TITLE: Commercial Gaming Systems for Neurorehabilitation: Clinical Effectiveness

DATE: 18 February 2015

RESEARCH QUESTIONS

1. What is the evidence for the clinical effectiveness of commercial gaming systems for patients undergoing neurorehabilitation in a hospital or clinic environment?

2. What is the evidence for the clinical effectiveness of home-based commercial gaming systems for out-patients undergoing neurorehabilitation?

KEY FINDINGS

Six systematic reviews and seventeen randomized controlled trials were identified regarding the use of commercial gaming systems for neurorehabilitation.

METHODS

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2015, Issue 2), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2010 and February 3, 2015. Internet links were 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 1: Selection Criteria

<table>
<thead>
<tr>
<th>Population</th>
<th>Patients undergoing rehabilitation therapy (acquired or traumatic brain injury, stroke, cerebral palsy, multiple sclerosis, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Use of commercial gaming systems (e.g., Xbox, Kinect, Wii, Wii Fit, etc.)</td>
</tr>
<tr>
<td>Comparator</td>
<td>None</td>
</tr>
<tr>
<td>Comparator</td>
<td>Any other established method of neurorehabilitation</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Clinical benefits: improved function outcomes (e.g., upper extremity function, range of motion, strength, coordination, balance, mobility, gait, etc.)</td>
</tr>
<tr>
<td>Study Designs</td>
<td>Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies</td>
</tr>
</tbody>
</table>

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 and non-randomized studies.

Six systematic reviews and seventeen randomized controlled trials were identified regarding the use of commercial gaming systems for neurorehabilitation. No relevant health technology assessments were identified.

Non-randomized studies and additional references of potential interest are provided in the appendix.

OVERALL SUMMARY OF FINDINGS

Due to the large amount of higher quality evidence identified, non-randomized studies were not summarized, but instead are provided in the appendix.

One systematic review found evidence to support the use of exercise based computer games as a tool to facilitate the rehabilitation of clinical balance measures, when compared with traditional balance training, in patients with Parkinson’s disease. One review found evidence to support the use of commercial gaming as a rehabilitation tool for stroke patients. One review found video games, in conjunction with conventional rehabilitation methods, to be potentially useful for upper arm improvement in stroke patients.

The randomized controlled trials varied by intervention and patient population. The majority of studies used Nintendo Wii, two studies used Xbox Kinect, and two studies did not report the gaming consoles used in their abstracts. Most studies found outcomes for gaming patients to be comparable to traditional rehabilitation methods. Table 2 summarizes the detailed findings of these trials.
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Patient Population</th>
<th>Gaming Intervention</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adults</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bower, 2014</td>
<td>N = 30, stroke</td>
<td>Nintendo Wii Fit Plus and Wii Sports/Sports Resort</td>
<td>Gaming in-patients had significant improvements in balance and non-significant improvements in arm function.</td>
</tr>
<tr>
<td>Choi, 2014</td>
<td>N = 20, subacute stroke</td>
<td>Nintendo Wii</td>
<td>Compared to conventional occupational therapy, gaming was as effective for improved upper extremity and daily living function.</td>
</tr>
<tr>
<td>Cuthbert, 2014</td>
<td>NR, TBI</td>
<td>Nintendo Wii</td>
<td>Gaming was comparable to conventional therapy for balance outcomes for in-patients with TBI.</td>
</tr>
<tr>
<td>Hung, 2014</td>
<td>N = 30, chronic stroke</td>
<td>Nintendo Wii Fit</td>
<td>The gaming group showed more initial improvement in balance than the conventional therapy group; however, the effects were not maintained at three months.</td>
</tr>
<tr>
<td>Morone, 2014</td>
<td>N = 50, subacute stroke</td>
<td>Nintendo Wii Fit</td>
<td>Compared to usual balance therapy, gaming was more effective at improving balance and daily living function.</td>
</tr>
<tr>
<td>Prosperini, 2014</td>
<td>N = 27, multiple sclerosis</td>
<td>Nintendo Wii</td>
<td>Gaming improved clinical outcomes related to postural sway and diffusion-tensor imaging parameters.</td>
</tr>
<tr>
<td>Barcala, 2013</td>
<td>N = 20, stroke</td>
<td>Nintendo Wii Fit</td>
<td>Gaming led to improvements in balance, body symmetry, and function, but this improvement was similar to the outcomes with conventional therapy.</td>
</tr>
<tr>
<td>Brichetto, 2013</td>
<td>N = 36, multiple sclerosis</td>
<td>Nintendo Wii</td>
<td>Balance was significantly improved for the patients in the gaming intervention.</td>
</tr>
<tr>
<td>Fritz, 2013</td>
<td>N = 30, chronic stroke</td>
<td>NR</td>
<td>Non-significant improvements in balance and mobility were seen in the gaming patients.</td>
</tr>
<tr>
<td>Lee, 2013</td>
<td>N = 14, chronic stroke</td>
<td>Xbox Kinect</td>
<td>Gaming improved motor and daily living function, but was not significant compared to conventional therapy.</td>
</tr>
<tr>
<td>McClanachan, 2013</td>
<td>N = 21, ABI</td>
<td>NR</td>
<td>Compared to usual therapy, gaming patients experienced non-significant improvements in gait, endurance, and balance.</td>
</tr>
<tr>
<td>Nilsagard, 2013</td>
<td>N = 84, multiple sclerosis</td>
<td>Nintendo Wii Fit</td>
<td>Several measures of balance were improved for gaming patients, but the differences were not significant compared to no intervention.</td>
</tr>
<tr>
<td>Prosperini, 2013</td>
<td>N = 36, multiple sclerosis</td>
<td>Nintendo Wii Balance Board System</td>
<td>There was some evidence that a home based gaming system was an effective tool for balance rehabilitation.</td>
</tr>
<tr>
<td>Sin, 2013</td>
<td>N = 40, stroke</td>
<td>Xbox Kinect</td>
<td>Upper extremity function was significantly improved in patients that received gaming and conventional therapy, compared to conventional therapy alone.</td>
</tr>
<tr>
<td>Saposnik, 2010</td>
<td>N = 22, stroke</td>
<td>Nintendo Wii</td>
<td>Compared to recreational therapy, gaming patients experienced significant improvement in arm motor function.</td>
</tr>
</tbody>
</table>
### Table 2: Summary of Included Randomized Controlled Trials

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Patient Population</th>
<th>Gaming Intervention</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiu, 2014</td>
<td>N = 62, cerebral palsy</td>
<td>Nintendo Wii Sports Resort</td>
<td>Gaming did not improve hand function, strength or coordination in this group of patients.</td>
</tr>
<tr>
<td>Ramstrand, 2012</td>
<td>N = 18, cerebral palsy</td>
<td>Nintendo Wii Fit and Wii Balance Board</td>
<td>Gaming was not an effective intervention in this group of patients.</td>
</tr>
</tbody>
</table>

ABI = acquired brain injury; NR = not reported; TBI = traumatic brain injury.
REFERENCES SUMMARIZED

Health Technology Assessments
No literature identified.

Systematic Reviews and Meta-analyses


Randomized Controlled Trials

Adults


PubMed: PM24102295

PubMed: PM22674972

PubMed: PM23478168

PubMed: PM24051993

PubMed: PM20508185

Children

PubMed: PM24849793

PubMed: PM23187015

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APPENDIX – FURTHER INFORMATION:

Systematic Reviews – No Reported Outcomes in Abstract

   Structured abstract: http://www.crd.york.ac.uk/CRDWeb/ShowRecord.asp?AccessionNumber=12014032905


Non-Randomized Studies

Adults


PubMed: PM25206611

PubMed: PM24029009

PubMed: PM23770422

PubMed: PM24185843

PubMed: PM22068375

PubMed: PM21533334

PubMed: PM24453702

PubMed: PM20544153
Children


