



How Virtual Reality (VR) is Revolutionizing Rehabilitation

By: Dr. Kathleen Weissberg, MS, OTD, OTR/L, CMDCP, CDP, CFPS, CGCS
National Director of Education, Select Rehabilitation

Statistics by 2050

Conventional rehabilitation therapies (physical, occupational, and speech therapy) are shedding their traditional skin and using virtual reality in therapy sessions to help patients achieve their goals. But, what is virtual reality and does it really work?

By 2050 the world population is projected to reach 9.7 billion people, with older adults older than age 65 accounting for approximately 16% of the total population. Increased life expectancy implies a higher risk of developing various chronic diseases, including cardiovascular diseases, cancer, dementia, osteoarthritis, and stroke. Seniors are more likely to have issues with falls and cognition as well.

Balance and gait are crucial factors for the well-being of elderly individuals. Around 13% of adults aged 65 to 69 experience issues with balance, a number that increases to 46% for those over 85 years old. Similarly, it is estimated that 35% of non-institutionalized adults over 70 years of age have gait disorders, which increases their risk of institutionalization and death by 2.2 times compared to those without these disorders. Additionally, balance and gait disturbances are associ-

Balance and gait are crucial factors for the well-being of elderly individuals. Around 13% of adults aged 65 to 69 and 46% of those over 85 years old experience issues with balance.

ated with a higher risk of falls. About 1/3 of non-institutionalized adults over 65 years old experiences one fall during the year. Injuries from falls, particularly hip fractures, significantly contribute to the mortality burden of elderly individuals and represent the leading cause of injury related accidental death among those aged 65 or older.

Cognitive impairment occurs in the elderly for a variety of reasons, some of which include CVA, TBI, depressive “pseudo-dementia”, and benign senescent forgetfulness. Of the general population, approximately 600,000 Americans suffer a new or recurrent stroke and 1.5 million experience a head injury each year. Cognitive decline in the elderly is prevalent, with about two-thirds of Americans experiencing some level of impairment by age 70. According to a 2022 Columbia University study, 10% of US adults over 65 have dementia, and 22% have mild cognitive impairment.

Virtual reality therapy is currently being used to address physical and cognitive dysfunctions in elderly populations. Virtual reality is a novel and innovative technology, which immerses individuals in a computer generated, multi-sensory, 3-dimensional world wherein they interact with the virtual environment using a headset or exercise equipment. **Virtual reality therapy has shown significant improvements when used to address function, cognition, exercise, ADL, and motivation.**

Virtual Reality's Impact

Impact on function:

Rehabilitative services are given to individuals when movement and function are affected by age, injury, pain, illness, disorders, situations, and environmental influences. The notion is that functional movement is essential to living a healthy lifestyle. Numerous studies have found that virtual reality can help individuals with stroke, traumatic brain injury, and cerebral palsy improve their functional ability as they recover. Studies have proven the effectiveness of virtual reality in a variety of conditions, including a variety of neurological and musculoskeletal disorders, to improve balance, coordination, acute and chronic pain. Virtual reality makes it possible

Conventional rehabilitation therapies (physical, occupational, and speech therapy) are shedding their traditional skin and using virtual reality in therapy sessions to help patients achieve their goals.

to practice activities within enriched, secure and challenging environments. Through immersive virtual reality technology, multisensory stimulation is greater and can enable better sensory motor integration of performed tasks. In general, virtual reality exercise has demonstrated positive effects on components of older adults' motor ability by engaging older adults motor skills and promoting sensory motor learning and cortical plasticity to improve motor ability. Systematic reviews demonstrate that use of virtual reality can lead to improvements of physical and functional abilities in older people, including strength, gait, range of motion, and balance.

Exercise:

The use of virtual reality using interactive games as a complementary tool in rehabilitation has been a frequent focus of research since the late 1990s. Many studies suggest that exercise using virtual reality in elderly patients promotes improvements in mobility, muscular strength of the lower limbs, imbalance control, and reaction time. Use of virtual

Virtual reality makes it possible to practice activities within enriched, secure and challenging environments. Through immersive virtual reality technology, multisensory stimulation is greater and can enable better sensory motor integration of performed tasks.

reality and exergaming has been shown to help prevent falls by optimizing motor learning by combining physical and cognitive demands in an attractive and interactive way, motivating players to focus their attention not on the movements themselves, but on the outcome of the movements in the game. Moreover, compared to conventional balance and exercise training, virtual reality therapy exhibits superior outcomes for static and dynamic balance, gait disorders, low back pain, posture, range of motion, and lower limb strength in this population. Its use has been proven to increase adherence to an exercise program by over 30% compared to conventional exercise therapies.

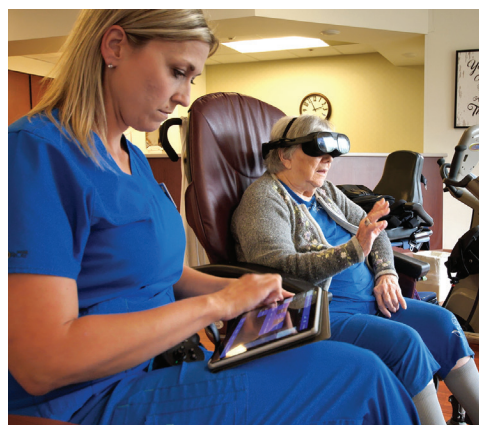
Cognition:

Virtual reality has emerged as a potentially valuable tool in the field of cognitive intervention for those with mild cognitive

impairment and various types of dementia, offering real and ecologically valid demands to stimulate neuroplasticity and enhance regenerative processes. Studies have shown that users of virtual reality training had consistent improvements in attention, executive function, visual and verbal memory, and memory strategy. Furthermore, virtual reality has been found to promote language, executive function, short term and working memory. Favorable psychological effects, including a reduction in depressive symptoms and anxiety are also apparent. There is vast potential to use virtual reality technology in neuropsychological rehabilitation to improve quality of life and cognitive performance in older adults.

Activities of Daily Living (ADLs):

Research shows that virtual reality has high potential to help individuals improve performance of Instrumental Activities of Daily Living (IADL). There are 11 IADLs that are more complex and, as such, may present a challenge for some older adults. These include tasks such as care of others, care of pets and animals, child rearing, communication management, driving and community mobility, financial management, home



establishment in management, meal preparation and cleanup, religious and spiritual expression, safety and emergency maintenance, and shopping. Paper and pencil therapy has traditionally been utilized to address deficits in these areas, and while beneficial and validated, has presented difficulty in maintaining motivation.

IADL tasks are more complex and require participants to plan, organize, problem solve,

In general, virtual reality exercise has demonstrated positive effects on components of older adults' motor ability by engaging older adults motor skills and promoting sensory motor learning and cortical plasticity to improve motor ability. Systematic reviews demonstrate that use of virtual reality can lead to improvements of physical and functional abilities in older people, including strength, gait, range of motion, and balance.

and multitask in a spatial and visual context, making them particularly relevant for autonomous daily living. Virtual reality immersion provides a distraction free environment for participants to focus on completing these activities. In this way, virtual reality allows for the simulation of real-world environments in which one can safely interact in real time, providing an environment for patients to practice therapeutic tasks that would otherwise not be feasible in the real world due to resource limitations or safety concerns. When simulated with mixed reality, to which sensory feedback and proprioception were added, improvements have been observed in executive functions, planning, retention, rigid thinking, cognitive flexibility, attention, problem solving and specifically selective attention. In addition, increased retention of visual figurative material, general memory, visual spatial memory, and working memory, have been identified.

What does this mean for Rehabilitation?

Virtual reality immersion offers therapists and clients the ability to engage in higher level activities such as grocery shopping, safety awareness in a home environment, meal preparation and others, all without leaving the therapy clinic. For myriad reasons, the client may not have the means or ability to address these tasks "hands-on," and virtual reality fills this void.

The ecological component of these tasks makes them suitable for transferring what has been learned to the real world, emphasizing the potential benefits of these interventions for improving activities of daily living. These positive effects of virtual reality are even more noticeable in individuals with cognitive impairments.

Motivation / Enjoyment:

One of the dangers of long-term rehabilitative therapy is when users become bored and lose interest in the exercises. Researchers have questioned, "Can an immersive virtual reality experience maintain engagement beyond the novelty? And show continued rehabilitative improvement when used in conjunction with traditional therapy?" The answer is, "Yes!!"

Traditional therapy may be stressful, uncomfortable, and daunting, leading to lower patient engagement and longer recovery time. Research overwhelmingly supports the use of virtual reality to improve cognitive function, attentiveness, and executive functions. Virtual reality can help with functional impairment, pain relief, balance, mobility, visual impairment, muscle strength, motor control, coordination, and range of motion.

It is reasonably well established that the rehabilitation process can become unnecessarily prolonged if the patient loses interest and if there is a paucity of human and technological resources. Additionally, rehabilitation professionals have long accepted the belief that engagement in meaningful activity contributes to human development and can enhance health and well-being. Virtual reality has the power to transform tedious, repetitive activities into more enjoyable, meaningful and engaging ones – all which can lead to improvement in patient satisfaction, involvement, realism, and attention during therapeutic sessions without regard to geography or time constraints. Virtual reality allows adjusting a training activity in a limited space without changing the surroundings physically. Virtual reality positively affects participants' motivation and enjoyment, ultimately leading to increased engagement with the therapy. Patients focus on the game during treatment, forgetting physical deficits and creating a pleasant experience. In fact, in one study, it was described that the elderly participant lost their sense of time as they were fully immersed in the virtual reality. Research has shown that engaging in a virtual environment during treatment can distract from pain and discomfort while motivating the user to achieve their therapy goals. In addition, virtual reality has been shown to be an effective way to provide therapy for individuals suffering from phobias, post-traumatic stress disorder, depression and other mental health concerns

Drawbacks to Virtual Reality

Are there drawbacks to virtual reality? Yes, in some cases. Some of the perceived drawbacks of using virtual reality, from the client perspective, include that the device may

Virtual reality immersion offers therapists and clients the ability to engage in higher level activities such as grocery shopping, safety awareness in a home environment, meal preparation and others, all without leaving the therapy clinic.

feel heavy, inconvenient, and it can be hot to wear. Some participants have experienced unwanted effects, including visual disturbances, disorientation, postural instability, nausea, headache, and postural discomfort, among others. Much of this can be mitigated by the amount of time the headset is worn. While no specific guidelines exist, the maximum duration for an immersive virtual reality session should not exceed 70 minutes, to avoid experiencing virtual reality induced symptoms and effects. In most published studies, the typical duration is approximately 30 minutes.

The current generation has higher rates of chronic disease and disability than any other and as the elderly population continues to grow, so does the demand for new and innovative solutions to tackle age-related chronic diseases and disabilities. Despite evidence for the health benefits of keeping active, low motivation is often a challenge when seeking to counteract physical inactivity and sedentary lifestyles, through exercise programs. This is where virtual reality can help! Through virtual reality, clients are able to elicit rehabilitative responses similar to traditional therapy, remain engaged, recover more quickly, improve function – and maintain gains long after therapy has ended.

Virtual reality remains a buzzword used to describe many types of immersive interventions from solving simple puzzles, immersing oneself in natural habitats, visiting another country, or simulating IADL. Interventions should be personalized to each participant to increase satisfaction and quality of life. Virtual reality systems are now of higher quality and lower prices than previously and are appropriate to address goals in many rehabilitative settings including outpatient, skilled nursing, home care, and others.

Virtual reality can help improve the cost, precision, and availability of therapy and despite variations in training protocols, can facilitate functional improvement and make therapy more enjoyable and encouraging. Novel technologies such as these, when used appropriately, demonstrate significantly more improvement than routine therapy alone and have the potential to solve some of the challenges currently seen in traditional therapy.

Virtual reality technology enables older adults to interact with the outside world in genuinely innovative ways that promote engagement, wellness, access, and above all, positive outcomes. As an adjunct to traditional therapy, virtual reality has the potential to have a positive impact on helping patients reach their goals. Is virtual reality coming to your therapy sessions? **The answer is probably yes.**

References

- Afzal, M., Ahmad, A., Bandpei, M., Gilani, S., Hanif, A., & Waqas, M., (2022). Effects of virtual reality exercises and routine physical therapy on pain intensity and functional disability in patients with chronic low back pain. *Journal of the Pakistani Medical Association*, 72(3), 413- 417.
- Buele, J., Varela-Aldas, J., & Palacios-Navarro, G. (2023). Virtual reality applications based on instrumental activities of daily living (IADLs) for cognitive intervention and older adults: A systematic review. *Journal of NeuroEngineering and Rehabilitation*, 20, 168.
- Campo-Prieto, P., Cancela-Carral, J., Alsina-Rey, B., & Rodriguez-Fuentes, G. (2022). Immersive virtual reality as a novel physical therapy approach for nonagenarians: Usability and effects on balance outcomes of a game-based exercise program. *Journal of Clinical Medicine*, 11.
- Dwarkadas, A., Talasila, V., Challa, R. & KGS. (2024). A review of the application of virtual and augmented reality in physical and occupational therapy. *Software: Practice and Experience*, 54(8), 1378-1407.
- Elor, A., Powell, M., Mahmoodi, E., Teodorescu, M., & Kurniawan, S. (2022). Gaming beyond the novelty effect of immersive virtual reality for physical rehabilitation. *IEEE Transactions on Games*, 14(1), 107-115.
- Foran, A. (2011). Learning from experience: Shared constructs in virtual reality and occupational therapy. *International Journal of Therapy and Rehabilitation*, 18(7), 362-369.
- Hoeg, E., Povlsen, T., Bruun-Pederson, J., et al. (2021). System immersion in virtual reality-based rehabilitation of motor function in older adults: A systematic review and meta-analysis. *Frontiers in Virtual Reality*, 2, 647993.
- Massetti, T., da Silva, T., Crocetta, T., et al. (2018). The clinical utility of virtual reality in neurorhabilitation: A systematic review. *Journal of Central Nervous System Disease*, 10, 1-18.
- Molina, K., Ricci, N., de Moraes, S., & Perracini, M. (2014). Virtual reality using games for improving physical functioning in older adults: A systematic review. *Journal of NeuroEngineering and Rehabilitation*, 11, 156.
- Powell, M., Elor, A., Teodorescu, M., & Kurniawan, S. (2020). OpenButterfly: Multimodal rehabilitation analysis of immersive virtual reality for physical therapy. *American Journal of Sports Science and Medicine*, 8(1), 23-35.
- Rodriguez-Almagro, D., Achalandabaso-Ochoa, A., Ibanez-Vera, A., Gongora-Rodriguez, J., & Rodriguez-Huguet, M. (2024). Effectiveness of virtual reality therapy on balance and gait in the elderly: A systematic review. *Healthcare*, 12, 158.

For more information, please contact:

Shelley Wisnowski

Senior Vice President of Business Development

swisnowski@selectrehab.com

(877) 497-7838



2600 Compass Rd.
Glenview, Illinois 60026

www.SelectRehab.com