

# Virtual Reality: A Distraction Intervention for Chemotherapy

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ONS Excellence in Cancer Nursing Research Award

**Purpose/Objectives:** To explore virtual reality (VR) as a distraction intervention to relieve symptom distress in adults receiving chemotherapy treatments for breast, colon, and lung cancer.

**Design:** Crossover design in which participants served as their own control.

**Setting:** Outpatient clinic at a comprehensive cancer center in the southeastern United States.

**Sample:** 123 adults receiving initial chemotherapy treatments.

**Methods:** Participants were randomly assigned to receive the VR distraction intervention during one chemotherapy treatment and then received no intervention (control) during an alternate matched chemotherapy treatment. The Adapted Symptom Distress Scale–2, Revised Piper Fatigue Scale, and State Anxiety Inventory were used to measure symptom distress. The Presence Questionnaire and an open-ended questionnaire were used to evaluate the subjects' VR experience. The influence of type of cancer, age, and gender on symptom outcomes was explored. Mixed models were used to test for differences in levels of symptom distress.

**Main Research Variables:** Virtual reality and symptom distress.

**Findings:** Patients had an altered perception of time ( $p < 0.001$ ) when using VR, which validates the distracting capacity of the intervention. Evaluation of the intervention indicated that patients believed the head-mounted device was easy to use, they experienced no cybersickness, and 82% would use VR again. However, analysis demonstrated no significant differences in symptom distress immediately or two days following chemotherapy treatments.

**Conclusions:** Patients stated that using VR made the treatment seem shorter and that chemotherapy treatments with VR were better than treatments without the distraction intervention. However, positive experiences did not result in a decrease in symptom distress. The findings support the idea that using VR can help to make chemotherapy treatments more tolerable, but clinicians should not assume that use of VR will improve chemotherapy-related symptoms.

**Implications for Nursing:** Patients found using VR during chemotherapy treatments to be enjoyable. VR is a feasible and cost-effective distraction intervention to implement in the clinical setting.

## Key Points . . .

- ▶ Virtual reality is feasible to use as a distraction intervention during chemotherapy treatments and is well accepted by patients.
- ▶ Virtual reality alters the perception of time, making treatments seem shorter.
- ▶ Clinicians should not assume that the use of virtual reality will improve chemotherapy-related symptoms.

associated chemotherapy-related distress symptoms, patients often have difficulty adhering to the prescribed schedule. Developing interventions to assist people to better tolerate cancer treatments and, therefore, increase their chances for survival is an oncology nursing priority and a major focus of oncology nursing research.

The specific aim of this study was to determine the immediate and long-term effects of a virtual reality (VR) distraction intervention on symptom distress levels in adults with lung, colon, or breast cancer receiving IV chemotherapy. Specific research questions included whether measurements



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Digital Object Identifier: 10.1188/07.ONF.39-46

Cancer continues to be a major health problem in the United States. Chemotherapy is prescribed either prior to or after surgery in an attempt to diminish tumor mass, eradicate occult micrometastatic disease, and increase disease-free survival. The chances for survival are enhanced if patients receive all of the recommended chemotherapy treatments for their specific disease. However, because of

of symptom distress levels would be lower immediately following chemotherapy treatments in adults who received a VR distraction intervention versus no VR intervention, whether a VR intervention mitigates chemotherapy-related symptoms during the initial 48 hours following a chemotherapy session, and whether the type of cancer, age, gender, or sense of presence influences the effectiveness of a VR intervention on relieving symptom distress.

## Background

### Chemotherapy-Associated Symptoms

Cancer is a leading cause of morbidity and mortality in adults; one of every two men and one of every three women in the United States will develop cancer in their lifetime. The most common types of cancer are breast, lung, colon, and prostate (Jemal et al., 2006). Standard treatment often involves neoadjuvant or adjuvant chemotherapy administered via IV in several matched cycles two to four weeks apart. However, physical symptoms often begin during the administration of chemotherapeutic agents. Common symptoms include nausea, vomiting, and fatigue, as well as anorexia, pain, and sleep disturbances (Miaskowski & Lee, 1999; Payne, 2002; Rhodes & McDaniel, 2001; Sarna, 1998; Visovsky & Schneider, 2003). As a result of chemotherapy, patients with cancer frequently experience changes in mental state, manifested as feelings of depression, helplessness, anxiety, and difficulty in concentrating (Cimprich, 1999; Coons, Leventhal, Nerenz, Love, & Larson, 1987; Munkres, Oberst, & Hughes, 1992). Symptom distress or discomfort stemming from symptoms interferes with a person's ability to perform activities of daily living and affects quality of life (Cimprich; Grant, 1997; Macquart-Moulin et al., 1999; Pickett, 1991).

Adherence to prescribed chemotherapy treatments is extremely important. Decreased dosages or interruption in treatments can diminish the chances for long-term remission or cure. Symptom distress is a major cause of morbidity and a reason why patients with cancer discontinue treatments prematurely (Dodd, Miaskowski, & Paul, 2001; Watson & Marvell, 1992). Therefore, developing interventions that enable people to better tolerate chemotherapy, improve their quality of life, and increase their chances of survival is critical. One such intervention may be distraction, which is an emotion-focused coping strategy.

### Theoretical Model

The present study used Lazarus and Folkman's (1984) stress and coping model as a theoretical framework. Lazarus and Folkman defined stress as a relationship between a person and the environment that the person evaluates as taxing or exceeding available resources and threatening well-being. Coping responses reflect the thoughts and activities that people use to manage stressful situations. Lazarus and Folkman noted that individuals turn to emotion-focused coping strategies when they perceive that nothing can be done to change a threatening condition. Emotion-focused strategies include changing thoughts, making positive comparisons, and finding positive value in negative events. Distraction is an emotion-focused coping strategy because it diverts the focus of attention away from unpleasant stimuli by manipulating the environment. Distraction interventions are effective because individuals can concentrate on pleasant or interesting stimuli instead of focusing on unpleas-

ant symptoms. Techniques such as humor, relaxation, music, imagery, and VR all are classified as distraction interventions, and they can relieve physical symptoms such as pain, anxiety, nausea, and stress. Distraction also can alleviate psychological symptoms (Kolcaba & Fox, 1999; Lerman et al., 1990). The current study evaluated the theoretical model by testing the premise that VR, as a distraction intervention, decreases the symptom distress associated with chemotherapy treatments in adults.

### Use of Distraction by Patients with Cancer

Vasterling, Jenkins, Tope, and Burish (1993) found that patients receiving chemotherapy who used a cognitive distraction or relaxation technique reported less nausea than a control group. The researchers randomly assigned 60 patients to one of three interventions: cognitive distraction, relaxation training, or no intervention. Patients were followed for five consecutive chemotherapy sessions. Those who used distraction or relaxation had significantly less anticipatory nausea and lower systolic blood pressure after chemotherapy than control patients. Ezzone, Baker, Rosselet, and Terepka (1998) found that music distraction was effective in reducing nausea and vomiting in patients receiving chemotherapy prior to bone marrow transplantation. Similarly, guided imagery significantly reduced discomfort in women with early-stage breast cancer (Kolcaba & Fox, 1999). Astin, Shapiro, Eisenberg, and Forsys (2003), who conducted a meta-analysis of mind-body interventions for chemotherapy symptoms, concluded that therapies such as relaxation and hypnosis should be considered as treatment adjuncts for patients with cancer because they show efficacy in improving mood, quality of life, and coping with the disease as well as treatment-related side effects.

Although several types of relaxation have been found to be effective as distraction strategies, interventions require patients to concentrate consciously and continuously on the distraction strategy; individuals cannot allow competing stimuli from the environment to dominate their awareness. In addition, many distraction interventions, such as imagery and progressive relaxation, require patients to practice the technique prior to contact with unpleasant stimuli, and, even with practice, some individuals are unable to divert their attention from unpleasant symptoms.

In a meta-analysis of interventions for symptom management, Smith, Holcombe, and Stullenbarger (1994) found that relaxation produced a poor result for management of nausea and vomiting. Similarly, Gross (1995), who compared the incidence and severity of symptoms in a relaxation and guided imagery intervention group with a cancer care instruction control group of women receiving chemotherapy for breast cancer, found no significant differences in symptoms between groups. One possible explanation for the finding was that maintaining a self-induced image or state of relaxation for longer than 20 minutes may have been too difficult for participants. Theoretically, interventions that are immersive and engage several senses simultaneously are better distracters (Schneider, 1998; Witmer & Singer, 1998). Therefore, because chemotherapy treatments can last for several hours, an intervention that provides images and is interactive is likely to be more effective than a passive distraction technique (Groer, Thomas, & Shoffner, 1992).

### Virtual Reality

VR offers the possibility of creating therapeutic environments for the assessment and treatment of medical conditions.

In 1993, Phillips predicted that the use of VR as a clinical tool would become an actuality in health care and that nurse researchers would need to evaluate nursing applications for this technology. Rizzo and Wiederhold (2000) defined VR as “an advanced interface that allows the user to ‘interact’ with and become ‘immersed’ within a computer-generated environment.” VR is a computer-simulated technique that allows individuals to hear and feel stimuli that correspond with a visual image by wearing a head-mounted device that projects the images and accompanying sounds. VR is interactive, causes people to become immersed, and engages several senses simultaneously (Arthur, 1992; Pratt, Zyda, & Kelleher, 1995). The sense of touch is involved through use of a computer mouse that allows manipulation of images. The head-mounted display portrays engaging images and blocks competing stimuli. VR does not require practice prior to use in the clinical setting, and the headset prevents individuals from focusing on competing stimuli (Witmer & Singer, 1998).

Studies have demonstrated that the effectiveness of virtual environments is linked to the sense of presence reported by individuals using VR equipment (Witmer & Singer, 1998). Presence is defined as “the subjective experience of being in one place or environment, even when one is physically situated in another” (Witmer & Singer, p. 225). Presence depends on the ability to focus (i.e., direct attention toward something), which is similar to distraction. Research suggests that people who have the capability or tendency to become involved or immersed (Witmer & Singer) as well as have a distancing coping style (Lerman et al., 1990) should benefit easily from distraction interventions.

Few tests have been performed using VR as a distraction intervention, and none has included a large sample. One of the few studies of VR explored the feasibility of using a virtual vision head-mounted display and travelogue tape as a distraction intervention for 50 adults undergoing a routine gastric laboratory procedure (Kozarek et al., 1997). Improved tolerance to the procedure, measured using a visual analog scale (VAS), was noted in 85% of patients. Ratings by nurses using the same scale confirmed that the distraction intervention was effective. The study, however, did not employ a control condition.

Using a randomized, control design with 30 subjects, Wint, Eshelman, Steele, and Guzzetta (2002) reported no statistically significant differences in VAS pain scores between adolescents with cancer who received VR as a distraction intervention during lumbar punctures and those who did not receive the intervention. However, an improvement was noted in VAS scores in the intervention group, and 77% of subjects who used the head-mounted display reported that VR was an effective distracter.

Schneider and Workman (1999) reported improvements in symptom distress when children used a VR distraction intervention during outpatient chemotherapy treatments, and their findings were reproduced in a sample of adult women receiving chemotherapy for breast cancer (Schneider, Prince-Paul, Allen, Silverman, & Talaba, 2004). Results of a series of pilot studies supported the premise that VR helps to mitigate chemotherapy-related symptoms. Most of the children (82%) and adults (94%) were able to use the headset without difficulty. Among women with breast cancer, analysis using paired t tests demonstrated a significant decrease in symptom distress and fatigue. Older adults experienced a significant de-

crease in anxiety. Researchers noted a consistent trend toward improved symptoms 48 hours later. In all studies, patients had an altered perception of time when using VR, validating its capacity for distraction. Evaluation indicated that VR was easy to use, more than 86% would use VR again, and participants experienced no cybersickness (i.e., symptoms associated with using VR equipment) (Schneider, 1999; Schneider, Ellis, Coombs, Shonkwiler, & Folsom, 2003; Schneider et al., 2004; Schneider & Workman, 2000).

Tse (2003) used a crossover design to test the effectiveness of VR with a sample of 33 adult Chinese patients during leg ulcer dressing changes. When subjects used the VR distraction intervention, pain intensity ratings on a VAS were significantly lower following the dressing changes. In Japan, Oshuga et al. (1998) developed the “bedside wellness system,” which allows bedridden patients to take a virtual walk through a forest. Images are portrayed on bedside screens, with corresponding sensations (e.g., bird sounds, cool breezes) produced by the system. A study with 20 healthy subjects suggested that the intervention helped people to relax, and the system now is being used with adult patients with cancer. Frere, Crout, Yorty, and McNeil (2001), who used a crossover design (N = 25) to test the distracting qualities of a head-mounted display during dental prophylaxis, found that fear and pain were reduced significantly during the distraction condition.

VR was more effective than Nintendo® 64 (Nintendo of America Inc., Redmond, WA) video games in controlling burn pain during dressing changes in a sample of 12 adults and children (Hoffman, Patterson, & Carrougner, 2000). Subjects reported that the environment created by the head-mounted device was more engaging than the flat-screen Nintendo images. In follow-up research using a sample of seven adults and children, pain ratings were compared during range-of-motion exercises. Pain was significantly lower when patients used VR than when they had no distraction. Furthermore, pain continued to be lower even with repeated use of VR, suggesting that the intervention was a true distracter, not just a novel experience (Hoffman, Patterson, Carrougner, & Sharar, 2001). Using a VAS, Hoffman et al. (2001) found that two adults who wore a VR helmet and experienced flying through a three-dimensional snow world had less pain than when they had no distraction or watched a movie. In a ground-breaking study reported in *Scientific American*, Hoffman (2004) demonstrated that VR changed the way that individuals interpreted pain signals in addition to significantly reducing pain-related brain activity. Functional magnetic resonance imaging demonstrated less pain-related activity in the five regions of the brain when subjects used VR. Now, VR also is being used to treat phobias, including the fear of flying (Wiederhold, Gervitz, & Wiederhold, 1998) and fear of heights (Rothbaum et al., 1995), and for rehabilitation of individuals with cognitive and functional impairments (Rizzo, 2002; Rizzo, Buckwalter, Neumann, Kesselman, & Thiebaut, 1998). With the increasing use of VR, conducting empirical studies to determine its efficacy is imperative.

## Methods

### Sample

Study participants were recruited from a comprehensive cancer center in the southeastern United States. The human



subjects review board and the protocol review committee of the comprehensive cancer center approved the study. Subject enrollment occurred over two-and-a-half years beginning in November 2002. Eligible subjects were identified (N = 191), and 123 individuals (64%) agreed to participate. The 123 adults were receiving initial chemotherapy for breast (52%), colon (16%), or lung cancer (33%). Twenty-three subjects did not complete the entire study. Reasons for attrition included a discontinuation or change in chemotherapy treatments, lack of willingness to complete questionnaires, or lack of willingness to complete data for the control condition following use of VR during the first chemotherapy treatment. Inclusion criteria were (a) first diagnosis of breast, colon, or lung cancer; (b) 18 years of age or older; (c) planned treatment, including at least two matched cycles of IV chemotherapy; (d) the ability to read and write in English and give informed consent; (e) no clinical evidence of primary or metastatic disease to the brain; and (f) no history of motion sickness or seizures. A sample size of 105 was determined to be sufficient to test the effectiveness of the intervention.

## Design

A crossover design was used to examine VR as a distraction intervention to relieve symptom distress in outpatients receiving chemotherapy and to determine the immediate and 48-hour post-treatment effect on symptom distress. Participants were randomly assigned to receive the VR distraction intervention during one chemotherapy treatment and to receive no intervention (control) during an alternate matched chemotherapy treatment. The within-subjects design allowed for control of chemotherapeutic agents, antiemetics, age, gender, and cancer diagnosis.

## Virtual Reality Distraction Intervention

VR is a computer-simulated technique that allows individuals who wear a head-mounted device to become immersed in scenarios through visual and auditory stimuli that they manipulate. For the current study, a commercially available headset (i-Glasses<sup>®</sup> SVGA Head-Mounted Display, i-O Display Systems, Menlo Park, CA) was used. The eight-ounce, head-mounted display portrays engaging images and blocks competing stimuli. Participants wore a VR headset during an IV chemotherapy treatment and chose from four possible CD-ROM-based VR scenarios: deep sea diving (Oceans Below<sup>®</sup>, CounterTop Software, Renton, WA), walking through an art museum (A World of Art<sup>®</sup>, CounterTop Software), exploring ancient worlds (Timelapse<sup>®</sup>, Hammerhead Entertainment, Encinitas, CA), and solving a mystery (Titanic: Adventure Out of Time<sup>®</sup>, Hammerhead Entertainment). Each scenario was long enough to last the duration of the chemotherapy infusion. Because the goal of the intervention was distraction, participants were free to change scenarios at any time.

## Instruments

The **Presence Questionnaire (PQ)** (Witmer & Singer, 1998) and the **Evaluation of Virtual Reality Intervention** were used to validate the distracting qualities of the intervention. The PQ, a 32-item questionnaire that uses a seven-point semantic differential scale with a midpoint anchor, measured the degree of distraction. Possible scores range from 19–133, with higher

scores indicating a greater sense of presence. The reliability of the PQ is 0.88 (Cronbach's alpha). Content and construct validity for the 19 scored items has been established (Witmer & Singer). The Evaluation of VR Intervention is an open-ended questionnaire that was used to elicit subjects' evaluation of the intervention, including the perception of time while using VR equipment. The questionnaire elicits responses about the ease of equipment use, length of time the equipment was used, scenario choices, effectiveness of VR as a distracter, and desire to use VR during future treatments. The questionnaire was reviewed by a panel of experts for content validity.

Symptom distress, defined as a general indicator of symptoms experienced by patients with cancer (McCorkle & Young, 1978), was assessed globally using the **Adapted Symptom Distress Scale–2 (ASDS-2)** by Rhodes, McDaniel, Homan, Johnson, and Madsen (2000). More specific measures of symptom distress included the **State Anxiety Inventory for Adults (SAI)** (Spielberger, 1983) and the **Revised Piper Fatigue Scale (PFS)** (Piper et al., 1998).

The ASDS-2 is an adaptation of the Symptom Distress Scale (McCorkle & Young, 1978) that measures symptom experience. The 31-item, Likert-type instrument measures patients' perceptions of the occurrence and distress of 14 symptoms commonly experienced by patients with cancer undergoing chemotherapy or radiation treatments. Total symptom experience scores range from 0–124. Content validity of the ASDS-2 is supported by the inclusion of symptoms reported by patients in research studies. The scale discriminates between healthy patients and patients with cancer (Rhodes et al., 2000). Internal consistencies using Cronbach's alpha in a sample of adult patients receiving chemotherapy or radiation therapy were 0.91 for the total experience scale, 0.76 for the distress subscale, and 0.90 for the occurrence subscale (Rhodes et al.).

The PFS is composed of 22 items on a 0–10 numeric scale. For a total score, the scores on all items are summed and divided by 22, with higher scores indicating greater levels of fatigue. Five open-ended questions provide information on symptom distress not captured in the quantitative ratings. The standardized alpha for the entire PFS with a population of patients with breast cancer was 0.97, and Cronbach's alphas for all of the subscales were greater than 0.92. Concurrent validity has been supported by significant correlations with the Profile of Mood States (McNair, Lorr, & Droppleman, 1971) and the Fatigue Symptom Checklist (Yoshitake, 1978).

The SAI was developed to measure transitory state anxiety in adults, including anxiety induced by stressful procedures (Spielberger, 1983). Patients rate each item on a Likert-type scale of 0–3. A total score of 0–60 is obtained by adding the scores for each item. The reliability and validity of the instrument are well established. Alpha reliability in a sample of women with breast cancer who used guided imagery during radiation therapy was 0.90 (Kolcaba & Fox, 1999). The instrument has convergent and discriminant validity (Spielberger, 1970).

## Procedure

Potential participants were identified through referral from medical oncologists and clinic nurses. Consent was obtained and the first set of questionnaires was completed while patients waited to begin their treatments. Following completion of the questionnaires, subjects were randomly assigned to receive VR during their first chemotherapy treatment (group A) or their

second chemotherapy treatment (group B) in a 1:1 ratio. During the control and VR intervention chemotherapy treatments, patients sat in a reclining treatment chair. Outpatient clinic nurses provided standard care, including teaching regarding the chemotherapeutic agents and side-effect management, obtaining IV access, administering antiemetic medications, administering chemotherapy, and providing instructions on home care. On average, each chemotherapy treatment lasted 45–90 minutes. Because the antiemetic medications and chemotherapeutic agents remained constant for each person during both chemotherapy treatments, the amount of time in the clinic was similar for the control and VR conditions. The chemotherapeutic agents, antiemetics, and pain medications prescribed to patients for the control and VR chemotherapy treatments were recorded.

For the chemotherapy treatment with VR, a research nurse demonstrated how to use the VR equipment and provided a brief explanation after IV access was obtained. The research nurse assisted the subjects with putting on the eight-ounce headset and recorded the time when the intervention was initiated (see Figure 1). Subjects used the equipment for 5–10 minutes to get accustomed to it, and then the clinic nurse administered the chemotherapy. If patients received vesicant chemotherapy, the nurse instructed them to report any burning or pain at the injection site. Patients were able to report symptoms while participating in VR. Participants continued using the equipment throughout the duration of chemotherapy administration.

For the control condition, clinic nurses followed all normal and customary nursing procedures. Subjects were free to participate in any activities they chose during treatment, such as watching television, conversing with others, or reading. These activities are considered standard practice in the outpatient clinic. The time and type of any distraction activities that subjects may have used during the chemotherapy treatment were recorded.

For the control and intervention conditions, individuals were asked to provide written responses to the ASDS-2, SAI, and PFS following the completion of chemotherapy and be-

fore leaving the clinic. Each study participant was given a set of questionnaires and instructed to complete them at home 48-hours postchemotherapy. Written responses were completed by the patient at home and reported to the researcher via telephone. The project director or principal investigator collected all necessary data.

## Data Analysis

Data for each subject was recorded on standardized data forms and then entered into a spreadsheet. The resulting file was imported into SAS 8.2 (SAS Institute Inc., Cary, NC) for data management and statistical analysis. To ensure data integrity, distributions (e.g., stem and leaf diagrams), summary statistics (e.g., minimums, maximums, means), and individual records were scrutinized. In initial analyses using baseline data, the researcher examined whether, despite randomization, treatment group was related to any dependent variable at baseline but found no evidence that this was the case. To analyze the research questions, a class of statistical models variously referred to as mixed models (Littell, Milliken, Stroup, & Wolfinger, 1996; Verbeke & Molenberghs, 1997), hierarchical linear models (Bryk & Raudenbush, 1992), and multilevel models (Goldstein, 1995) was used.

Descriptive statistics were used to analyze responses to the Evaluation of VR Intervention questionnaire. To determine whether an elapsed time compression effect was present, a dependent-samples *t* test was used to compare the mean amount of time that patients perceived they used the VR with the actual recorded time that the VR was used. The total score on the PQ was correlated with mean symptom distress (i.e., ASDS-2, PFS, SAI) scores immediately following chemotherapy treatments. Negative correlations would suggest that higher levels of interaction with the VR distraction intervention were related to lower levels of symptom distress.

## Findings

### Sample

The average participant was 54 years old, female, and Caucasian. Additional demographic variables are displayed in Table 1.

### The Intervention

Patients had an altered perception of time ( $p < 0.001$ ) when using the VR, which validates the distracting capacity of the intervention. When an average chemotherapy treatment lasted 58 minutes, participants reported that it only felt as though 47 minutes had elapsed while using the VR. Evaluation of the intervention indicated that patients believed the head-mounted device was easy to use, they experienced no cybersickness, 86% liked the VR intervention, and 82% would use VR again. However, analysis found no significant differences in symptom distress immediately or two days following chemotherapy treatments when participants used VR.

Table 2 presents means over time together with the results of significance tests based on the mixed regression models. As indicated in the last column of the table, treatment was unrelated to change in the ASDS-2 and the PFS. Time 2–time 1 decline was greater in the treatment group for both outcomes, but neither difference was of sufficient magnitude to be significant. Although the main effects of treatment also were nonsignificant for the SAI ( $p = 0.15, 0.94$ ), a significant



**Figure 1. Patient Using Virtual Reality in a Clinic**

*Note.* Reprinted with permission from Duke University Medical Center.

**Table 1. Sample Characteristics**

Characteristic	n	%
<b>Age (years)</b>		
Range = 32–78	–	–
$\bar{X}$ = 53.97	–	–
SD = 10.89	–	–
<b>Gender</b>		
Female	95	77
Male	28	23
<b>Diagnosis</b>		
Breast	64	52
Colon	19	16
Lung	40	33
<b>Race</b>		
Caucasian	112	91
Other	11	9

N = 123

Note. Because of rounding, not all percentages total 100.

crossover effect was present ( $p = 0.03$ ) for time 2–time 1 change. Among those who received VR first, the time 2–time 1 difference ( $-3.34$ ) was significant at 0.01.

Whether the effects of VR varied over measures of cancer diagnosis, age, and gender was examined. Results for all interactive tests were negative for all outcomes, indicating that the effects of VR do not vary across levels for these potential moderators. Significant ( $p < 0.01$ ) Pearson correlations were found between PQ and PFS ( $-0.296$ ) and SAI ( $-0.308$ ), suggesting that higher levels of interaction with VR were related to lower levels of symptom distress.

## Discussion

VR was found to be a distraction intervention that was feasible to implement in the clinic setting. The current study employed the largest sample to date using VR as a distraction intervention. Patients found the headset easy to use during

chemotherapy treatments. The intervention was noninvasive and cost effective. Assuming that a laptop computer, a VR headset, and the software last for one year and that two patients per day use the equipment, the cost per patient for a VR session is \$5–\$10. Wearing the head-mounted display resulted in a significant elapsed time compression effect, which helps to validate the distracting capabilities of the VR. Evaluation of the intervention indicated that individuals believed the head-mounted display was easy to use, and more than 82% of patients expressed an interest in using the VR again during subsequent chemotherapy treatments. Subjective data and patient evaluation of the VR experience support the hypothesis that the distraction intervention made chemotherapy treatments more tolerable. Perhaps helping patients to concentrate on pleasant scenarios and helping time to pass more quickly is a more realistic goal for the vulnerable population receiving chemotherapy treatments.

Analysis did not support the premise that VR as a distraction intervention decreases symptom distress associated with chemotherapy treatments for adults. No significant differences were found in measures of symptom distress immediately or two days following chemotherapy treatments. A consistent trend was noted toward improved symptoms on all measures immediately following completion of chemotherapy for participants using VR. The findings were unexpected and differ from previous VR pilot studies conducted by the authors. One plausible explanation is that the sample consisted of older patients with a variety of diagnoses, including lung cancer. Expecting a distraction intervention to mitigate the intense physical symptoms associated with the disease may not be realistic. In addition, the literature supports the notion that older patients may report less symptom distress (Dodd, Onishi, Dibble, & Larson, 1996), making detecting a difference in symptom distress as a result of the VR intervention less likely. The current study employed a single session of VR, whereas other distraction interventions that were found to alter symptoms tested the repeated use of music or imagery (Ezzone et al., 1998; Kolcaba & Fox, 1999). In the current study, which measured patients' symptoms as an outcome variable,

**Table 2. Statistical Results for the Virtual Reality Intervention**

Variable	Condition	T1			T2			T2 $\bar{X}$ to T1 $\bar{X}$ Change	T3			T3 $\bar{X}$ to T1 $\bar{X}$ Change	p <sup>a</sup>	
		$\bar{X}$	SD	N	$\bar{X}$	SD	N		$\bar{X}$	SD	N		T2–T1	T3–T1
ASDSTOT	All	23.12	12.41	214	19.74	11.89	214	–3.38	21.19	12.31	210	–1.93	0.43	0.35
	Treatment	23.64	12.91	107	19.86	12.57	107	–3.78	22.00	11.86	106	–1.64		
	Control	22.59	11.93	107	19.63	11.23	107	–2.96	20.37	12.76	104	–2.22		
SAITOT	All	38.50	12.54	214	33.46	11.06	213	–5.04	35.04	11.67	210	–3.46	0.15 <sup>b</sup>	0.94
	Treatment	39.07	12.96	107	33.23	16.48	107	–5.84	35.22	11.92	106	–3.85		
	Control	37.93	12.15	107	33.68	10.67	106	–4.25	34.86	11.47	104	–3.07		
PFSTOT	All	2.57	1.91	214	2.89	1.91	213	0.32	3.22	2.18	210	0.65	0.52	0.52
	Treatment	2.55	1.90	107	2.91	1.92	107	0.36	3.27	2.17	106	0.72		
	Control	2.59	1.93	107	2.87	1.90	106	0.28	3.17	2.21	104	0.58		

<sup>a</sup> Treatment versus control

<sup>b</sup> A significant treatment by period interaction ( $p = 0.03$ ) was present. Among those who received virtual reality first, decline in state anxiety ( $-3.34$ ,  $p = 0.01$ ) was statistically significant. Among those who received virtual reality second, no difference was found between the treatment and control groups.

ASDSTOT—Adapted Symptom Distress Scale total score; PFSTOT—Revised Piper Fatigue Scale total score; SAITOT—State Anxiety Inventory total score; T1—time before chemotherapy; T2—time immediately after chemotherapy; T3—time 48 hours after chemotherapy



patients did not experience cybersickness as a result of using the head-mounted display.

Analysis demonstrated a significant crossover effect. Individuals who received the VR during their first chemotherapy treatment had significantly less anxiety, compared with the control condition during the second chemotherapy treatment. The finding suggests that using the distraction intervention is most effective during the initial chemotherapy treatment, when patients are more anxious and less likely to have developed coping skills for the stressful situation. Future studies need to explore the timing of the intervention. VR may be useful as a cognitive-behavioral intervention to increase patients' self-efficacy in coping with cancer treatments. The findings also identified a relationship between higher levels of presence in the virtual environment and lower levels of fatigue and anxiety. The negative correlations suggest that more involvement with the distraction intervention was related to lower levels of symptom distress. The finding supports the premise that the immersive and interactive qualities of VR make it an effective intervention for management of chemotherapy-related symptom distress.

Limitations of the study included the single study site and the lack of standardized measures to capture satisfaction with use of the VR during chemotherapy treatment. The intervention was used only once with each patient, and determining

whether patients had enough exposure to the intervention to produce an effect on symptoms was not possible. A stronger "dosage" of VR may be needed. Future studies need to be conducted that explore the repeated use of the distraction intervention.

## Implications for Nursing

Patients found using VR during chemotherapy treatments to be enjoyable. The VR intervention is feasible and cost effective to implement in the clinic setting. The nonpharmacologic intervention appears safe and does not make symptoms worse. None of the subjects in the present study reported any unusual symptoms, such as dizziness, increased nausea, or visual disturbances. Like other treatments, the intervention should be used with caution. Clinicians should instruct patients to discontinue VR if any untoward reactions are experienced. The findings support the notion that using VR can help make chemotherapy treatments more tolerable, but clinicians should not assume that use of VR will improve chemotherapy-related symptoms.

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