2).

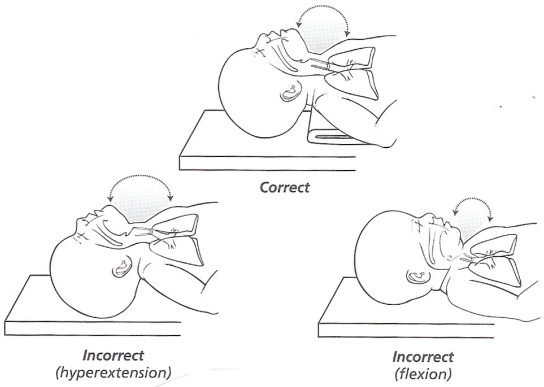


Figure 2.2. Correct and incorrect head positions for resuscitation

Figure 2-1. Page from *Textbook of Neonatal Resuscitation, 5th Edition*.

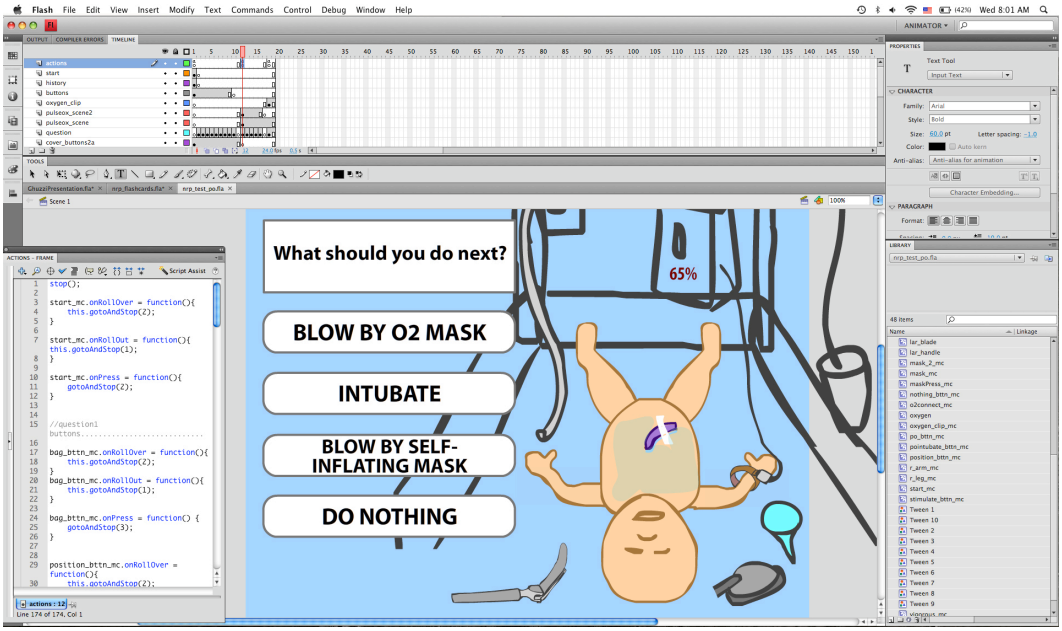


Figure 3-12. Screen shot from Adobe® Flash® preliminary programming.

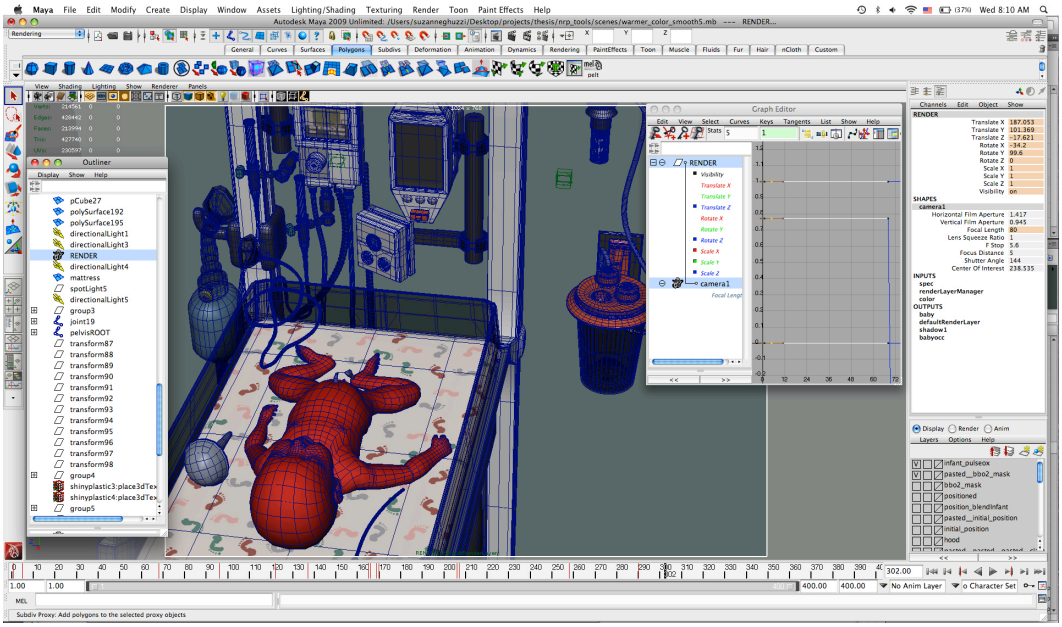


Figure 3-13. Screen shot from Autodesk® Maya® modeling stage.

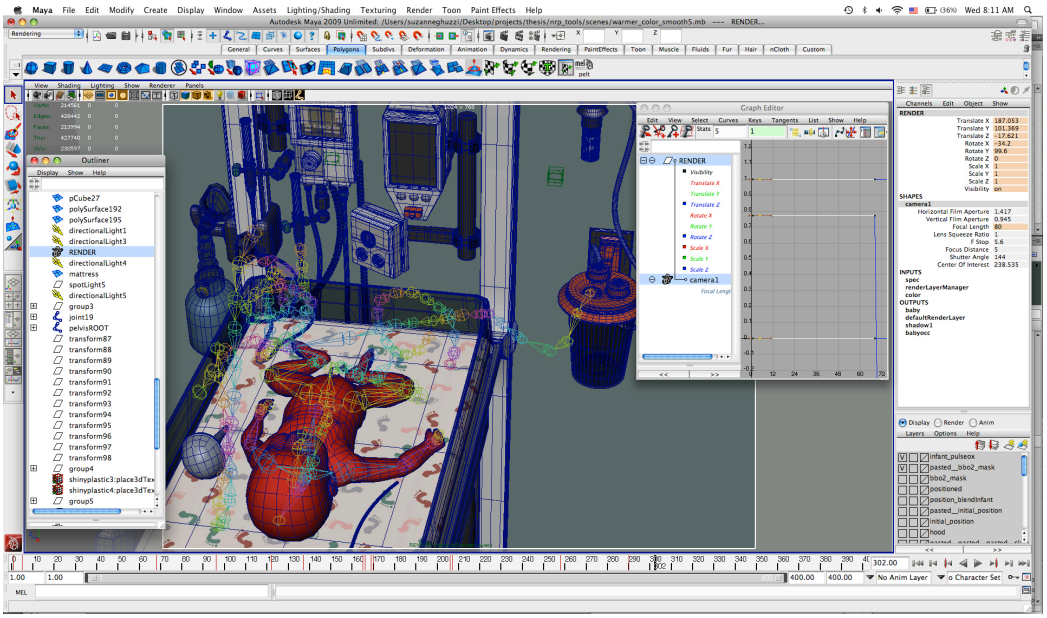


Figure 3-14. Screen shot from Autodesk® Maya® animation stage.

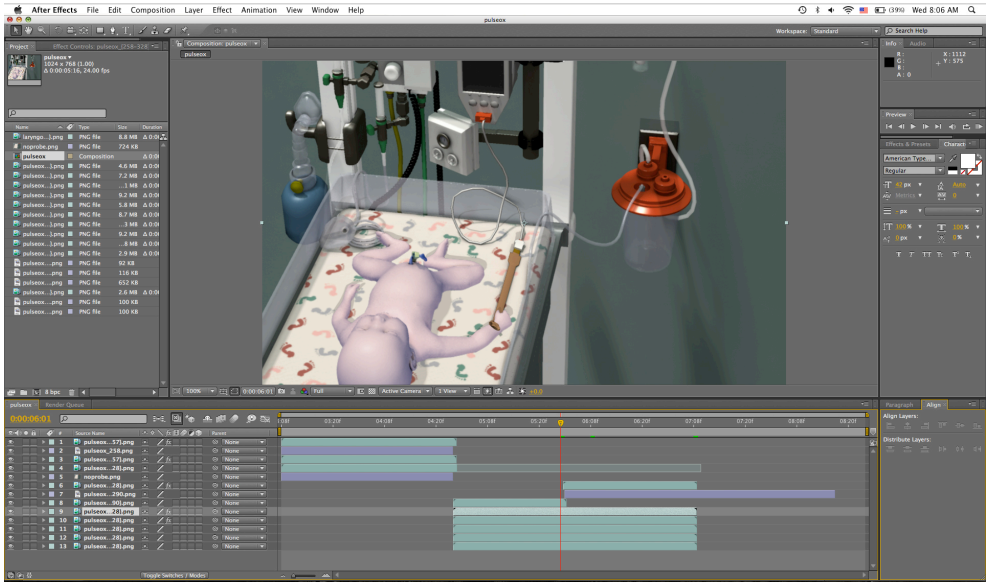
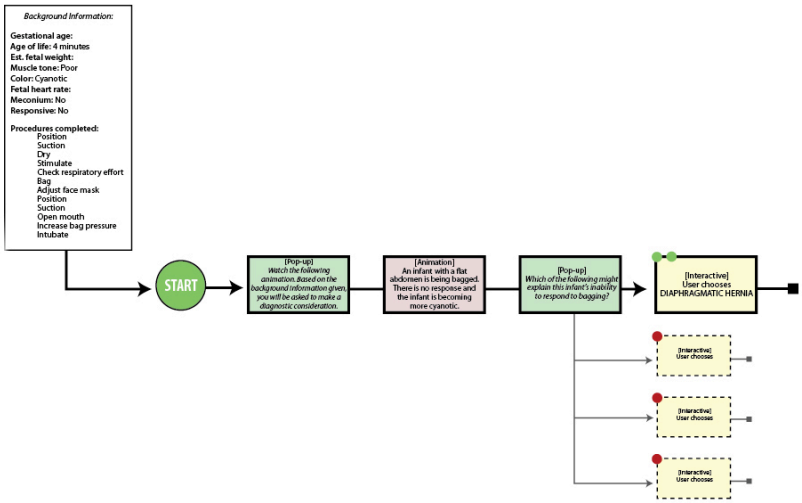


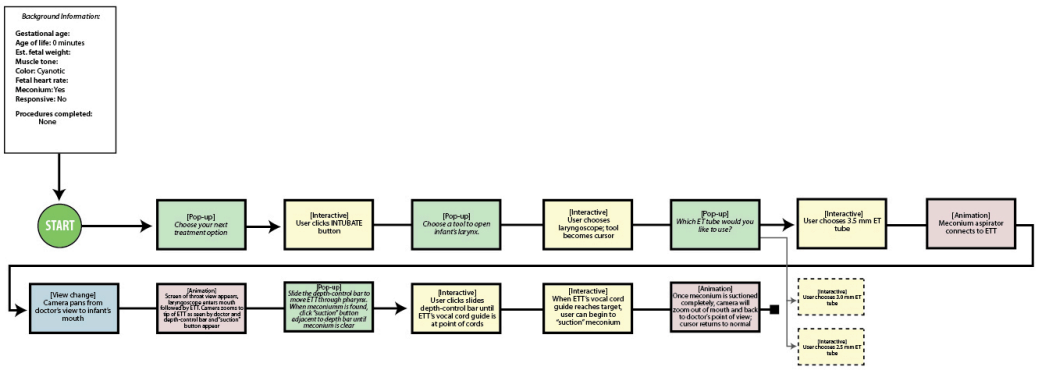
Figure 3-15. Screen shot from Adobe® AfterEffects® render later composites.

APPENDIX B
Flowcharts

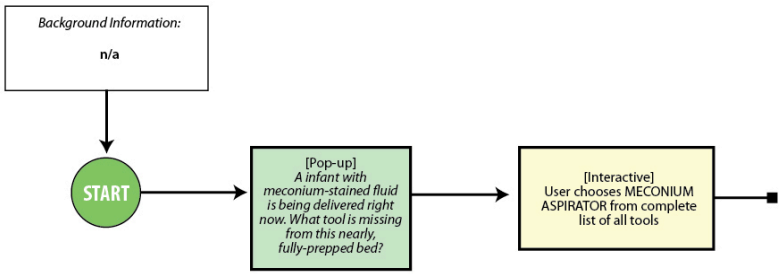
DIAPHRAGMATIC HERNIA: Level II



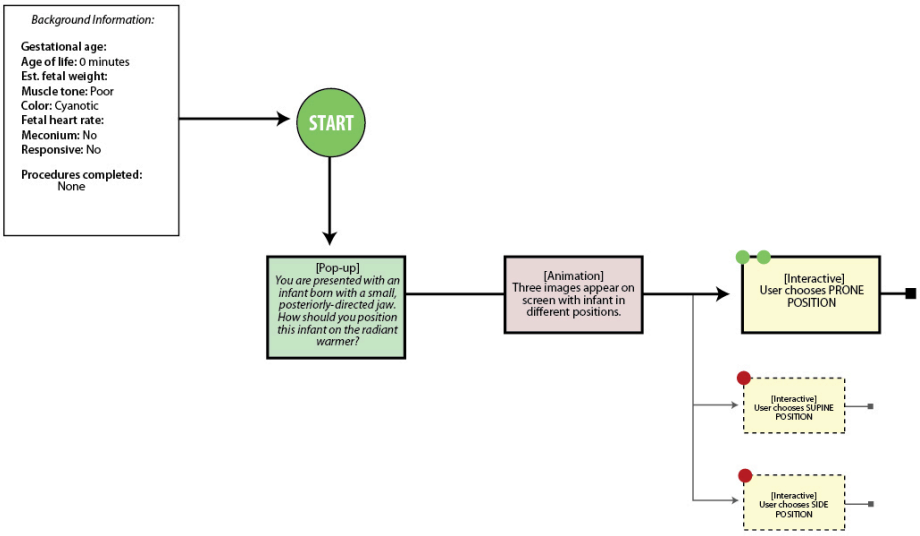
SUCTION FOR MECONIUM SCENARIO: Level III



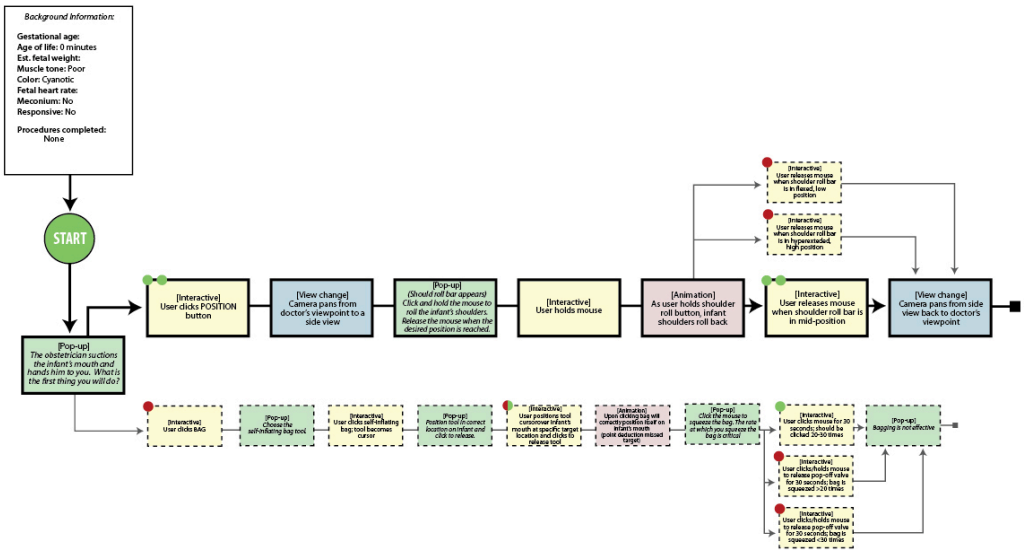
SOMETHING IS MISSING: Level I



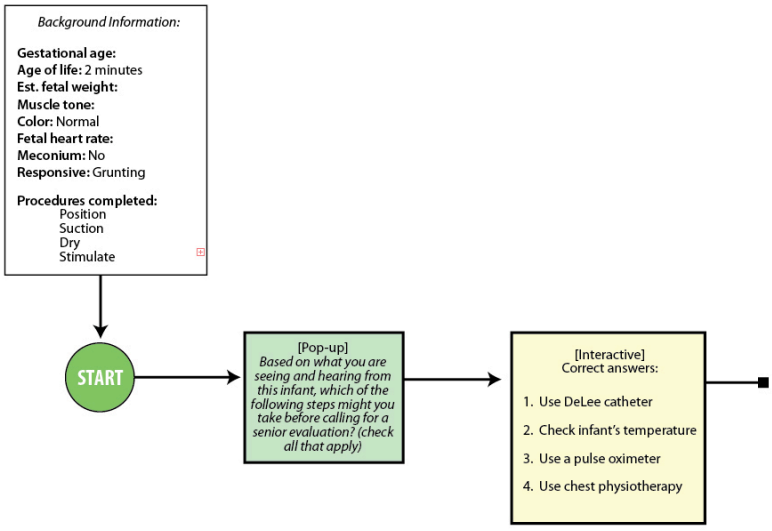
SMALL, POSTERIOR JAW: Level I



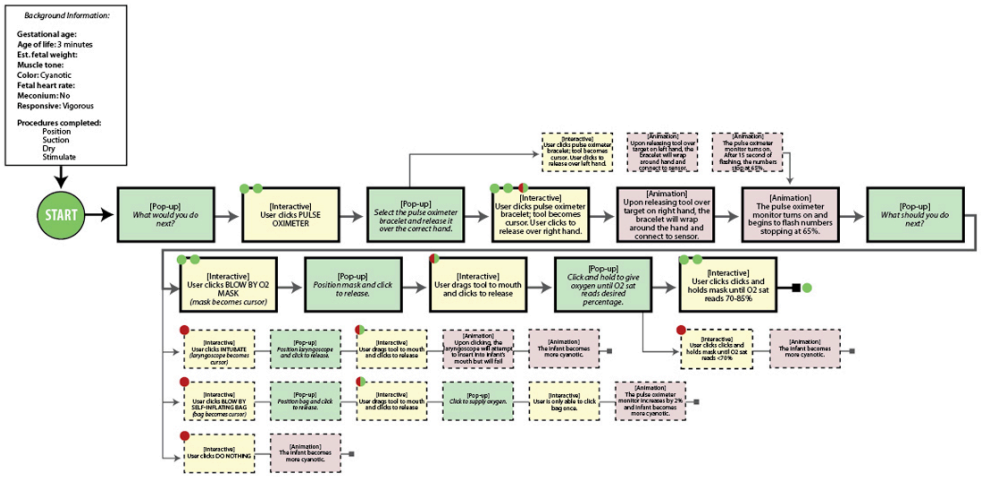
NO MECONIUM, CYANOTIC SCENARIO: Level II



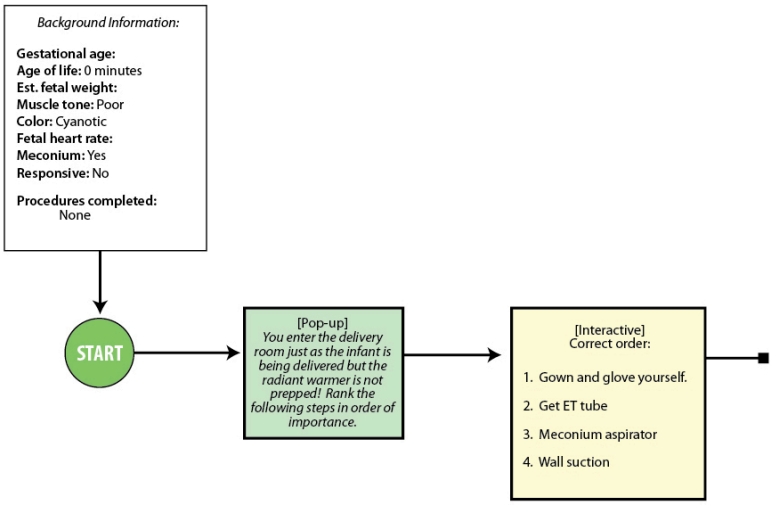
GRUNTING INFANT: Level II



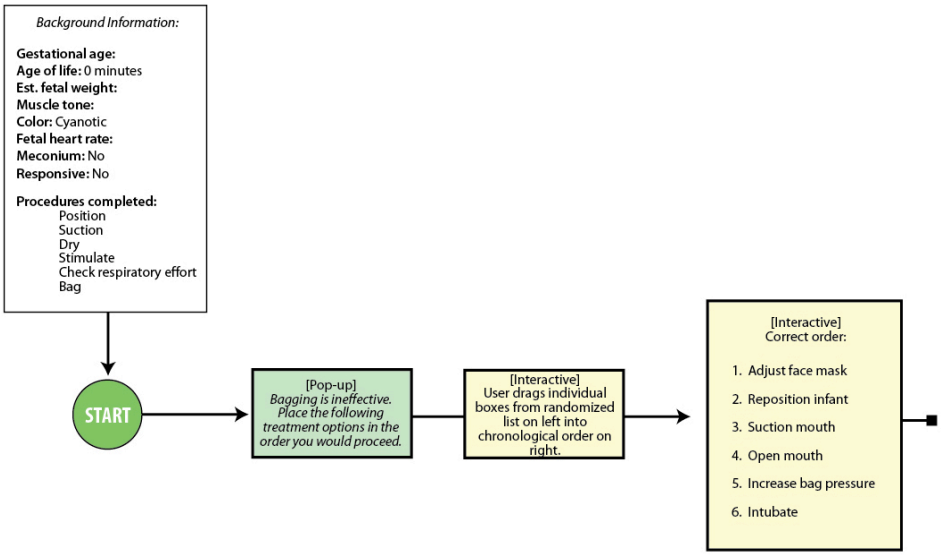
PULSE OXIMETER SCENARIO: Level III



UNPREPPED BED: Level II



MRSOPI ARRANGEMENT: Level I



APPENDIX C
Physician Evaluations

Neonatal Resuscitation: Interactive Flash Cards for Pediatric Health Professionals

Physician evaluation

Name/ credentials: Greg Jackson, MD

Do you feel this application can be used as a relevant supplement for the AHA/AAP's NRP training?

Absolutely - the current NRP training lacks
- Instant feedback on results
- interaction with the book
- feedback on the grade at the end of the test
- Real scenarios (the book is a little more theoretical)

Do you feel the clinical content of this application is appropriate for NRP training?

- Yes - it is highly relevant and practical. The scenarios are based on "real life" issues that occur in the delivery room

Do you feel the application is appropriate for the target audience? (first and third-year residents, attendings, fellows and PNPs)

Yes - they add a level of complexity that would augment the trainee's learning

Do you feel the application is visually pleasing and will enhance the audiences' learning of NRP?

Yes - the color is close to reality

Visually, do you feel the application is an accurate representation of NRP?

Yes, it gives a real life color that is similar to the Delivery Room we utilize, and similar to the equipment used

What, if anything, would you change about this application?

Add more scenarios
The technology and presentation of cases is very good
One future idea is to have a "voice-over" that describes the case

How do you see this application being used in the future?

- Addition of other scenarios
- Presentation to the AAP - NRP Committee
- We will use it for a research project, testing residents who DO versus those that DO NOT utilize this tool

Do you feel the final application met the goals of the original project?

- Yes, it exceeds expectations

Comments about the application:

The expandability of the program is quite nice, and ease of use by the user is excellent.

Neonatal Resuscitation: Interactive Flash Cards for Pediatric Health Professionals

Physician evaluation

Name/ credentials: Laura McClanden, MD

Do you feel this application can be used as a relevant supplement for the AHA/AAP's NRP training?

Yes. It is relevant & includes the newest changes to the 6th edition NRP, which will be released in October of this year.

Do you feel the clinical content of this application is appropriate for NRP training?

Yes, the content accurately reflects concepts presented in NRP training and will reinforce the information in a clinical scenario.

Do you feel the application is appropriate for the target audience? (first and third-year residents, attendings, fellows and PNPs)

Yes, the application is perfect for the target audience. It will be useful for both first time learners and ~~for~~ those wishing to brush up on basic NRP skills. Plus it will be much more fun than just reading the textbook!

Do you feel the application is visually pleasing and will enhance the audiences' learning of NRP?

Yes, the application looks terrific. The entire setup of the infant warmer, the equipment, and the baby are life like and easy to identify. In addition, the setup for the questions and answers is clear and pretty.

Visually, do you feel the application is an accurate representation of NRP?

Extremely accurate. Suzanne spent a lot of time and effort making sure each piece of equipment looked accurate according to what we use and what NRP recommends. Also the scenarios accurately depict what the infant would be doing during the scenario.

What, if anything, would you change about this application?

Right now, nothing.
I think the project as imagined has been fully realized.

How do you see this application being used in the future?

We can use it in conjunction with our formal NRP training for pediatric interns (we have a new set every month), and use it to enhance continuing education of PNP's (pediatric nurse practitioners) and faculty. In the future we can also continue to add scenarios as NRP changes in the future to keep up with the newest evidence based medicine.

Do you feel the final application met the goals of the original project?

Definitely, the goals included creating a fun and visually stimulating way to enhance NRP training, which it is.

Comments about the application:

It looks wonderful and Suzanne has been a joy to work with!

BIBLIOGRAPHY

Busari, J.O., Arnold A. 2009. Educating doctors in the clinical workplace: Unraveling the process of teaching and learning in the medical resident as teacher. *Journal of Postgraduate Medicine* (55): 278 - 83.

Holzinger, Andreas and Michael D. Kickmeler-Rust. 2009. Learning performance with interactive simulations in medical education: Lessons learned from results of learning complex physiological models with the HAEMOdynamics SIMulator. *Computers & Education* 52 (2): 292 - 301.

Kattwinkel, John, ed. 2006. *Textbook of Neonatal Resuscitation, 5th Edition*. American Academy of Pediatrics and American Heart Association.

Parkland Hospital Medical Services. "Women & Infants: Newborn Nursey," Parkland Memorial Hospital, http://www.parklandhospital.com/medical_services/women_infants/newborn_nursery.html (accessed August 16, 2010).

Sward, Katherine et al. 2008. Use of a Web-based Game to Teach Pediatric Content to Medical Students. *Ambulatory Pediatrics* (8): 354-9.

Vento, Maximo et al. 2009. Preterm Resuscitation With Low Oxygen Causes Less Oxidative Stress, Inflammation, and Chronic Lung Disease. *Pediatrics* 124, no. 3 (September 3), http://pediatrics.aappublications.org/cgi/content/full/124/3/e439 (accessed June 6, 2010).

Wang, Casey L. et al, "Resuscitation of Preterm Neonates by Using Room Air or 100% Oxygen," Pediatrics 121 (2008): 1083 - 1089.