

Use of Virtual Reality Videos to Reduce Anxiety for Radiation Oncology Patients

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### Abstract

**Purpose:** To implement a non-pharmacologic approach to reduce anxiety in patients receiving radiation treatment.

**Background and Significance:** Anxiety is a prevalent health problem affecting up to 30% of the general population. Over 95% of radiation oncology patients report anxiety often related to not knowing what to expect during treatments. The current guideline for management of anxiety is the use of benzodiazepines; which can impose a risk to patients. Evidence demonstrates virtual reality videos can be an effective non-pharmacologic approach to reduce anxiety..

**Design:** Observational cohort evidence based project.

**Setting:** Outpatient radiation oncology facility in the Southwest United States.

**Sample:** 40 patients who have not previously undergone radiation therapy, but have been prescribed radiation treatments for malignant or non malignant conditions.

**Methods:** Patients who had not previously undergone radiation treatments were identified based on chart review and consented for participation in the project. The patient's were assessed for both their general (trait) anxiety and situational (state) anxiety using The State Trait Anxiety inventory (STAI). They were then shown a virtual reality video that walked them through what they would experience during their radiation treatment. The patient's were re-administered the STAI questionnaire following the video to assess any change in anxiety levels.

**Variables:** Trait and State anxiety scores before and after the virtual reality video intervention.

**Findings/Outcomes:** A paired t-test was conducted to assess the data. There was a significant difference in the state anxiety scores pre intervention ( $m = 32.65$ ,  $SD = 11.47$ ) and post intervention ( $M = 25.50$ ,  $SD 8.95$ ),  $p = < 0.001$ .

**Conclusions:** The use of virtual reality videos was an effective non-pharmacological approach to reduce anxiety in patients receiving radiation treatment.

**Implications for nursing:** The results provide support for the use of a virtual reality intervention as a non-pharmacologic option to reduce anxiety for patients.

*Keywords:* Radiation oncology, anxiety, virtual reality, patients

### The Use of Virtual Reality Videos to Reduce Anxiety

When a patient is diagnosed with cancer and presents for an initial consultation regarding the role of radiation in their treatment, they often experience significant anxiety. Their new diagnosis which is often grave, combined with the steep learning curve about the world of oncology is certainly anxiety provoking. Physiological and psychological health issues, stemming from anxiety, can have a negative impact on a cancer patient's well-being. Current guidelines recommend only benzodiazepines for the management of anxiety; however, the use of these medications can present a risk to the patient. Non-pharmacologic approaches such as the use of virtual reality videos have been found to be an effective approach to manage situational anxiety in many patients.

#### **Background and Significance**

Chen and Chang (2012) describe the significant emotional challenges and myriad of emotions oncology patients experience, including: acceptance of illness, facing mortality, altered financial and socioeconomic stability, self reproach, and changes in their perception of self. They also recount patient self reports of negative feelings which they described as mental distress manifested as worries, fear, bad anticipations, shock, hopelessness, and anger. The concepts of mental distress, worries, and fear are defined as anxiety by the National Cancer Institute (2015). The issue of anxiety in cancer patients can manifest at various times during their cancer diagnosis and treatment. Anxiety can affect a patient's behavior and willingness to proceed with treatment. The National Cancer Institute (2015) recommends addressing anxiety with cancer patients at all stages of their treatment. Evaluation tools such as the State Trait Anxiety Inventory (STAI) are recommended by the American Psychological Association (2017) to evaluate a patient's anxiety at different times during an illness. Current guidelines from the National Comprehensive Cancer

Network (NCCN) recommend evaluation of anxiety followed by treatment with, psychotherapy with or without anxiolytic and with or without antidepressant. No non-pharmacological interventions are recommended beyond psychotherapy (National Comprehensive Cancer Network, 2015). Dunn et al., (2012) used the STAI to evaluate the trajectory of anxiety in oncology patients before, during, and after radiation treatments. Their results showed that 95% of the patients had anxiety prior to their first radiation treatment.

A retrospective chart review of the electronic medical records at the clinical site demonstrated 7- 8% of patients who have undergone radiation treatment in the past five years had a co morbid diagnosis of anxiety. At the clinical site where this project was implemented patients are currently assessed for anxiety in an informal manner. Patients are asked if they have anxiety and or claustrophobia at the time of their initial consultation. A standardized tool for assessment of anxiety is not used. If a patient reports anxiety, the current standard of care at the clinical site is to prescribe a benzodiazepine for management of the patient's symptoms. Patients are not presented a non-pharmacologic approach to help manage anxiety.

The use of benzodiazepines present potential side effects and risk to patients. Rosenberg (2015) looked at the association between use of benzodiazepines and higher incidents of Alzheimer's. Her research showed that patients who had used benzodiazepines for more than 180 doses had markedly higher rates of Alzheimer's disease; 33% versus the control group of 22%. Furthermore, her research provided evidence that use of benzodiazepines at any time increased the risk of Alzheimer's by 43% to 51%. Other concerning side effects of benzodiazepine use include sedation in the first few weeks of therapy, unsteadiness, poor coordination, and disorientation (Lader, 2011). In a retrospective study performed by van Strien, A. M., Koek, H. L., van Marum, R. J., & Emmelot-Vonk, M. H. (2013) data was presented confirming that use of psychotropic

medications including benzodiazepines significantly increase the frequency of falls in the elderly. While the use of benzodiazepines can be effective in the management of situational anxiety, the medication can have many unacceptable side effects for patients receiving care at an outpatient radiation oncology center. Use of benzodiazepines prevent patients from driving to their appointments, can effect cognitive functioning, and reduces a patient's ability to make important decisions during a time that can be very tumultuous. This has lead to the following clinical question: (P) In oncology patients undergoing radiation treatments, (I) how does a virtual reality intervention, (C) versus use of benzodiazepines, (O) affect the level of anxiety (T) prior to radiation treatments?

### **Search Strategy**

To answer the clinical question, an extensive search of the literature was performed. Three databases were searched including: Cumulative Index of Nursing and Allied Health Literature (CINAHL), Public/Publisher MEDLINE PubMed, and Psychological Information Database (PsychINFO). Search strategies included restricting the publication date to 2010-2016, peer reviewed journals, and only those written in English.

The database searches were performed using key words, MeSH terms, and Boolean Connectors. Key words used in combination for all search strategies were *anxiety, radiation oncology nursing, radiation oncology, virtual reality, VR, virtual reality exposure, virtual reality therapy, cancer patients, education, treatment, anxiety disorders, simulation, quality of life, intervention, and health* (Appendix A).

A systematic search was conducted and studies were initially reviewed for relevance.

Studies with virtual reality as an intervention and studies with anxiety as an outcome were reviewed in greater detail. Ten studies that best addressed one or more component of the PICOT question were identified.

### **Critical Appraisal and Synthesis of Evidence**

Three of the studies chosen for relevance were systematic reviews (level I evidence), four randomized control trials (level II evidence), one Quasi-experimental trial (level III evidence), one qualitative study (level V evidence), and one mixed methods study (level IV). Nine of the ten studies addressed anxiety as one of the dependent variables and all had non-pharmacological interventions including music therapy, psychotherapy, and hypnosis as the independent variable. All nine studies showed decreased anxiety after the intervention. Statistical analysis was performed in all of the studies and every study showed statistically significant results with (p) ranging from 0.05 to  $< 0.001$  (Appendix B). Eight of ten studies evaluated cancer patients and three studies specifically addressed cancer patients undergoing radiation therapy. Six studies used virtual reality as the intervention to reduce anxiety. The instruments used to evaluate the change in the dependent variables were predominantly validated tools including State Trait Anxiety Inventory (STAI), Self Rating Anxiety Scale (SAS), Self Rating Depression Scale (SDS) and Visual Analog Scales (VAS). Bias was not evident in the selected studies. Three studies had government based grants, five studies did not have any financial assistance, and the remaining two studies received financial assistance from private health foundations.

### **Purpose Statement**

The purpose of the project is to demonstrate that virtual reality videos can be an effective non-pharmacologic approach for managing anxiety for patients undergoing radiation treatments.

The goal is to facilitate a practice change where the use of virtual reality videos would be considered in place of benzodiazepines for patients prior to their radiation treatments.

### **Theoretical Framework**

Roy's Adaptation Model (Roy, 1991) was selected to help guide an intervention to reduce anxiety for oncology patients receiving radiation (Appendix C). The model has four essential elements: the person receiving nursing care, the environment, health, and nursing. The model is designed to assist with changes in nursing practice and nursing research. In the proposed practice change, all of the elements are addressed; the person receiving care is the oncology patient, the environment is the radiation oncology department, the health issue is anxiety, and nursing is the nursing staff at the facility who will be working to evaluate the proposed practice change following implementation of the non-pharmacological intervention with virtual reality to decrease anxiety in patient's in place of benzodiazepines.

### **Evidence Based Model**

The Rosswurm and Larrabee Evidence Based Model (1999), has been chosen to guide the process towards creating a practice change (Appendix D). For the planned project, the need for a practice change was identified after collection of internal and external evidence which identified the need to evaluate possible non-pharmacological interventions for treatment of cancer patients who have situational anxiety related to radiation treatments. A review of current evidence helped identify possible interventions and evidence related to anxiety in cancer patients and possible interventions were collected and synthesized. The details of the practice change intervention were designed and the virtual reality videos were created for each treatment modality. The project was then implemented and data was collected to determine efficacy.



## Methods

Approval for the project was obtained from Arizona State University Institutional Review Board and permission to implement the project at the clinical site was obtained from the medical director of the practice.

The setting for the project was an outpatient radiation oncology facility in the Southwest United States with four physicians and one physician's assistant. The center has three different radiation machines providing different modalities for delivering radiation. Evidence based practice is at the core of every treatment and intervention discussion at the center. The providers and center staff all expressed enthusiasm for the project and participated in making patients aware of the opportunity to learn about the project details.

Inclusion criteria for eligible patients to participate in the project were English speaking, adult patients who had been prescribed radiation by their radiation oncologist. The patients had not previously received radiation treatments. Patients with both malignant and non malignant conditions were included.

The instrument used to measure anxiety was the Spielberger State-Trait Anxiety Inventories (STAI). The STAI instrument is an established assessment tool with construct validity and internal reliability (Spielberger, 1983). The STAI instrument is a self evaluation tool that is divided into two questionnaires. The first questionnaire is an assessment of Trait or general anxiety. The second questionnaire is an assessment of State of situational anxiety. Each questionnaire is comprised of 20 items which are scored on a Likert scale from 1-4. The responses were scored from 1 ("not at all") to 4 ("very much so"). The Trait anxiety questionnaire is a self assessment of how a patient "generally feels" in day to day life. The State anxiety questionnaire is a self assessment of how the patient feels "in that moment" or "right now".

Patients who had not previously undergone radiation treatments were identified based on chart review and consented for participation in the project prior to their first radiation treatment. This was generally done on the day of their initial consultation with the radiation oncologist. Once written consent was obtained patients were administered both the Trait and State anxiety questionnaires. The patient then watched a virtual reality video of their specific planned radiation treatment modality wearing specialized virtual reality glasses. The appropriate video was chosen based on which treatment machine was ordered for the patient's radiation and based on whether the patient would need to wear a face mask for their treatment. The video walked the patient through what they would see, hear, and experience during their radiation treatment. Immediately following the video the patient completed a second State anxiety questionnaire to assess any change in anxiety levels following the intervention.

SPSS®, version 23 was used for statistical data analysis. Descriptive statistics and frequency distributions were generated on the sample. A paired- samples t-test was conducted to compare pre and post intervention anxiety scores. Pearson's correlations were performed to examine the relationship between anxiety scores and gender, treatment type, age and diagnosis.

Funding was not requested or obtained for the project. The project costs included the cost to reproduce the STAI questionnaire which is copyrighted. The cost was 50c per questionnaire. The Virtual reality videos were made at no cost and the virtual reality goggles cost \$40. No other costs were incurred for the project.

### **Results**

The sample was composed of 40 adult patients, 23 men, and 17 women. The patient's age ranged from 24 to 84 years, ( $M = 64.25$ ,  $SD 13.74$ ). Twenty six (65%) of the patients had a cancer diagnosis with the remaining 18(35%) having non malignant conditions including meningiomas,

vestibular schwannomas and trigeminal neuralgia. The number of patients requiring a face mask for immobilization for their treatment was 15 (37.5%). Two different treatment machines were used by the participating patients, 12 (30%) patients were treated on the Truebeam machine, and the remaining 28 patients were treated on the Cyberknife machine.

A paired t-test was conducted to compare the patient's state anxiety scores prior to the virtual reality intervention and their state anxiety score following the intervention. There was a significant difference in the state pre intervention anxiety scores ( $m = 32.65$ ,  $SD = 11.47$ ) and the state post intervention scores ( $M = 25.50$ ,  $SD 8.95$ ). There was a significant difference in the anxiety scores pre and post the virtual reality intervention  $t(39) = 6.03$ ,  $p = < 0.001$ . (Appendix E)

Bivariate correlations were run and demonstrated that there was no statistical correlation between patient's age and trait anxiety levels. There was no correlation between patients needing to wear a mask and state anxiety levels. There was also no correlation between gender and state anxiety levels.

### **Discussion**

The results demonstrate that using a virtual reality video intervention is an effective way to reduce anxiety in patients prior to receiving radiation treatment. The findings from the project are consistent with the evidence found in the available literature.

Strengths of the project include the inclusion of patients with multiple diagnoses and patients receiving treatments with different modalities of radiation. The project was not cost prohibitive and the intervention can be carried on at no additional cost to the clinical site.

Limitations of the project are the relatively small sample size of 40 patients and that the project was only carried out at one site.

### **Conclusions**

The results of the project provide support for the use of a virtual reality intervention as a non pharmacologic option to manage anxiety and potentially reduce patients' use of benzodiazepines.

All patients should be screened for anxiety using a standardized tool as part of routine care for patients prior to radiation treatments. Virtual reality videos can be considered as a non-pharmacologic therapeutic option in the place of benzodiazepines for patients with anxiety thereby reducing risk to the patient resulting from side effects related to those medications.

## References

- American Psychological Association (2017). Retrieved from <http://www.apa.org/pi/about/publications/caregivers/practice-settings/assessment/tools/trait-state.aspx>
- Baños, R. M., Espinoza, M., García-Palacios, A., Cervera, J. M., Esquerdo, G., Barrajón, E., & Botella, C. (2013). A positive psychological intervention using virtual reality for patients with advanced cancer in a hospital setting: a pilot study to assess feasibility. *Supportive Care in Cancer, 21*(1), 263-270
- Chen, L. C., Wang, T. F., Shih, Y. N., & Wu, L. J. (2013). Fifteen-minute music intervention reduces pre-radiotherapy anxiety in oncology patients. *European Journal of Oncology Nursing, 17*(4), 436-441.
- Chen, P. Y., & Chang, H. C. (2012). The coping process of patients with cancer. *European Journal of Oncology Nursing, 16*(1), 10-16.
- Chirico, A., Lucidi, F., De Laurentiis, M., Milanese, C., Napoli, A., & Giordano, A. (2016). Virtual Reality in Health System: Beyond Entertainment. A Mini-Review on the Efficacy of VR During Cancer Treatment. *Journal of cellular physiology, 231*(2), 275-287.
- Dunn, L. B., Aouizerat, B. E., Cooper, B. A., Dodd, M., Lee, K., West, C., ... & Miaskowski, C. (2012). Trajectories of anxiety in oncology patients and family caregivers during and after radiation therapy. *European Journal of Oncology Nursing, 16*(1), 1-9.
- Guo, Z., Tang, H. Y., Li, H., Tan, S. K., Feng, K. H., Huang, Y. C., ... & Jiang, W. (2013). The benefits of psychosocial interventions for cancer patients undergoing radiotherapy. *Health and quality of life outcomes, 11*(1).

- Lader, M. (2011). Benzodiazepines revisited—will we ever learn?. *Addiction*, 106(12), 2086-2109.
- Li, X. M., Zhou, K. N., Yan, H., Wang, D. L., & Zhang, Y. P. (2012). Effects of music therapy on anxiety of patients with breast cancer after radical mastectomy: a randomized clinical trial. *Journal of advanced nursing*, 68(5), 1145-1155.
- McCann, R. A., Armstrong, C. M., Skopp, N. A., Edwards-Stewart, A., Smolenski, D. J., June, J. D., ... & Reger, G. M. (2014). Virtual reality exposure therapy for the treatment of anxiety disorders: An evaluation of research quality. *Journal of anxiety disorders*, 28(6), 625-631.
- National Cancer Institute (2015). Retrieved from <http://www.cancer.gov/about/cancer/coping/feelings#stress>
- National Comprehensive Cancer Network (2015) Retrieved from [Http://www.nccn.org/patients/resources/life\\_with\\_cancer/managing\\_symptoms/mood\\_changes.aspx](Http://www.nccn.org/patients/resources/life_with_cancer/managing_symptoms/mood_changes.aspx)
- Opriş, D., Pinteă, S., García-Palacios, A., Botella, C., Szamosközi, Ş., & David, D. (2012). Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis. *Depression and anxiety*, 29(2), 85-93.
- Rosenberg, K. (2015). Benzodiazepine Use Increases Alzheimer's Risk. *AJN The American Journal of Nursing*, 115(1), 56.
- Rosswurm, M. A., & Larrabee, J. H. (1999). A model for change to evidence-based practice. *Image: The Journal of Nursing Scholarship*, 31(4), 317-322.
- Roy, C. (1991). *The Roy adaptation model: The definitive statement*. McGraw-Hill/Appleton & Lange.

Shimotsu, S., Karasawa, K., Kawase, E., Ito, K., Saito, A. I., Izawa, H., & Horikawa, N. (2010).

An investigation of anxiety about radiotherapy deploying the Radiotherapy Categorical Anxiety Scale. *International journal of clinical oncology*, *15*(5), 457-461.

Spielberger, C., 1983. *Manual for the State-Trait Anxiety Inventory*. Consulting Psychologists Press, Palo Alto, CA.

Sulé-Suso, J., Finney, S., Bisson, J., Hammersley, S., Jassel, S., Knight, R., ... & Collins, D.

(2015). Pilot study on virtual imaging for patient information on radiotherapy planning and delivery. *Radiography*, *21*(3), 273-277.

van Strien, A. M., Koek, H. L., van Marum, R. J., & Emmelot-Vonk, M. H. (2013). Psychotropic medications, including short acting benzodiazepines, strongly increase the frequency of falls in elderly. *Maturitas*, *74*(4), 357-362.

Zhao, X., You, X., Shi, C., & Gan, S. (2015). Hypnosis therapy using augmented reality technology: treatment for psychological stress and anxiety. *Behavior & Information Technology*, *34*(6), 646-653.

## Appendix A Data base search results

<b><u>Key words</u></b>	<b><u>Yield</u></b>
<b><u>CINAHL</u></b>	
anxiety	54, 848
+ radiation oncology	2,146
anxiety + cancer patients or oncology patients	6,241
cancer patients + anxiety + radiation	137
education + virtual reality + anxiety	7
cancer patients + virtual reality	30
cancer patients + virtual reality + radiation	5
<b><u>PubMed</u></b>	
anxiety	63,000
radiation therapy	151, 412
cancer patient	3,281
cancer patient + oncology + radiation/radiation therapy	375, 713
cancer patient + oncology + radiation/radiation therapy + anxiety	1,293
anxiety + cancer patients + oncology + radiation	
+ reality therapy/augmented reality/virtual reality	78
<b><u>PsychINFO</u></b>	
anxiety + radiation	357
anxiety + cancer patients	43
anxiety + radiation + cancer patients	82
anxiety + radiation + cancer patients + situational anxiety	2
anxiety + radiation + cancer patients + virtual reality	2
anxiety + radiation + cancer patients + alternative therapies	4

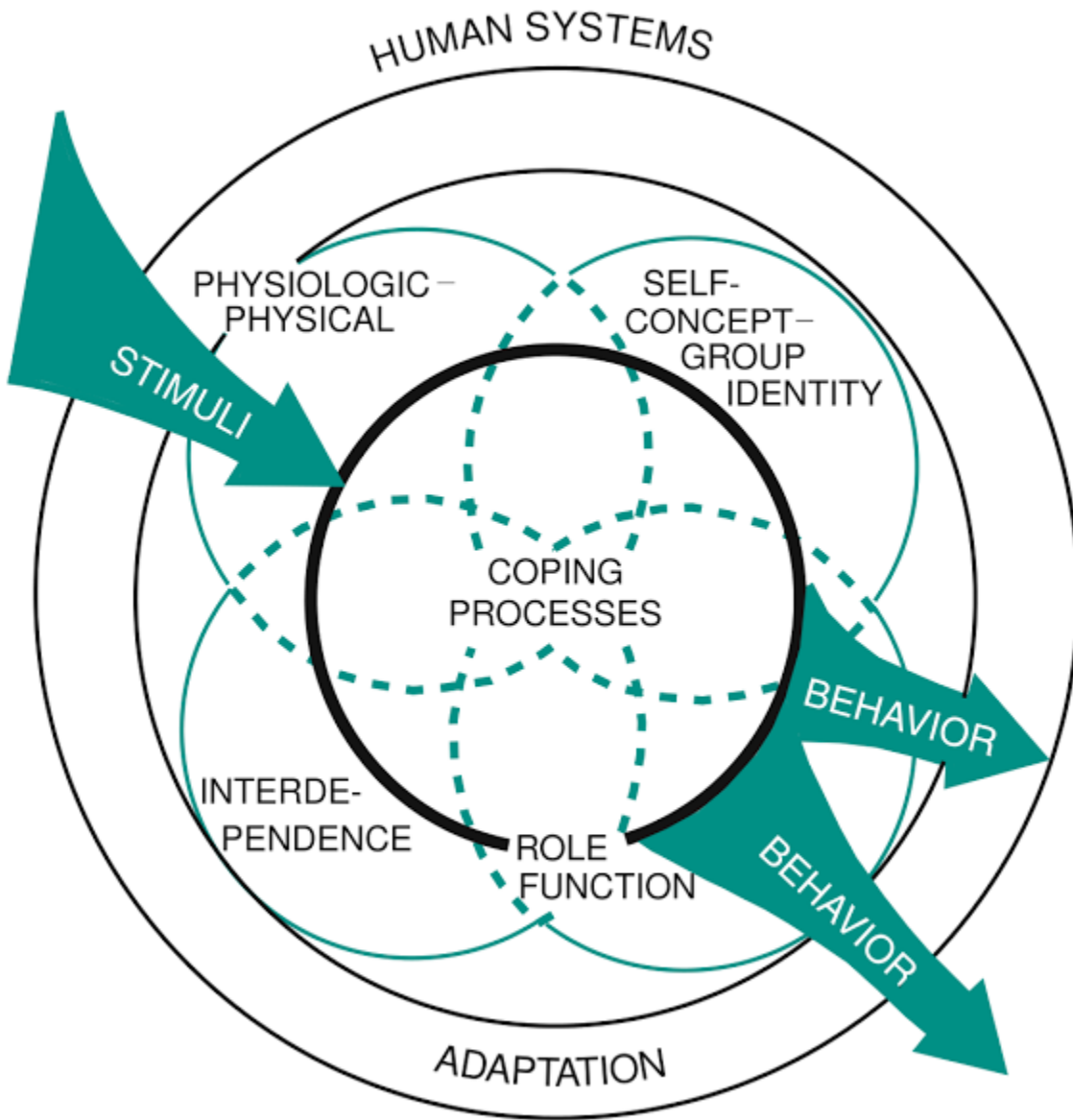


Appendix B Synthesis Table

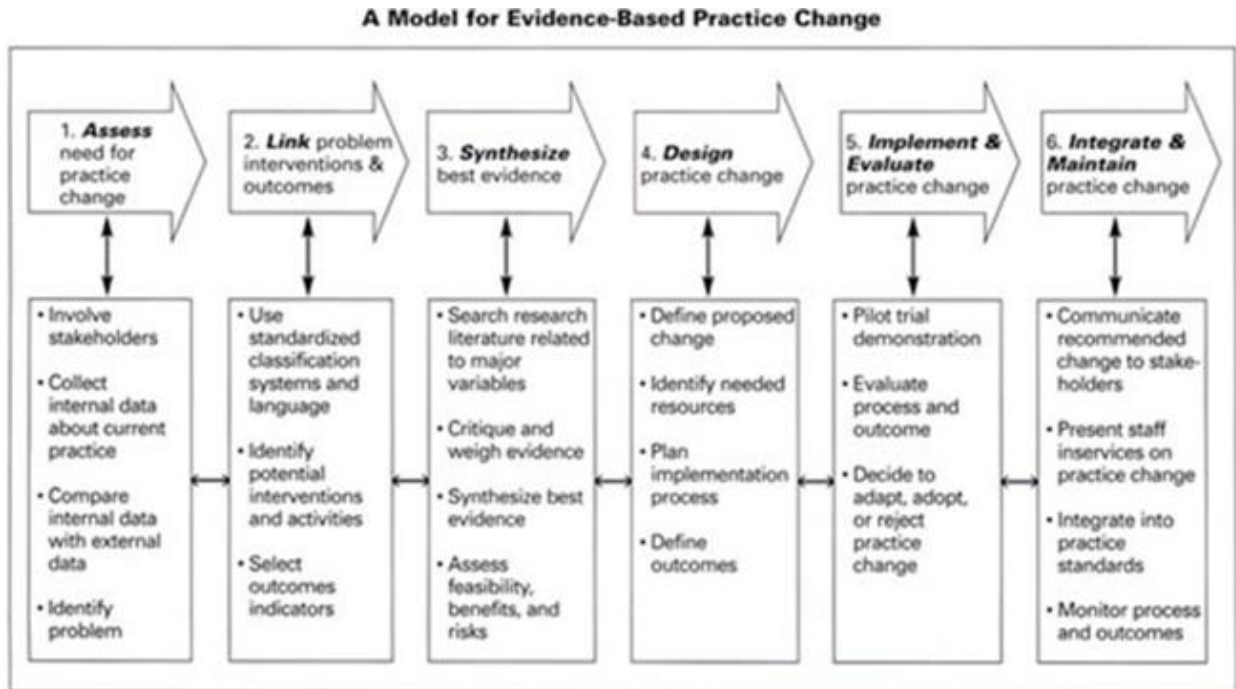
	Year of Study	Level of Evidence	Type of Study	Instrument	Control	N	n	IV	Anxiety	Radiation patients	Cancer patients
Banos	2013	II	RCT	VAS	No	NA	19	VR	Dec	No	Yes
Chen	2013	III	Quasi-Experimental	STAI	Yes	NA	200	Music	Dec	Yes	Yes
Chirico	2016	I	Systematic Review	STAI	Yes	19 RCT	NA	VR	Dec	No	Yes
Gou	2013	II	RCT	SDS & SAS	Yes	NA	178	Psycho-therapy	Dec	No	Yes
Li	2012	II	RCT	STAI	Yes	NA	120	Music	Dec	No	Yes
McCann	2014	I	Systematic Review	NA	Yes	27 RCT	1080	VR	Dec	No	No
Opris	2012	I	Meta-Analysis	NA	Yes	23 RCT	397	VRET	Dec	No	No
Shimotsu	2010	VI	Mixed methods	RCAS	No	NA	382	NI	N/M	Yes	Yes
Sule-Suso	2015	V	Qualitative	Open- Ended Questionnaire	No	NA	150	VR/VI	Dec	Yes	Yes
Zhao	2015	II	RCT	SAS	Yes	NA	49	Hypnosis & AR/VR	Dec	No	No

**AR:** Artificial Reality, **Dec:** Decrease, **Inc:** Increase, **Info:** Information Provided to Patients, **IV:** Independent Variable, **NA:** Not Applicable, **N:** Number of Studies Reviewed, **n:** Number of Patients in study, **NI:** No Intervention, **N/M:** Not Measured, **RCAS:** Radiation Categorical Anxiety Scale, **RCT:** Randomized Control Trial, **SAS:** Self Rating Anxiety Scale, **SDS:** Self Rating Depression Scale, **STAI:** State Trait Anxiety Inventory, **VAS:** Visual analog scale, **VI:** Virtual Imaging, **VR:** Virtual Reality, **VRET:** Virtual Reality Exposure Therapy

Appendix C Roy's Adaptation Model



Appendix D Evidence Based Model (EBP) figure.



Source: Rosswurm & Larabee, 1999.

## Appendix E t-test results

State anxiety scores before and after virtual reality video intervention.

<b>Variable</b>	<b>Pre virtual reality video</b>		<b>Post virtual reality video</b>	
	n	m(SD)	n	m(SD)
<b>State anxiety score</b>	40	32.65(11.47)	40	25.50(8.95)

$p \leq 0.001$