Chapter 6
Exposure to Immersive Relaxing Virtual Environments for Hospitalized Patients

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ABSTRACT

Hospitalized patients are often characterized by various stress factors that can have an impact on their mental health and hospital experience. Improving the quality of life of these bedridden patients is an important task by relieving their anxiety, reducing their pain, and encouraging them in their fight against disease. Virtual reality has already been proved to be a novel and promising tool to improve the quality of life of hospitalized patients. Therefore, the purpose of this chapter is to focus on studies that gave evidence to the feasibility of virtual reality relaxation therapies for hospitalized patients, which virtual reality relaxation therapies are most used, and the benefits and limitations of this type of intervention.

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INTRODUCTION

Virtual reality (VR) as became more developed over the years (Figueiredo et al., 2021) by enabling patients to immerse themselves in virtual settings, which serves as a mimic of real-world experiences, and becoming more prevalent in the field of therapeutic therapy. (Bruno et al., 2022; Glantz et al., 2003; Rizzo & Kim, 2005).

Interactivity with media can give patients a sense of control, making it more enjoyable than passively watching television. It can produce simulated experiences of the real world that, to some degree, satisfy the desire to go out and experience the outside world. Some contents of VR would relax patients or empower them in their fight against diseases (Ohsuga & Oyama, 1998). The experience of VR may help users feel safer, more in control, and more comfortable than in outpatient therapy through direct visualization without the stress of real-world stimulation (Stetz et al., 2011). For people with limited access to nature (e.g., elderly in nursing homes, hospital patients, or prison inmates), even visual representations of nature can relieve stress and improve emotional well-being (Gamble & Howard, 2016; Leather et al., 1998; Maller et al., 2006; Tuena et al., 2020).

The mental state of hospitalized patients can be destabilized by various stressors. These individuals usually wage an uphill battle against illness, undergoing daily examinations, surgeries, and treatments (Ohsuga & Oyama, 1998). They suffer from pain and other symptoms. They are anxious about their current condition and diagnosis, as well as their future prognosis (Chang, 2019). A sudden illness can disrupt their life plans, so they usually need some time and support to accept the situation. Prolonged hospital stays isolates patients from the outside world (Chiarchiaro et al., 2013). It deprives them of their work, social activities, happy time with family and hobbies. Terminally ill patients suffer from fear of death, fear of even greater pain and financial burden, and worry about the future of their families (Ohsuga & Oyama, 1998). Such instability of mental state can disrupt physical homeostasis, leading to physical and psychological problems (OYAMA, 1998). The effects of these persistent psychological symptoms after acute illness are associated with long-term functional impairments, such as chronic pain (Brennstuhl et al., 2015). Therefore, the mental health care of bedridden patients is an important challenge for the medical institution (Ohsuga & Oyama, 1998).

The traditional focus of medical care has been on diagnosis, treatment, and clarifying the causes of illness. This has changed rapidly in recent years, and there is now more focus on improving patients' quality of life (QOL) (Oyama et al., 2000).

Improving the QOL of bedridden patients is an important task in the era of rapidly aging population. The experience of an acute life-threatening event is stressful, in and of itself, there is evidence that hospitalization exacerbate patients' psychological outcomes (Alzahrani, 2021; Chang, Carter, et al., 2016; Chang, Sumner, et al., 2016). Therefore, a new type of facility that improves their QOL by relieving their anxiety, reducing their pain, encouraging them in their fight against diseases, and facilitating their movement is needed to prevent the disuse syndrome caused by a long and immobile life in bed (Ohsuga et al., 1998). VR technology that allows to improve the interactivity and reality of the system is promising for this type of facility (Gershon et al., 2004; Hoffman et al., 2004; Mallari et al., 2019; Ohsuga et al., 1998; Ohsuga & Oyama, 1998).

Recommendations for an optimal medical environment is to promote early exercise, a comfortable environment, pain management, and good sleep. VR can be used by the care team to achieve some of these recommendations, promoting an optimal environment (Ong et al., 2020). Considering this, the purpose

of this chapter will focus on studies that gave evidence to the feasibility of VR relaxation therapies for hospitalized patients, which VR relaxation therapies are most used, and the benefits and limitations of this type of intervention.

MAIN FOCUS OF THIS CHAPTURE

Virtual Reality

VR is "a three-dimensional computer-generated 360° immersion provided by head-mounted display or stereoscopic glasses" (Guenther et al., 2022). It can create a multi-sensory experience using other devices such as headphones and optional haptic feedback, providing a perfect distraction and immersion in the "virtual world" (Guenther et al., 2022). Besides animated clips, 360° cameras can have the ability to simulate any existing place into a virtual environment, and it can be explored and followed with just head movements (Gigante, 1993; Guenther et al., 2022).

To understand better how VR works, it is important to define two words often used: "immersion" and "sense of presence". "Immersion" is an objective term referred to the amount of stimulation de VR system creates. A user's panoramic vision, resolution, richness, knowledge about the material, and shutting off other physical realities present in the surroundings are all part of what Slater (2018) refers to as immersion, which measures the degree to which computers allow interaction of the users to better represent reality (Slater, 2018). "Sense of presence" is a subjective term for the illusion that participant experience when using the VR system (Hoffman et al., 2006; McKinnon & Clarke, 2004). "Sense of presence", which "often involves a strong connection with the content and/or form of an experience," is the sensation of being engaged with virtual world representations (Donga et al., 2019; Lombard & Jones, 2015). This last one can be divided in two other concepts "Place Illusion" and Plausibility Illusion". The first one refers to the sense of being present in the virtual environment, and the second one, is the sense that the events that are being experienced in VR are actually happening (Freeman et al., 2017).

In addition to the ability of VR to create a sense of presence (Won et al., 2017) and capture the user's attention and emotions, VR has several other unique and appealing features, including the ability to control exactly what is presented to the client; the ability to tailor the treatment environment to each individual's needs; the ability to expose the client to a range of conditions that would be impractical or unsafe in the real world; and the ability to enhance confidentiality by replacing group treatment or in vivo desensitization, where one can be seen in treatment by others who can figure out what is going on (Glantz et al., 2003).

By combining numerous sensory stimuli through visual, auditory, tactile, and somatosensory systems, it can give the user possibilities to participate in a realistic environment that resembles real objects and events (Ahn & Hwang, 2019; Laakso et al., 2019; Laver et al., 2017; Murray et al., 2012). For these reasons VR, has lately emerged as a promising approach for pain management (Arane et al., 2017; Chan et al., 2018; Eijlers, Utens, Staals, De Nijs, et al., 2019; A. Li et al., 2011a; J. Li et al., 2020; Malloy & Milling, 2010), rehabilitation (Carrougher et al., 2009; Howard, 2017a), anxiety (Carl et al., 2019), phobias (Botella et al., 2017), and others.

Hospitalized Patients

The experience of transitioning from one location to another, from a familiar, predictable, and comfortable environment to an unexpected hospital environment, is part of the requirement for hospitalization during serious illness (Schumacher & Meleis, 1994). Given that it impacts the patients' wellbeing and fosters a feeling of vulnerability, this change may be quite distressing for the patients. According to a meta-synthesis, hospitalization and transfer are stressful, unpredictable, and frightening for patients (Uhrenfeldt et al., 2013).

Various stressors have the potential to destabilize the mental state of hospitalized patients. These people typically battle against the illness, enduring regular checkups, operations, and therapies (Ohsuga & Oyama, 1998). Surgery, radiation, chemotherapy, or other methods of treatment may be used alone or in combination. Due to the harsh side effects of these treatments, people may not follow advised programs (Macmillan, 2013). They frequently experience pain and other symptoms and they are concerned about their present health, their diagnosis, and their prognosis for the future (Chang, 2019; Voiriot et al., 2022). A sudden sickness can interfere with their plans for the future; therefore, they typically require some time and support to adjust. Patients become cut off from the outside world during extended hospital stays (Chiarchiaro et al., 2013). They are deprived of their jobs, social lives, enjoyable moments spent with friends and family, and interests. Patients who are nearing the end of their lives experience fear of dying, fear of additional suffering and financial load, and worry about the future of their family (Macmillan, 2013). Such mental instability can interfere with physical homeostasis, resulting in psychological and physical problems (Linden et al., 2012) and, consequently, poor QOL (Bours et al., 2016; Linden et al., 2012; Zajacova et al., 2015). Following an acute illness, these persisting psychological symptoms are linked to long-term functional deficits such chronic pain and others (Brennstuhl et al., 2015). It is common knowledge that higher levels of stress and worry can lead to lower pain tolerance and higher pain ratings. Anxiety levels that are higher can make it more difficult to express needs and establish positive patient-provider relationships. Additionally, increased situational anxiety may result in less satisfied patients (Walther-Larsen et al., 2019). Prior to undertaking difficult medical interventions, a patient's pain and/or anxiety must be appropriately managed to ensure patient compliance and a satisfactory outcome (Canbulat et al., 2014). As a result, the medical facility faces a significant problem in providing for the mental health of bedridden patients (Ohsuga & Oyama, 1998).

The experience of the patient is a significant consideration while evaluating the medical services (Doyle et al., 2013). It is the result of a number of variables (Bjertnaes et al., 2012) including the way in which treatment is delivered, how well patients are treated, how well they are coordinated, how they are admitted, how the hospital is set up, and how they are demographically and medically (Park et al., 2020). Previous studies had a specific goal in mind, such as exploring the experiences of patients in a particular setting or those who were elderly, or they were primarily concerned with validating the experiences of patients who were anxious or satisfied (Lee et al., 2020; Lilleheie et al., 2020; Péculo-Carrasco et al., 2020; Rathert et al., 2012). Furthermore, there not been many research that have particularly examined the experiences of components that define patient safety, despite the fact that there is a study on how doctors and nurses perceive patient safety (Lee et al., 2022).

The paradigm for providing medical services has begun to shift from one that is provider and disease-centered to one that is patient-centered (Doyle et al., 2013); World Health Organization, 2000). The management of safety-related hazards is the primary responsibility of medical service providers and healthcare systems since patient safety is a key determinant of the quality of healthcare. Without

ensuring patient safety, care may not be patient-centered and may result in unfavorable health effects (Vicent, 2010). Not only is high-quality healthcare vital for the operation of medical facilities, but it is also crucial for the wellbeing and comfort of patients (Campbell, 2020).

As previously said, being admitted to a hospital prevented the patients from experiencing the outdoors. Even so, people can find various means of connecting with nature while in the hospital (i.e., "breathe in some fresh air" or sat close to the window "to sense and enjoy" the view of the lake, trees, and other greenery). No matter the setting, the goal of being near nature seemed to be the same: the sights of nature soothed and divert them from unhappy thoughts and feelings (Rasmussen & Edvardsson, 2007; Timmermann et al., 2015). Other studies have shown that appealing sensory impressions in the hospital environment such as sunlight streaming through a window (Walch et al., 2005) or a film or pictures depicting natural scenery, all have a positive effect on the patients' pain and stress levels (Diette et al., 2003; TSE et al., 2002). An early study has suggested that a view through a window of natural settings is associated with a shorter stay in the hospital after surgery (Ulrich, 1984).

Additionally, the leisure activities created in the majority of therapies effectively decreased the levels of stress, anxiety, fear, and pain in patients by diverting them from negative thoughts and feelings. They also enhanced aspects like mood, behavior, communication, wellbeing, satisfaction, and hospital adaptability. The need for more training, more time, and more suitable areas for them to grow is one of the key obstacles to establishing hospital recreational activities. The development of leisure interventions while the patient is hospitalized is seen advantageous by medical specialists (Adam-Castelló et al., 2023). While studies confirm that patients would prefer different leisure activities if they were provided in hospitals, most adult hospitalized patients spend their free time watching television, reading, listening to music, etc (Bermúdez Rey et al., 2019).

To maintain their physical and mental welfare, hospitalized patients are encouraged to participate in leisure activities (Clarke et al., 2018). Therefore, nurses must support the promotion of leisure and the management of hospital resources in order to enhance patient-centered care and contribute to a better hospital experience (Van Rooyen & Janine, 2013).

VR can be a promising tool for creating opportunities to make patients more exposed to virtual nature, to participate actively in leisure activities significant for them, and many other interventions.

Virtual Reality in Hospitalized Patients

There are multiple techniques that can help reduce distress in the clinical settings such as the removal from the source of distress, the provision of a quiet and/or private space, being envolved in distractive tasks (e.g. colouring books) (Rajendran et al., 2020) and listening to quiet music (Hartling et al., 2013; Uman et al., 2008). Studies also have demonstrated that passive distraction modalities such as watching TV or playing games on a tablet, can relieve pain and anxiety (Henderson, n.d.). Its efficacy has been measured by biomarkers that demonstrate a diminution in body movement and reduce pulse, race, blood pressure and respiratory rate (Uman et al., 2008).

Nevertheless, these methods may not be always viable, especially in emergency departments (EDs), where bright lights, noise and constant movement are part of the normal functioning system. It has been raised a new preoccupation about the suitability of EDs to address the specific needs of adolescents and young adults (AYAs). Some concerns related to the ambience, the comfort and the extended waiting times in the EDs are being spoken out by the AYAs, referring, also, that thy would prefer the EDs to allow for access to adequate technology and entertainment (Fry et al., 2007; Rutherford et al., 2010).

Besides that, in the Intensive Care Unit (ICU) there are a lot of factors, such as immobility sensory impairment, pain and agitation that are commonly related to the increase of the risk of delirium (Morrison et al., 2003; Bruno et al., 2022). Plus, it is very common for critically ill patients to be given sedatives and analgesics for the management of anxiety and stress, which is also associated with the increased risk of delirium (Pandharipande & Ely, 2005; Tate et al., 2012). Given the lack of effective pharmacologic interventions to prevent or treat delirium, hospitals need non-pharmacological interventions that are safe, feasible, and easy to implement in the busy medical environment. VR may meet this demands and improve bedside treatment (Jawed et al., 2021).

Recently, the interest of using VR in the health sector has been increasing, with studies conducted in a large spectrum of clinical conditions, that include pain management (Eijlers, et al., 2019; Kenney & Milling, 2016), rehabilitation (Howard, 2017), anxiety (Carl et al., 2019), phobias (Botella et al., 2017) and post-traumatic stress disorder (Deng et al., 2019; Kothgassner et al., 2019; M. J. Park et al., 2019; Wechsler et al., 2019). Moreover, VR interventions have been proved effective in situations related to natural disasters (Zolfaghari et al., 2022).

VR has initially been effective in lowering pain and anxiety in hospitalized (Spiegel et al., 2019; Tashjian et al., 2017 (Mosadeghi et al., 2016),) and post-operative patients (Mosso-Vázquez et al., 2014) and it is well-tolerated by the patients when used for cognitive and motor rehabilitation (Dascal, Reid, IsHak, et al., 2017). VR may also be a useful adjunct for promoting mobility in critically ill patients who commonly undergo invasive procedures and experience pain and anxiety (Jawed et al., 2021).

VR has shown to decrease preoperative anxiety (Gerber et al., 2019) and can serve as a pleasant distraction during outpatient procedures (Slater & Wilbur, 1997). Furthermore, it decreases the mean pain score when used during procedures (Schubert et al., 1999). Prior studies successfully demonstrated VR to be an effective non-pharmacologic technique for reducing pain and stress in both burn and cardiac surgery patients (Hoffman et al., 2008; Mosso-Vázquez et al., 2014).

Within cancer care, it was reviewed that VR had a statistically significant positive effect in patients. This was substantiated by Bani Mohammad et al. (2019) which reported decreased pain and state anxiety levels post VR use by women with severe/chronic pain following breast cancer treatment (Bani Mohammad & Ahmad, 2019). However, a recent meta-analysis of cancer-related symptom management (Zeng et al., 2019) revealed that the only statistically significant impact was reduced fatigue levels. Other studies (Schneider et al., 2003, 2004) using VR reported positive results as a distraction technique during chemotherapy administration. The distracting character of VR was validated by other trials of more diverse cohorts that showed a significant influence on lowering perception of time when receiving chemotherapy (Schneider et al., 2011; Schneider & Hood, 2007).

Lee et al. (2023) realized a systematic review that showed that VR is a feasible and acceptable innovative method to reduce psychological distress and improve QOL in the place where the participants stayed (e.g., hospitals, ICU, workplaces, and home). This demonstrates that VR may be a viable and engaging method for bringing useful clinical interventions to hospitalized patients, healthcare professionals, and patients (Lee et al., 2023).

There are three major advantages when talking about VR, the first one is that it represents one way of addressing the limitations of imaginal exposure and overcomes the inability to engage in enough detail and affective level to recreate the traumatic events, the second one is that it is an appropriated tool for delivering patients' information. And the last one is that VR allows to truthfully, reconstruct phases of the treatment to replace and adjust possible delusional memories, which are the major contributors to psychological distress (Bekelis et al., 2017; Peri & Gofman, 2014).

The experience of negative sensations like anxiety or distress is reduced by VR's mechanisms such as active distraction and potential immersion in an alternative environment (Kenney & Milling, 2016). More specific, VR-based interventions engage cognitive resources through high multisensory stimulation, due to the immersion in a three-dimensional spatial environment, this produces positive responses in the autonomic nervous system, in real time (Cho et al., 2017; Melzack, 2001; Persky & Lewis, 2019).

To improve the effectiveness of VR content, it's essential to base its development on current knowledge of core psychopathology and psychological sciences. Previous studies have focused on displaying peaceful or pleasant images, such as natural landscapes, in immersive VR environments, without an active treatment component. The reason for this is that nature stimuli are readily available, safe for most individuals, can induce positive emotions effectively, and had the advantage of being universally available to a large population with heterogeneous symptoms (S.-A. Lee et al., 2023).

Combining visual and auditory stimuli in VR can be utilized to create an immersive experience that can decrease perceived distress and negative affect and promote relaxation and positive affect (Ebrahimi et al., 2015). This VR interventions are being developed for multiple psychological and psychiatric conditions (Helton, 2004; Marteau & Bekker, 1992). Also, adding tactile and olfactory components to VR will make it easier to create a more realistic VR environment for psychological therapies. Additionally, the way the VR intervention was designed may be to blame for the variations in efficacy in the domain across numerous research. The use of VR in customized medicine will be supported by interventions in VR that have been specifically developed to be more effective (Aminov et al., 2018; Groenveld et al., 2022). The benefits of VR relaxing for reducing psychological distress and high patient satisfaction have been demonstrated (S.-A. Lee et al., 2023).

Pain Management

Most patients in hospitals feel pain, which can be either acute or chronic (Li et al., 2017; Bruno et al., 2022). A physical damage causes acute pain, which might manifest slowly or fast. It can disappear after the injury heals after a few minutes to six months. Contrarily, persistent pain lasts longer than six months after the anticipated time for recovery (Swieboda et al., 2013). Cancer patients typically experience pain from the disease itself as well as pain from treatments like chemotherapy, radiation, and other painful procedures (Treede et al., 2015). Cancer pain has elements of both acute and chronic pain, prompting pain specialists to classify it separately (Berry. P. H et al., 2001). One of the biggest issues in healthcare is still dealing with the pain brought on by demanding medical procedures. Therefore, it is important for all healthcare organizations to comprehend the advantages of pain management throughout these medical operations (Ibrahim et al., 2021). (Bruno et al., 2022)

Pharmacological techniques primarily reliant on opioids are the approach to pain management that is most frequently utilized (Gamst-Jensen et al., 2014). However, these techniques' analgesic effects wear off with prolonged usage and may result in a variety of undesirable physical side effects as well as psychological consequences (Holtman & Jellish, 2012; Retrouvey & Shahrokhi, 2015). Therefore, non-pharmacological approaches are receiving a lot of attention from researchers as alternatives for treating pain associated with uncomfortable medical procedures (Retrouvey & Shahrokhi, 2015). Physical methods (such as positioning, pressure, hot and cold treatments, etc.) and cognitive-behavioral methods (such as guided imagery, relaxation techniques, and diversionary activities like music, reading, and video games) are examples of non-pharmacological approaches (Karabulut et al., 2016; Koller & Goldman, 2012; Olsen & Weinberg, 2017).

The most popular non-pharmacological therapy for pain management in recent years is distraction. Distraction is a useful approach that helps patients turn their focus away from uncomfortable stimuli in order to lessen their discomfort (Koller & Goldman, 2012). Melzack and Wall (1965) explained the logic of why distraction reduces pain. According to their belief, if the patient is kept properly distracted, their experience of pain will be diminished (Melzack & Wall, 1965). Given the effectiveness of distraction therapies, there is an increasing desire to suggest more immersive and interactive distraction strategies, including using VR to manage pain.

As a substitute for traditional pain intervention, VR distraction has become extremely popular in recent years. As a result, numerous effective trials have been carried out for treating a variety of psychological illnesses such phobias as well as managing pain during difficult medical operations (Ridout et al., 2021) as well as the treatment of many psychological disorders such as phobias (Emmelkamp & Meyerbröker, 2021). By immersing people in a virtual world, VR is redefining pain management by reducing it at the hospitals (Addab et al., 2022).

The usefulness of VR distraction for pain management has been the subject of numerous controlled studies in prior reviews of literature (Ibrahim et al., 2021). Pain relief through this technology has already been demonstrated as effective in several studies (Guenther et al., 2022; Gupta et al., 2018; A. Li et al., 2011) although, in order to get results, the participants experiencing virtual environments are required to have some mental capacity to distract themselves from the pain or painful stimuli (Gupta et al., 2018; Pourmand et al., 2018). Research showed reduced pain scores in acute and chronic pain when using VR-based therapies as a complementary adjunct or alternative non-pharmacologic analgesic (Ahmadpour et al., 2019; Chuan et al., 2021).

Physical therapy exercises, which are crucial both before and after treatment, can cause considerable agony in patients with severe burns. This might make it harder for patients, especially kids, to adhere to their physical therapy regimen (Ehde et al., 1998). Numerous successful controlled research with children and adults suggest that VR technology is gaining popularity as a substitute for controlling pain in teenagers with burn injuries (Joo et al., 2020). Results by Ibrahim et al. indicated that VR is a useful technique for easing pain in burn victims (Ibrahim et al., 2021). These findings, along with the accessibility of VR technology, have inspired authors to look at the potential of low-cost VR distraction. These outcomes are in line with those of Hoffman et al., who found that using VR during physical therapy resulted in patients experiencing less pain, less discomfort, and greater enjoyment. (Hoffman et al., 2014).

Ibrahim et al. (2021) also provided a number of research that demonstrated the effectiveness of VR distraction as an additional tool for pain management during medical operations. Additionally, their research confirmed that VR had analgesic effects on pain relief, that it was a more effective intervention than passive ones, and that immersive VR distraction reduced pain more than non-immersive VR (Ibrahim et al., 2021).

Contrary to acute pain, the length of chronic pain begins six months in advance and lasts through the anticipated healing time (Swieboda et al., 2013). There have been few research on the use of VR to treat chronic pain, despite the vast number of studies supporting the effectiveness of VR for treating acute pain (Gromala et al., 2016; Keefe et al., 2012). For instance, Chen et al.'s findings indicated that VR therapies can be used to successfully manage chronic pain (Chen et al., 2017).

Pain is frequently a side effect of both the disease and its therapy for cancer patients. Chemotherapy is currently the most used cancer treatment. However, physical side effects like exhaustion, discomfort, insomnia, and other symptoms usually begin during chemotherapy treatment sessions. As a result, cancer

patients commonly experience anxiety, depression, and helplessness, which causes them to forgo necessary treatments and reduces their chances of recovering (Ibrahim et al., 2021).

The management of chronic pain requires the use of efficient diversionary strategies. The impact of employing VR in treating chronic pain has, however, only been the subject of a small number of research investigations. The research reported by Ibrahim et al. (2021) demonstrated the value of using VR for a brief period of time. Investigating the effects of consumption over extended and repeated time periods is necessary since chronic pain is a persistent condition. Therefore, patients can benefit from VR distraction at home. Additionally, it's critical to conduct more research on how long VR's analgesic impact lasts (Ibrahim et al., 2021). However, some research indicates that although VR technology can be used to reduce pain, it has had limited success in raising pain tolerance, which may help to explain why it is less proved for managing chronic pain (Huang et al., 2022).

VR distraction could become a crucial tool for controlling and minimizing cancer pain. VR technology has proven to be a viable diversion tool with distinct qualities for reducing pain related to various medical and clinical procedures (Ibrahim et al., 2021).

The results of the research demonstrated that employing any kind of distraction is preferable to using none. Additionally, active distraction outperforms passive distraction in terms of effectiveness. Ibrahim et al. (2021) showed that using VR distraction techniques reduced pain intensity greatly because high-tech devices offer far more presence and immersion than low-tech ones. In other words, the analgesic impact increases with the quality of the VR system (Ibrahim et al., 2021).

Anxiety and Stress

It is very common for hospitalized patients to feel anxiety or stress or even both, due to various factors. So, it was felt the need to find ways to reduce and prevent those symptoms and make the stay in the hospital less stressful, and with it the new developing VR technology sounded like a good option to try. Studies concluded that the active distraction using VR reduces significantly the levels of anxiety and anger in patients in the ED (Sikka et al., 2019), most of the patients state that they feel "calm" or "relaxed" after the VR experience and related this feeling to the distraction or the immersion felt during the experience (Zolfaghari et al., 2022b).

VR relaxation has been shown to reduce anxiety and stress in children and adult patients in preoperative situations (Ganry et al., 2018; J. H. Ryu et al., 2017). For patients in postoperative situations, VR relaxation also represents a tremendous social impact, serving as an additional support mechanism for stress avoidance and reduction (Freeman et al., 2017). Additionally, how the VR system interacts with the virtual environment's dynamics will impact how effective emotion induction is (Wu et al., 2016). Patients in hospitals can benefit from VR's ability to alter subjective experience using it as a diversion from chronic or procedure pain or anxiety, or as a break in confined or stressful situations like hospital wards or emergency rooms (Dascal, Reid, Ishak, et al., 2017). It remains important to expand the applications of VR to improve the patient experience (Dascal, Reid, Ishak, et al., 2017). In Zhu et al. (2019) study, it was used VR relaxation sequences to demonstrate changes in the levels of relaxation before and after their intervention (Zhu et al., 2019). Additionally, Lee et al.'s (2017) study shown that VR content is highly successful in increasing patient satisfaction as well as having positive impacts on stress release and relaxation. The same study also shown how VR content can affect brainwave alterations, including an increase in theta waves in the frontal lobe and a decrease in alpha and beta waves, which are similar to those that occur while a person is resting peacefully (Lee et al., 2017). Bernaerts et al. (2022) have

suggested that VR can be used as a therapy for relaxation and diversion in pediatric hospitalized patients (Bernaerts et al., 2022). These results were in line with recent research that investigated the viability of the VR distraction (Agrawal et al., 2019; Birnie et al., 2018; Dunn et al., 2019). A general finding of the Osmayly (2019) trial was that a VR-relaxation intervention could improve the hospital experience and reduce anxiety and depressive symptoms (Osmaily, 2019).

Another tool that has gained power over the last years is the Mindfulness. This tool is very powerful when reducing emotional stress and increasing the overall well-being of the people who experience it. So, a VR-based mindfulness intervention showed to be more effective than passive distraction techniques at decreasing short-term anxiety during the hospital state. When the patients put the VR headset on, they are taken on a guided mindfulness journey. This "ride" allows the patients to follow a virtual character and slow their breathing so it can match the virtual character's tasks and allows them to focus and induce a calm-mindfulness state, mainly when they need to relief their anxiety and detract themselves from the ambient they are current in (Butt et al., 2022).

Other intervention is related to musical activities. Studies by Scheufler et al. (Scheufler et al., 2021) and West and Silverman in 2020 (West & Silverman, 2020) showed the same effective interventions. The first one is listening to the hospitalized patient's favorite music, the second one is actively creating music with instruments and the last one is listening to music at the same time as visualizing a guided imagery. These three interventions can be applied using VR and it was proven that the music takes a leading role in decreasing anxiety, promoting relaxation and inhibiting problems which is fundamental in hospitalized patients(Adam-Castelló et al., 2023).

There is one more intervention that is using natural VR landscape experience once studies done previously suggested that the visual exposure to natural environments can protect patients from environmental stressors and it also has a relaxing effect (Anderson et al., 2017; Gerber et al., 2017). Studies showed that the VR equipment can be safely used without interfering with the life support equipment with risk of only mild adverse effects and a very elevated level of acceptance by patients and ICU providers (Jawed et al., 2021). In order to determine which VR materials have the greatest effects on stress reduction and relaxation, Lee et al. (2017) performed a survey. In particular, woodland views were most frequently chosen as stress relief and relaxation tools in VR environments (C. Lee et al., 2017). Other naturalistic environments were also proved to reduce anxiety and stress (Beukeboom et al., 2012) and accompanied by natural noises may increase the stress-reducing effects (Annerstedt et al., 2013).

Related to this last topic, it is obvious that the view of the nature and the sunlight or daylight that pass through the windows are high valued by the patients as it allowed them to feel relaxed and peaceful and it brough joyful moments despite the situation they are in and how difficult and vulnerable it is. The patients describe these stimuli as positive distractions that allow them to escape from their negative thoughts, giving them a sense of hope and inner peace. Besides that, the view of the nature can bring good memories that involved relatives or significant others. The feeling that these memories left in the patient is positive and empowering. These experiences visualizing the nature can also bring memories that represent important parts of their life story and consequently their identity. Remembering these memories can be made with their loved ones which is significant and can invigorate their current life situation. Lastly these memories serve as a reminder for the patients that nothing and no one can change their past experiences and good times. The VR technology is a good way to bring back these memories and recreate environments that the patient is familiar with (Timmermann et al., 2015).

VR technology is allowing the patients to step out of their situation into a "safe space" which is very liked by the patients, inclusively they reported that the times passes by quickly during the intervention

and that the distractive qualities may be helpful during lengthy or perceived unpleasant procedures (O'Gara et al., 2022).

Sleep Deprivation

Other studies that examined the detrimental effects for hospitalized patients (Bakken et al., 2012; Bonnet, 1985; Bonnet & Arand, 2003; BOYKO et al., 2012; Martin et al., 2010; Tamburri et al., 2004) addressed the significance of inadequate sleep in hospitals.

Depending on the care population and setting, prevalence rates of poor sleep in hospitalized patients range from 47 to 67% (Meissner et al., 1998; Talih et al., 2018). As an illustration, it is estimated that 50% of all medical inpatients have trouble sleeping through the night (Southwell & Wistow, 1995) and that they sleep an hour and a half less on average than they do at home (Dobing et al., 2016). Given the rising body of research linking sleep deprivation to both immediate and long-term implications in hospitalized patients, this high incidence is concerning (Miller et al., 2019).

Sleep is critical for a good hospital experience as well as for preserving health, healing, and psychological functioning. Growth hormones, which are in charge of body renewal and repair, are mostly released when you sleep (Li et al., 2016; Sofi et al., 2014). Lack of sleep has negative effects on the body, such as lowered pain tolerance, immune system impairment (Irwin et al., 2016), delayed healing, confusion, disorientation and delusions (Li et al., 2016), as well as elevated blood pressure (Spira et al., 2014) and heart rate (Duclos et al., 2014). The longer-term effects include poorer performance in daily living tasks (Dobing et al., 2016; Irwin et al., 2016), decreased physical functioning after hospital discharge (Ho et al., 2017; Martin et al., 2011), higher overall mortality one year after discharge (Li et al., 2016) and increased susceptibility to mental health problems (Lee et al., 2017; Li et al., 2016; Sofi et al., 2014; Spira et al., 2014), such as delirium (Pace et al., 2018; Vin-Raviv et al., 2018). Sleep deprivation has been linked to delirium as well as other geriatric disorders including falls, which are common in hospitalized older patients (Stone et al., 2008). Hospitals have tried a variety of improvement techniques to improve the quality of patient sleep in their facilities as a result of these various negative effects (DuBose & Hadi, 2016).

Furthermore, in a variety of medical and psychiatric patients, poor, disturbed, or fragmented sleep while hospitalized is associated with higher impairment ratings at the time of release, poorer healthcare satisfaction, increased medical complications, and increased mortality rates (Duclos et al., 2014; Ho et al., 2017; Martin et al., 2011; Pace et al., 2018; Stewart & Arora, 2018; Vin-Raviv et al., 2018).

Environmental noise was the most often reported sleep-disturbing factor in a study by Adib-Hajbaghery et al. (2012), although lighting conditions had a bigger detrimental impact on sleep quality (Adib-Hajbaghery et al., 2012). Environmental circumstances were substantially linked with sleep quality (DuBose & Hadi, 2016). Hospitals usually point to noise as a significant factor in sleep disturbance. Studies on noise and sleep, frequently include high-quality, objective data on both environmental sound levels and sleep (Aaron et al., 1996; Elliott et al., 2013; FREEDMAN et al., 2001; Gabor et al., 2003; Park et al., 2014; Pimentel-Souza et al., 1996). The number of sound peaks and the number of arousals were found to be correlated (Aaron et al., 1996; FREEDMAN et al., 2001; Gabor et al., 2003). In older individuals, sleep problems can also be caused by acute sickness, pain, sadness, anxiety, and loss of social support (Stewart & Arora, 2018).

Noise and light have both been linked to poor sleep in hospitals (Adib-Hajbaghery et al., 2012; Redeker, 2000). Numerous research has found a direct link between hospital noise and sleep (Aaron et al., 1996;

Park et al., 2020; Pimentel-Souza et al., 1996). Through measures like quiet hours, hospitals have been able to lower noise and light levels (Gardner et al., 2009; Olson et al., 2001). Successful multifactorial solutions have often included reducing interruptions caused by nursing care tasks (Li et al., 2011; Norton et al., 2015; Patel et al., 2014), but rarely as a single intervention (Sheely, 1996).

Given that sleep is a state of non-responsiveness to environmental sensory cues, there are three main ways to support sleep: lowering the stimuli themselves; preventing the transmission of environmental sensory cues to the receiver; or lowering the brain's sensitivity to the stimuli. Simple tools (earplugs, eye masks) can be used to reduce the internal system's reception of environmental stimuli (Jones & Dawson, 2012; Le Guen et al., 2014; Richardson et al., 2007; Scotto et al., 2009; Yazdannik et al., 2014). Aromatherapy, massages, and midday light exposure are examples of relaxation techniques that can be used as part of lowering the brain's sensitivity to the stimuli to synchronize the circadian cycle (DuBose & Hadi, 2016).

In a hospital setting, sleep interventions would probably have a wide range of beneficial effects. Few research has concentrated on interventions in hospital settings, despite the rise in interest in sleep (Ferrie et al., 2011) and methods to promote sleep over the past two decades (Miller et al., 2019). Most of these research have focused on pharmacological intervention (Lenhart & Buysse, 2001). However, such interventions are restricted and may be contraindicated due to the adverse effects that some drugs have on weak hospitalized patients (Berry et al., 2013; Kolla et al., 2013), and it is recommended to avoid hypnotics and benzodiazepines in older persons due to an increased risk of delirium, falls, and fractures ("American Geriatrics Society 2015 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults," 2015). As a result, nonpharmacological therapies are thought to be the best first-line care for hospitalized patients (Lenhart & Buysse, 2001). However, two evaluations that looked into nonpharmacological therapies in hospital settings came to the conclusion that the quality of the available evidence was low or extremely low (Hu et al., 2015; Tamrat et al., 2014). Thus, it is unclear which non-pharmacological methods could enhance patients' sleep while they are in hospitals (Miller et al., 2019).

Regarding non-pharmacological therapies, there is compelling evidence for the beneficial effects of music on sleep (Ryu et al., 2012; Su et al., 2013; Zimmerman et al., 1996) and solid supporting data for the possibility that exposure to daylight light can lengthen sleep (Bano et al., 2014; Chong et al., 2013; Wakamura & Tokura, 2001; Yang et al., 2012). Although there is currently no data supporting the use of massage, relaxation techniques, or aromatherapy, these approaches may still be worth exploring further because they have been linked to several positive outcomes (DuBose & Hadi, 2016).

Conducting and interpreting studies including multiple therapies to enhance sleep is challenging. It is difficult to distinguish the effects of different tactics because the majority of the experimental study, as evaluated by DuBose et al., used a combination of strategies to enhance sleep for hospitalized patients (DuBose & Hadi, 2016). It can be draw the conclusion from the research that hospitals can improve their quality to promote better sleep (DuBose & Hadi, 2016).

VR can be viewed as a modern sleep problem intervention. The simple approach of giving patients eye masks and earplugs may be helpful, but improving the environment's sound and light levels is more efficient (DuBose & Hadi, 2016). Bright light exposure during the day as well as positive remedies like relaxing music in the evening have been demonstrated to be useful (DuBose & Hadi, 2016). A promising strategy for making these solutions easier and more practical to use in hospital treatment is VR. Although this is conceivable, more investigation is required.

Progressive muscular relaxation has also been shown to improve the self-reported quality of sleep (Alparslan et al., 2016) and put into practice guided imagery techniques, such watching calming music

videos (Wang et al., 2014; Zimmerman et al., 1996). VR has the capacity to immerse patients in tranquil virtual surroundings and play these soothing visuals with music, offering distraction from disruptions that may prevent them from getting a good night's sleep. As a result, VR can also be a facilitator in this type of interventions. This is reinforced by a study by Lee et al. that showed how VR meditation could improve hospitalized patients' sleep quality (Lee & Kang, 2020).

Raising patient satisfaction levels and enhancing healing may involve increasing awareness of the value of sleep in the hospital setting and implementing strategies to encourage a quiet environment and reduce sleep-disturbing elements (Mori et al., 2021).

FUTURE RESEARCH DIRECTIONS

Even though the use of Virtual Reality in the health sector has been increasing, there is still untapped potential to discover and is also necessary to better understand the best way to incorporate the VR technology as an effective tool in hospitalized patients, to manage symptoms like anxiety and distress (Lee et al., 2023). According to the research, VR distraction significantly reduces cancer-related pain and discomfort. Notably, the research cited suggest VR distraction as a promising addition to psychological and pain management. However, more investigation is required to establish the circumstances in which VR distraction will have more analgesic effects (Ibrahim et al., 2021).

Although the VR distraction therapy in ICUs seems feasible, not interfering with the life support equipment and not showing significant adverse events it is warrant for further research as a non-pharmacological intervention in the decrease of the pain, anxiety and delirium, all symptoms that can be felt by hospitalized patients (Jawed et al., 2021).

One of the limitations that was found on this research was the fact that some studies' results are based on self-reported data which can be criticized for validity, so, it is important diversify the kind of measurement used. Using objective measures, and psychological or behavioral data can be helpful to better collect and analyze the treatments outcomes(Lee et al., 2023; Miller et al., 2019). Other limitation was the fact that the duration of the intervention was inconsistent between studies which made it difficult to determine what is the optimal duration to maximize the outcomes and minimize the risk of adverse events (Lee et al., 2023). Plus, a long-term follow-up assessment is necessary to make sure that the treatment effect is enduring, or if this is not the case (Lee et al., 2023).

It is also interesting to understand who the most suitable person is to perform this kind of activity, whether it be the health professionals themselves, or someone from outside the institution (Adam-Castelló et al., 2023). Besides that, it is important to define the level of presence adequate for the participants to feel their experience as positive and beneficial (Jawed et al., 2021).

It is also important to actively compare the different interventions and determine the best treatment for all the specific settings, conditions and populations (Miller et al., 2019). The use of VR systems into stress reduction programs may assist to overcome some of the challenges associated with in-person interventions and may also provide a number of benefits, including improved adherence, easily accessible high-quality healthcare, and approaches for health prevention that are less expensive. The study that has been done so far on VR and stress should lay the foundation for future studies. In this regard, future researchers should establish rigorous study procedures and investigate VR aspects that are essential for enhancing VR's beneficial impacts on stressed people. The creation of theory-driven VR interventions and the assessment of their long-term impacts in comparison to other preventive programs should

therefore receive specific focus. Regardless of the circumstances, this will attempt to fully address the needs for mental health in the general population (Velana et al., 2022).

To create a successful preventative strategy, further research is required to examine environmental factors that can influence stress levels. The results of this study can encourage the use of VR for relaxing, but more research is required to see whether the effects last over the long term (Osmaily, 2019).

One of the most pertinent limitations to the use of virtual reality is motion sickness (Grassini & Laumann, 2020). Cybersickness "is triggered by conflicting signals between the vestibular, visual and proprioceptive systems" (Grassini et al., 2021). Besides having a lot of adverse effects like headache, eye strain, vertigo, disorientation, vomiting, nausea and others it is also very hard to predict because many factors contribute to its cause (LaViola, 2000). Research on the impact of the applicability of virtual reality and on the potentiating factors of uncomfortable effects such as cybersickness, underlying causes and the relationship between some variables such as gender, frequency, duration, position, among others, would be a promising guideline for clinical practice, future research and essentially to improve the participant's experience in VR experience.

To conclude, more studies are necessary to provide a more general picture of all the research to date and make more suggestions to improve the quality of future research in the use of VR-based therapies in hospitalized patients (Lee et al., 2023).

CONCLUSION

The purpose of this chapter was to analyze studies that gave evidence to the feasibility of VR relaxation therapies for hospitalized patients, which VR relaxation therapies are most used and the benefits and limitations of this type of intervention. VR has shown some good results in decreasing pain and anxiety and improving sleep quality of hospitalized patients. To reduce pain, this intervention works as a distraction method, that has been showed to be effective as a complementary adjunct or alternative non-pharmacological analgesic. Concerning anxiety and stress, resorting to interventions like mindfulness, music related activities, nature landscapes experiences and others, VR has shown positive results in reducing anxiety and stress in pre and post operative patients and make hospitalized patients feel in a "safe space" where the time passes by quickly. Lastly, referring to sleep deprivation, there are various factors that influence the quality of sleep in the hospital environment, and using VR interventions that can immerse patients in pleasant and enjoyable surroundings, improve patients sleep quality.

Overall, immersive relaxation experiences through virtual reality help reduce the physical and mental suffering process during hospitalization, contributing significantly to the release of negative emotional states. The ability to transport patients to other temporal and spatial spaces is a crucial factor in stabilizing pathological conditions.

Therefore, it can be concluded that the application of immersive relaxation experiences through virtual reality represents a strong alternative to the induction of relaxation practices for hospitalized patients, even though it's still necessary to determine some factors for its application so that the best experience and greater results can be obtained.

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KEY TERMS DEFINITIONS

Hospitalization: The act of being admitted to a hospital caused by a short- or long-term illness.

Mental Health: A state of well-being in which the individual is able to use his or her own abilities, recover from stressful situations, be productive and participate in the community.

Pain: Negative feeling or unpleasant sensory or emotional experience, having a negative impact on the person's quality of life.

Quality of Life: It's the individual perception of their personal, emotional, psychological and social well-being.

Relaxation: Set of techniques aimed to ensure the well-being of the individual, through the relief of physical, mental and emotional stress.

Sleep Deprivation: Condition where the individual doesn't get enough sleep for their body to recover.

Stress: Disparity between the demands that the person is presented and the person's ability to adapt to them.

Virtual Reality: Technology, generated by computers, that allows the participants to be immersed in a virtual environment by displaying scenes and objects that look real.