

Quality Assurance Project to Implement
Audiovisual Distraction in Pediatric Radiation Oncology
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Abstract

Approximately 15,270 children were diagnosed with cancer last year and a common treatment includes daily radiation therapy. Children must remain immobilized for the planning and treatment to ensure the radiation beam precisely delivers radiation to the tumor and reduces exposure to the normal surrounding tissue. Radiation therapy may last several weeks, which requires children to be put under daily anesthesia for an extended length of time to ensure immobilization. The risks for anesthesia include airway obstruction, broncho/laryngospasm, oxygen desaturation, apnea, nausea/vomiting, hypothermia, hypotension, hypoxia, cardiac arrest, sepsis due to central line access, and death. The relationship between daily anesthesia administration and neurotoxicity is currently unclear. The purpose of audiovisual distraction (AVD) during radiation therapy was to decrease anesthesia exposure, improve quality of life, and decrease anxiety of patients and families. A plan to implement an AVD device at the time of radiation planning and during daily treatments was conducted in a large pediatric radiation oncology practice in Arizona. Inclusion criteria were children needing radiation, between the ages of 5 and 15, who do not have history or complaint of visual impairment, who have the ability to follow directions for AVD, and were deemed candidates by the Radiation Oncologist and Child Life Specialist through physical and mental assessment. Data collection included anesthesia requirements, heart rate, PedsQL Tool, and time in treatment room gathered at the planning session and at the end of treatment. Microsoft SPSS was used for data analysis. Descriptive statistics were used to describe the sample and outcome variables. The aggregated data was analyzed to ascertain if the number of children in the inclusion age range had a decreased need for anesthesia, decreased anxiety, and increased quality of life. The primary outcome for the AVD was: all four children who participated were able to undergo radiation

therapy without the need for anesthesia . The children were able to remain awake for treatment could attend school, as permissible, eat before treatment, and spend significantly less time at the treatment facility. The concern of repetitive anesthesia and neurotoxicity will not be a factor in the child's long term late effects of treatment. The reduction of need on anesthesia staff and nursing staff was estimated to save over 500,000 dollars for the 89 treatments the four children underwent with the AVD. The benefits of the intervention not only provided a better treatment experience for all children, but it allowed the facility to utilize the treatment machine more efficiently, providing radiation therapy as an option to even more patients.



Quality Assurance Project to Implement Audiovisual Distraction in Pediatric Radiation Oncology

In 2017 roughly 15,270 children, between the ages of zero to 19, were diagnosed with cancer in the United States; of those children, 1,790 children will die of their disease (National Institute of Health [NIH], 2017). Globally 300,000 children are diagnosed with cancer each year. Approximately one in 285 children in the United States will be diagnosed with cancer before their 20th birthday (American Childhood Cancer Organization, 2017). A cancer diagnosis is overwhelming, frightening, and difficult for not only the patient but the family as well. The medical care for a child with cancer includes a large multidisciplinary team and the treatment course for pediatric oncology patients can involve chemotherapy, surgery, radiation therapy, stem cell transplant, and immunotherapy (NIH, 2017). Each treatment modality presents its own obstacles, limitations and complications. Radiation therapy introduces new obstacles for patients, family, and medical team. Children as young as infants are treated with radiation therapy. Radiation therapy requires patient immobilization to ensure the radiation beam precisely delivers radiation to the tumor and reduce exposure to the normal surrounding tissue (Verma, et al., 2016). The immobilization of the patient allows for daily reproducibility, which is key in treating the correct area of the body. If a child is unable to maintain immobilization on their own, anesthesia is necessary for treatment planning and daily treatment.

Background & Significance

The risks for anesthesia include airway obstruction, broncho/laryngospasm, oxygen desaturation, apnea, nausea/vomiting, hypothermia, hypotension, hypoxia, cardiac arrest, sepsis due to central line access, and death (Mizumoto et al., 2015; Tucker, Jain, & Mahesh, 2017). Children with cancer are at increased risks secondary to body systems that are often depleted due

to the comorbidities of cancer treatment. The usual risks of anesthesia are compounded by the fact that overall the body systems are not operating at the highest potential due to the treatment they are receiving. Children with cancer pose a potential for clinically significant deterioration under general anesthesia (Latham & Greenberg, 2010). Children receiving concurrent radiation therapy with chemotherapy are at increased risk for complications. The impact of daily anesthesia has long reaching effects, not only on the patient and family, but also within the healthcare system, potentially causing increased healthcare costs secondary to complications.

Pediatric sedation has increased over the years with the advancement of medications available to provide safe and effective sedation that impairs health outcomes. In Uffman, et al. (2017) a study of MRI utilization and associated use of anesthesia and sedation (A/S), the need for anesthesia increased from 21% to 28% from 2009 to 2014. With the advancements in sedation, the American Academy of Pediatrics and American Society of Anesthesia mandated guidelines and criteria to maintain procedural safety (Sterni, Beck, Cole, Carlson, & Turmelle, 2008). The most recent Guidelines of the American Academy of Pediatrics for anesthesia were published in 1992, which focus on single procedures. The medical community has an increasing interest and concern between the link of anesthesia and neurotoxicity caused by repetitive anesthesia. The Mayo Clinic conducted a study of 5,000 children and found that there is an increased risk in learning disabilities in children exposed to two or more anesthesia episodes before the age of four (Barton, Nickerson, Higgins, & Williams, 2017). Verma, et al. (2016) conclude that though radiation A/S is safe comparatively to the A/S of an operating room setting, there is still concern about the neurocognitive consequences of multiple anesthetics in pediatric patients. McMullen, Hanson, Bratton and Johnstone (2015) conducted a retrospective study to determine the safety parameters of A/S in children receiving radiotherapy. A/S needs vary with

each individual causing for case by case assessment. Gardling, Tornqvist, Mansson, and Hallstrom (2017) conducted a controlled clinical trial testing the development, feasibility/piloting, evaluation, and implementation of general anesthesia (GA). The study stated that GA for radiotherapy involves risk, sleep disruption, and suboptimal nutrition which leads to additional discomfort. The study showed that children who underwent GA for radiotherapy, displayed more negative emotional behavior through vocalization, activity, interaction, and level of cooperation. Most proton radiation centers are free standing and away from specialized pediatric care (Buchsbaum et al., 2013). During Buchsbaum et al. (2013) study, of the 138 patients treated with A/S, there were three events, one child fell off of a gurney and two other children had aspiration episodes, leading to intubation and hospital stay for both. The use of A/S during a study conducted by Mizumoto et al. (2014) identified the average time of a patient undergoing A/S was 50 minutes, and treatment started roughly seven minutes after induction of anesthesia. Scott et al. (2016) estimates the annual reduction of anesthesia with the use of a Child Life Specialist (CLS) for 100 patients to exceed \$775,000. Patients are required to be fasting for the radiation procedure with anesthesia. The fasting can be a challenge for both patients and families and cause increased compromised nutritional status in a patient population that is already at risk for nutritional deficit.

In a radiation department in the southwest United States, providers are currently anticipating the need for anesthesia on their interaction with the patient at the consultation. The provider in conjunction with the CLS decided if the child is developmentally and physically capable of receiving radiation therapy without anesthesia. The CLS is vital in the day to day treatment of children, especially in the radiation therapy setting. They are capable of walking children through treatment with reduced anxiety, assisting them with going under anesthesia

calmly or staying awake during treatment. The CLS is consulted to assess the child and determine if the child is developmentally able to attempt radiation therapy without anesthesia. In 2016 there were over 75 children, between the ages of four months old and 22 years old treated with radiation therapy in this facility. Radiation therapy treatment spanned between one week to eight weeks of Monday through Friday treatment. The number of pediatric and adult patients being treated every day continues to rise, and the time on the machine is coveted. The proton radiation beam can only treat for eleven hours a day due to daily maintenance. The time it takes to administer anesthesia and radiation therapy is longer than treatment of a child tolerating treatment safely without anesthesia, which in turns reduces the number of patients treated per day. In addition to having benefits for the patient, safely decreasing the use of anesthesia, when appropriate, would allow this facility to provide more sessions of treatment per day, which could possibly save additional lives.

Problem Statement/ PICO Statement

The standard of care for safe and effective radiation therapy for children who are likely to move during radiation therapy is to place the child under general anesthesia. Children between the ages of five and fifteen may be able to complete radiation therapy without anesthesia, with the help of an AVD device. In pediatric patients, how does an audiovisual distraction intervention compared to standard distraction reduce anesthesia exposure in children?

Search Strategy

An exhaustive literature search was performed to obtain research studies pertinent to the PICO question. The literature search was conducted in three scientific databases PubMed, CINHALL and Scopus. PubMed was utilized first, as it has a large selection of peer reviewed articles. CINHALL and Scopus were the second and third database used in the literature search.

A grey literature search was also conducted to discover any material not published and used for the background and significance. A hand search of articles was conducted in the reference list of two studies to obtain relevant research articles not found within the three database searches. An hour was spent with the a librarian to review search strategies to ensure exhaustive search was achieved. A literature review was conducted again in 2019 with no further research uncovered.

PubMed

The following keywords were included in the initial search: “anesthesia”, “pediatric” and “procedures”. This search yielded 9016 articles. The search was then limited to articles published in the last five years (2013-2018), English language, and the age range of birth to 18 years. The search results were reduced to 1982. The key word radiation therapy was added to the search criteria, 30 articles were generated through the search. Five studies were selected from the search results through examination of the title and abstract related to the content and relation to the problem statement. The previous search criteria were again entered into the search bar and “outpatient” was added to the keywords, this produced two studies, one in which was chosen for supporting research on pediatric anesthesia. In all, six research articles met the criteria to be selected to be analyzed for the purpose of supporting the PICO question.

CINHAL

The search started with the keywords “anesthesia”, “pediatrics” and “procedures”. The results of the search were 572 articles. The limit of full text was added to the exclusion criteria, reducing the results to 137. A time limit of articles published in the last five years was added, yielding 70 results. The keyword “radiation therapy” was added. The final search resulted in nine articles. Using preselected criteria, one of the nine was used in the evidence to support the PICO question.

Scopus

Scopus database was searched for articles and studies related to the PICO question. The first two key words searched were “anesthesia and pediatrics”. The search produced 20, 818 articles. The limitations added next were English language and last five years which reduced the results to 4721. The keywords “procedures and radiation therapy” were added to the search parameters. This search yielded 80 results. The review of the 80 articles produced nine studies that met the criteria used for the purpose of supporting the PICO question. The nine studies found in Scopus were previously found in the PubMed and CINHAI database searches and ancestry search. No new studies were selected for literature review.

Grey Literature

The search for grey literature began with a search of clinical trials using the keywords, “anesthesia, pediatric, and radiation oncology” with limitations of birth to 17 years old. Four clinical trials resulted in the search. One clinical trial titled, Ketamine Tolerance in Children after Repeated Administration During Radiotherapy Sessions, was applicable to research question. The clinical trial was completed in 2014. Background and significance information related to pediatric cancer was obtained through American Childhood Cancer Organization and National Institute of Health websites.

Ancestry Research

Ancestry searching was conducted on two research articles obtained during the database search. Through the hand search of Khurmi, Patel, Koushik, Daniels, and Kraus (2017) reference list, two research articles, written within five years, which were relevant to the PICO topic. Owusu-Agyemang (2014) reference list was also reviewed. One article from the reference list was used in the literature review. All three articles were ultimately later found in Scopus

database when the same keywords were used. The synthesis table with the selected studies can be seen in Appendix A.

Evidence Synthesis

There are several randomized control trials (RCT) that provide conclusive evidence that audiovisual distraction is beneficial in pediatric treatment. Burns-Nader (2017), Hua (2015), Jeffs (2014), and Khadra (2018) used audiovisual visual distraction in the treatment of children with burns during wound management care. The RCTs treated children between the ages two months and 17 years of age. All the studies concluded that children with the AV distraction reported less pain and anxiety with wound care compared to the children with pharmaceutical intervention and standard distractions.

Hinker (2017) conducted a pilot study of 23 pediatric patients undergoing radiation therapy treatment between the ages of three and 12 years, using an audiovisual-assisted therapeutic ambience during radiation treatment. The goal of the pilot study was to assess the AV system developed and the reduction of daily anesthesia. Hinker (2017) reported that 23 of the 25 (92%) of the patients were able to complete the prescribed radiation therapy treatments using the AV intervention without anesthesia. The median age of the pediatric patient was six. Seven of the 23 pediatric patients were originally treated with daily anesthesia, but effectively transitioned to the AV intervention and finished treatment without daily anesthesia. The synthesis of the evidence can be seen in table format in Appendix A.

The evidence gathered showed significant success of AVD in children who are undergoing painful medical procedures. The evidence can be applied to the use of AVD devices in children between the ages of five to fifteen. There is statistical significance of the articles

listed in Appendix A that AVD is a safe and effective method to distract and entertain children during medical procedures.

Purpose Statement

The purpose of this quality assurance project is to use an audiovisual device to decrease the need for general anesthesia, decrease anxiety, and increase patient and family quality of life for children between the ages of five to fifteen who are undergoing radiation therapy in a radiation oncology center in the southwest United States.

Contribution of Theory to Utility of the Evidence

Erickson's Modeling and Role Modeling Theory can be used to help the healthcare providers understand that each child is uniquely different and will have their own sets of needs (Butts & Rich, 2015), see Appendix B. The theory allowed the facility to understand that each child comes into the facility at a different stage of development, psychological development and physical and mental disabilities secondary to their cancer diagnosis. The staff can use the uniqueness of each patient and family to come up with appropriate preparation for radiation therapy. The child life therapist and staff used role modeling to help the child reduce anxiety with radiation therapy by show them how the AVD devices work and allow them to use the device before actual planning or treatment occur.

Evidence Based Practice Model

The Rosswurm and Larabee's Model for Evidence Based Practice Change was used to implement proposed project on reducing pediatric anesthesia. The model worked well in the hospital setting where the project was conducted. The hospital culture has a high regard for utilizing an organized and defined processes for change. The Model for Evidence Based Practice has organized and thoroughly defined steps. The model is a six step process to implement the

change in an organization (Appendix C). The steps include assess the need for change in practice, locate the best evidence, critically analyze the evidence, design practice change, implement and evaluate change in practice, and integrate and maintain change in practice (Melnyk & Fineout-Overholt, 2015).

Project Methods



International Review Board (IRB) at Arizona State University (ASU) approval was obtained for the quality assurance project. The institution where the project was conducted used a IRB wizard that provided an exempt status for the quality assurance project. All staff participating in the AVD project completed a human subjects protection module required by the institution where the project was conducted. Education on the AVD devices implemented was provided to the Radiation Oncology staff at a staff meeting to include: Radiation Oncologist, Nursing staff, Child Life Specialist, and Radiation Therapists. The Radiation Oncologist and the Child Life Specialist evaluated the child at the time of consult to assess the inclusion criteria for the AVD.

The candidacy was determined through physical exam and evaluation in a collaborative effort with both the Radiation Oncologist and the CLS in order to assess if a patient was socially and age appropriate. The CLS assessed the patient through developmental milestones of age, maturity level, history of school performance, ability to follow simple commands during consult, parental support and interaction, and history obtained from medical record as part of the standard of care.

Inclusion Criteria

All children needing radiation therapy between the ages of five and fifteen, who did not have a history or complaint of visual impairment who could view audiovisual media through an

iPad or iTV goggles were considered eligible. The candidate was able to follow the directions for AVD and are deemed candidates by the Radiation Oncologist and Child Life Specialist (CLS) through clinical judgment at time of consult. The Radiation Oncologist determined if AVD device was a reasonable option for the patient through physical and mental assessment at the time of consult. The CLS was introduced and the CLS determined if the patient was a candidate. All eligible patients were be offered the AVD device.

Exclusion Criteria

A history or complaint of visual impairment was determined through visual assessment at consult, evaluation of medical records as this is part of standard of care. Children who do not meet the screening of the radiation Oncologist and CLS will not meet candidacy for the AVD distraction tool.

Children who were deemed to be candidates for the AVD were given a participation letter at the time of radiation planning in either Spanish or English, and given the opportunity to ask questions. They were allowed to trial the AVD and decide if they want to be included in the project by the Doctorate of Nursing (DNP) student. A waiver of consent was obtained through ASU's IRB. The DNP student was available for guidance at the planning session and the child's first radiation treatment.

Budget

The AVD project budget was limited in the financial needs. The iTV Goggles were purchased by the Radiation Oncologist; the iPad was purchased by the Child Life Specialist department; and the movies were donated or were already owned by the Child Life Specialist department.

Data Collection

The demographics collected were the child's age, sex, cancer diagnosis, number of treatments, and the AVD device used. The PedsQL survey was assigned by the project team to be given to the child and parent at the time of simulation and at the end of treatment. The PedsQL survey tool was validated and reliable per previous research and is the standard of care at the facility. The treatment time in the room was assessed at first treatment and last treatment. The patient's heart rate was obtained at simulation and last treatment management visit. A descriptive analysis was conducted on the data collected.

Outcomes/Project Results/Impact

Results

Four children needing radiation therapy between the ages of five to fifteen years old participated. The average age of the children participating was ten (Sd=2.36) years and three months. The children's ages ranged from seven to twelve years of age. Half of the children were male (50%). The children's diagnoses were all different (Appendix D) The average number of treatment days were 22 (Sd=9.22), with a range of 12 to 31 treatment days. The average first treatment time was 43 (Sd=17.54) minutes, with a range of 22 to 64 minutes. The average first treatment heart was 102 (Sd=19.67) beats per minute, with a range of 73 to 116 beats per minute (Appendix D). The average baseline anxiety score for n=2 was 7.5 (Sd=6.36) points, with a range of three to twelve points. The baseline worry score was the exact same as the anxiety score.

The average last treatment time was 32.75 (Sd=6.99) minutes, with a range of 25 to 42 minutes. Three of the four children had a decreased in treatment time from the beginning of treatment to the end of treatment. Patient number four's treatment time is graphed, see appendix E. The average last treatment heart was 101 (Sd=11.90) beats per minute, with a range of 83 to

108 beats per minute. The end of treatment anxiety score and worry score were not observed due to all children being lost to follow up.

Impact

The time the children were able complete radiation treatment was decreased compared to the time needed to treat a child under anesthesia. The average cost of daily anesthesia is roughly six to seven thousand dollars per treatment. The 89 treatments the children were able to remain awake during, saved the patient and hospital an estimated \$534,000 on anesthesia cost alone. The reduced treatment time used by children not utilizing daily anesthesia, allows the department to treat more patients during the day.

Discussion

Limitations

The number of children who were able to participate in the AVD quality assurance project is a limitation. The limited number of children, four, limited the ability to establish statistical significance. Only descriptive analysis could be completed. Future research should enroll more patients with a longer time frame to enable more children to participate.

Three out of the four children were lost to follow up in regards to the PedsQL survey. The PedsQL was only collected at baseline and at the completion of treatment for one patient. Child number two completed a baseline, but did not complete a final survey. Child number one and four had a language listed as Spanish, although both patients spoke English. The language selection caused the PedsQL survey to not be triggered in the research department. The end of treatment visit with the Radiation Oncologist for child number two was canceled, thus canceling the PedsQL survey.

The children were capable of maintaining their nutritional status due to the ability to eat before treatment. The fall risk related to daily anesthesia is reduced and the child is capable of sustaining their school attendance as permitted. The condensed time spent at the hospital allows for an increased quality of life.

In the future, the children who are beginning treatment will be reviewed with the research department for the evaluation of need for the PedsQL survey. Going forward, if the child speaks English, the research coordinator will manually order the survey. The research coordinator has now attempted to obtain a Spanish version of the survey to reduce the number of children from being excluded based on language selected. The scheduling department was educated on the need to reschedule the PedsQL portion of an end of treatment management in the future.

Future Practice

The facility will continue to utilize the AVD devices in radiation therapy to reduce the anesthesia exposure to pediatric patients. The use of AVD can be evaluated in different healthcare settings to reduce anesthesia exposure. Magnetic resonance imaging (MRI) utilizes anesthesia in order to successfully obtain imaging in children. The AVD could be implemented in this setting to give children the ability to remain awake during scans. The adult Radiation Oncologist are discussing the implementation of the AVD for adult patients who have long treatment times or high anxiety. Further research should be conducted to examine a larger sample size to do further statistical analysis on this specific patient population.

The child's ability to remain awake for daily radiation therapy treatment not only improves the patient and family's quality of life it reduced the possible risk of complications. Reducing the number of children undergoing daily anesthesia will move up the treatment start time for all patients, thus reducing the time children under daily anesthesia must remain without

food or water. The benefits of the intervention will not only provide a better treatment experience for all children, but it will allow the facility to utilize the treatment machine more efficiently, providing radiation therapy as an option to even more patients.

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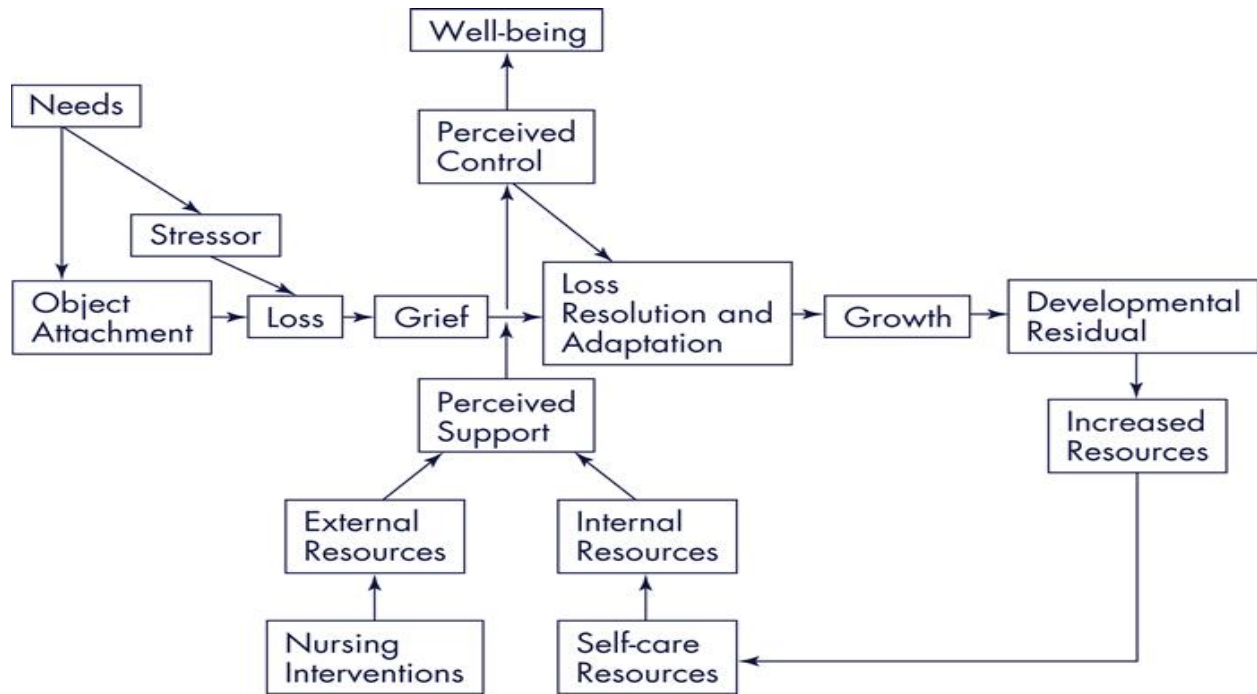
Synthesis Table

Studies	Bagattoni	Burns-Nader	Chad	Garrocho-Rangel	Hiniker	Hua	Jeffs	Khadra	Koller
Year	2017	2017	2018	2018	2017	2015	2014	2018	2012
Design	RCT	RCT	Pilot Study	RCT	Pilot Study	RCS	RCT	Pilot Study	SCR
LOE	II	II	III	II	III	II	II	III	I
Age	5-10 y	4-12y	6-17y	5-8y	3-12y	4-16y	10-17y	2mo-10y	0mo-19y
Gender	x	x		x	x				x
Number of Participants	48	30	17	40	23	65	30		1632
Virtual Reality Distraction Intervention			x			x	x	x	x
Audiovisual distraction Intervention	x	x		x	x				x
Pharmacological Intervention	x	x					x	x	
Wound Dressing Changes/ Burn Treatment		x				x	x	x	
Radiation Treatment					x				
Dental Procedures	x			x					
Length of treatment	x	x					x		
Heart Rate									
Anxiety	x	x	x			x		x	x
Modified Smith Scale								x	
Procedure Behavior Check List								x	
McMurtry children's fear scale			x						
Frankl				x					

Behavioural rating Scale									
Spielberger's State-Trait Anxiety Inventory for Children							x		
Pain		x	x			x		x	
Wong Baker Faces Scale	x	x	x			x			
FLACC	x			x				x	
Adolescent Pediatric Pain Tool							x		
Visual Analogue Scale	x					x			
Nurse's Reports		x							
Children's Emotional Manifestation Scale (CEMS)		x							
Pulse Rate/Oxygen Saturation				x		x			
CCLS		x							

Appendix B

Erickson's Modeling and Role Modeling Theory



Appendix C

Evidence Based Practice Change

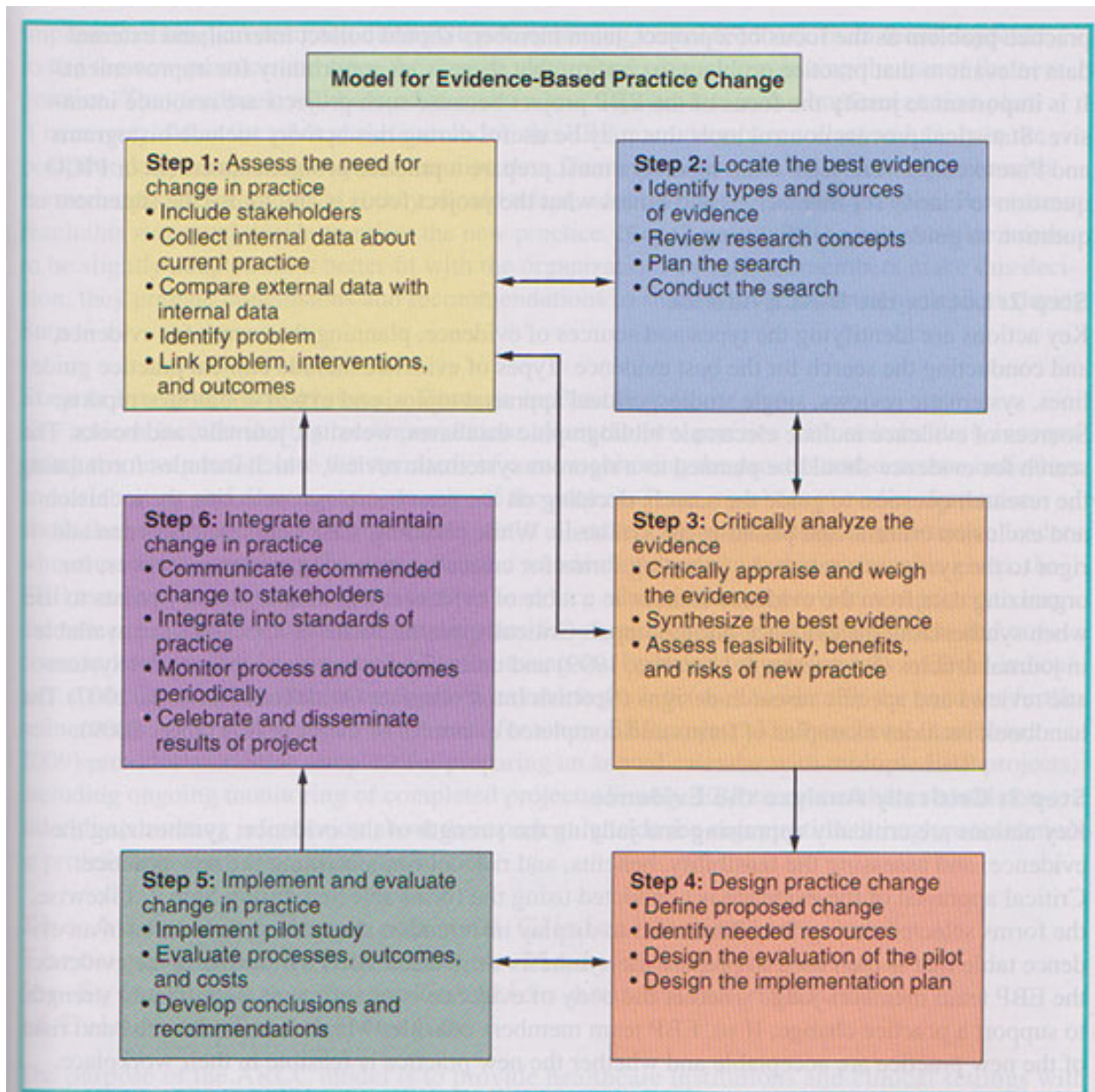


figure 11.4 A model of evidence-based practice change (Larrabee, J. H. [2009]. *Nurse to nurse: Evidence-based practice*. New York: McGraw-Hill. Used with permission.)

Appendix D

Descriptive Analysis Table

	Baseline	End of Tx
Tx Time (\bar{x})	43 (s.d.=17.54) minutes	32.75 (s.d.=6.99) minutes
Tx Time (range)	22-64 minutes	25 – 42 minutes
Heart Rate (\bar{x})	102 (s.d.+19.67) bpm	101 (s.d.= 11.90) bpm
Heart Rate (range)	73-116 bpm	83-108 bpm
Anxiety (n=2) Scores (\bar{x})	7.5 (s.d.= 6.36) points	Lost to follow up
Anxiety (n=2) Score (range)	3 – 12 points	Lost to follow up
Worry (n=2) Scores (\bar{x})	7.5 (s.d.= 6.36) points	Lost to follow up

Worry (n=2) Scores (range)	3 – 12 points	Lost to follow up
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Appendix E

Treatment Time of Patient Number 4 from Beginning to End

