TITLE: Immersive Technologies for Rehabilitation: Clinical and Cost-Effectiveness

DATE: 20 July 2016

RESEARCH QUESTIONS

1. What is the clinical effectiveness of immersive technologies for patients undergoing rehabilitation for cancer, orthopedic injury, spinal cord injury, amputation, or chronic pain?

2. What is the cost-effectiveness of immersive technologies for patients undergoing rehabilitation for cancer, orthopedic injury, spinal cord injury, amputation, or chronic pain?

KEY FINDINGS

One systematic review, three randomized controlled trials, and five non-randomized studies were identified regarding the clinical effectiveness of immersive technologies for patients undergoing rehabilitation for cancer, orthopedic injury, spinal cord injury, amputation, or chronic pain.

METHODS

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, economic studies, randomized controlled trials and non-randomized studies. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2011 and July 7, 2016. Internet links are provided where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.
SELECTION CRITERIA

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Selection Criteria</th>
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<tr>
<td><strong>Population</strong></td>
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<tr>
<td>Patients undergoing rehabilitation therapy for cancer (radiation and/or chemotherapy); orthopedic injury (post-operative or injury); amputation; chronic pain; or spinal cord injury</td>
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<td><strong>Interventions</strong></td>
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<tr>
<td>Immersive technology; Virtual reality technology (computer-generated visual or other sensory stimuli and interactivity); Commercial gaming systems</td>
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<td><strong>Comparators</strong></td>
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<tr>
<td>Other usual methods used for rehabilitation; No immersive technology; Virtual reality technology</td>
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<td><strong>Outcomes</strong></td>
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<td>Improved mobility/gait/balance; Upper extremity/arm function; Cognition; Social interaction</td>
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<td><strong>Study Designs</strong></td>
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<tr>
<td>Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic evaluations</td>
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RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and economic evaluations.

One systematic review, three randomized controlled trials, and five non-randomized studies were identified regarding the clinical effectiveness of immersive technologies for patients undergoing rehabilitation for cancer, orthopedic injury, spinal cord injury, amputation, or chronic pain. No relevant economic evaluations were identified.

Additional references of potential interest are provided in the appendix.

OVERALL SUMMARY OF FINDINGS

One systematic review examined the effectiveness of virtual reality for cancer patients. The authors concluded that the virtual reality intervention resulted in an improvement in the emotional health of the patients and also decreased cancer-related psychological symptoms.

Three randomized controlled trials and five non-randomized studies examined the effect of various immersive technologies on patients with cancer, orthopedic injury, spinal cord injury, amputation, or chronic pain. The characteristics and results of these studies are summarized in Table 2.
<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Patient Population</th>
<th>Intervention and Comparator</th>
<th>Results and Author's Conclusions</th>
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<tbody>
<tr>
<td><strong>Randomized Controlled Trials</strong></td>
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<td>Jin, 2016²</td>
<td>Chronic pain</td>
<td>VR game (Cryoslide) vs control group</td>
<td>Compared to baseline and the control group, perceived pain was significantly reduced in the intervention group.</td>
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<td>Punt, 2016³</td>
<td>Lateral ankle sprain</td>
<td>Nintendo Wii Fit vs physical therapy or no treatment</td>
<td>At 6 weeks, foot and ankle ability and pain scores had improved in all patients. No between group differences were recorded and Wii Fit was not more effective than physical therapy or no treatment.</td>
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<td>Garcia-Palacios, 2015⁴</td>
<td>Women with fibromyalgia</td>
<td>VR treatment vs usual care</td>
<td>Patients in the VR group demonstrated significant improvements in disability scores, perceived QoL, and some coping strategies. There were no differences reported in pain intensity or depression.</td>
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<tr>
<td><strong>Non-Randomized Studies</strong></td>
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<td>Dimbwadyo-Terrer, 2016⁵</td>
<td>Upper limb rehabilitation after spinal cord injury</td>
<td>Data glove (CyberTouch) combined with VR vs traditional rehabilitation</td>
<td>Improvements in muscle balance, functional parameters, dexterity, coordination, and fine grip tests were observed in the intervention group.</td>
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<td>Mortensen, 2015⁵</td>
<td>Women with fibromyalgia</td>
<td>Nintendo Wii vs PlayStation 3 Move vs Microsoft Xbox Kinect</td>
<td>The authors reported that, “there was no indication of general improvement in symptom severity or performance of [activities of daily living].”¹⁰</td>
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<td>Anderson, 2014⁷</td>
<td>Amputees</td>
<td>ARM Trainer vs Myoboy</td>
<td>The authors found no significant differences between the two systems in regard to muscle control development.</td>
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<tr>
<td>Hoffman, 2014⁷</td>
<td>Postthoracotomy lung cancer patients</td>
<td>Nintendo Wii Fit</td>
<td>The adherence rate was 88%. Patients experienced no adverse events and found the intervention to be highly acceptable.</td>
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<td>Gates, 2012⁷</td>
<td>Transtibial amputation</td>
<td>Overground walking vs treadmill walking in a computer assisted virtual reality environment (CAREN) in patients with and without transtibial amputation</td>
<td>Step time was decreased in both groups while walking in the CAREN. The authors concluded that using the treadmill in a virtual environment was similar enough to over ground walking that similar changes should occur in both.</td>
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</table>

QoL = quality of life; VR = virtual reality.

¹⁰ Verbatim from abstract.
REFERENCES SUMMARIZED

Health Technology Assessments
No literature identified.

Systematic Reviews and Meta-analyses


Randomized Controlled Trials


Non-Randomized Studies


Economic Evaluations
No literature identified.

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APPENDIX – FURTHER INFORMATION:

Randomized Controlled Trials – Alternate Outcomes


Non-Randomized Studies – Alternate Outcomes


Qualitative Studies


Review Articles


Immersive Technologies for Rehabilitation
Additional References


