PRIORITY BRIEFING

The purpose of this briefing paper is to aid Stakeholders in prioritising topics to be taken further by PenCLAHRC as the basis for a specific evaluation or implementation research project. This paper was compiled in 2-3 days.

Do active computer games have therapeutic and/or social benefits for children with motor impairments?

Question ID: 5

Question type: Intervention

Question: Do active computer games have therapeutic and/or social benefits for children with motor impairments?

Population: Children with a motor impairment (classified by the Gross Motor Function Classification System-GMFCS- or a similar validated scale) aged 5 – 25yrs who can cognitively engage with a game aimed at 4-7 year olds.
Intervention: This piece of research would be interested in those computer games that can be used in the home environment that require the user to be active (e.g. Nintendo Wii).
Control: Usual care (e.g. physiotherapy and occupational therapy) that a child with a motor impairment might expect to receive

Outcome: We would be interested in the motor benefits, social interaction and motivational benefits that the use of computer games may bring to this population. This work will improve our understanding of the use of computer games with this population, and help us to clarify the outcome measures which might measure the potential areas of benefit.

*Please note that the details included in the box are from the original submission and have been edited where necessary for clarity and precision

Motor impairments: Motor impairments are any limitations with movement that a child might have. These impairments are usually due to a neurological condition, for example Cerebral Palsy.

Active Computer games: Active computer games require the user to be physically active in some way in order to play the game. There are many examples of games platforms which hold these kinds of games on them, including the EyeToy: Kinetic, Gamercize, Nintendo's Wii and Wii Remote, Wii Fit, Wii Balance Board, Cyber coach, NeoRacer, Wii titles such as EA Sports Active, Cybex TRAZER, Powergrid Fitness Kilowatt, Lightspace Play Floor, PlayMotion, Yourself!Fitness, Expresso Fitness S2, i.play, Cyber ExerCycle, VEQTOR Sport Trainer and Sportwall. Some of these games are now being developed to allow for different levels of mobility which enables the key pad to be used to perform moves if necessary.

The Health Problem:

Government statistics (http://odi.dwp.gov.uk/disability-statistics-and-research/disability-facts-and-figures.php) state that one in twenty children in the

UK is born with a disability. This equates to approximately 770,000 children. In a 2009/10 needs assessment 143,902 children aged 0-18 years were reported to live in Devon. In Devon, it is reported that 1 in 20 children have Special Educational Needs (SEN) and of those, approximately 5% have a physical disability. This equates to 2-3 children per 1000 (which is in line with the prevalence of cerebral palsy, reported as 2 per 1000). In Cornwall a 2008 school census identified 13,800 children with SEN. No further information could be found on the number of children with a physical disability in Cornwall.

Guidelines:

No guidelines for the treatment of children with motor impairment could be found. NICE clinical guidelines on the management of spasticity in children with a non-progressive brain injury are due to be published in June 2012.

NHS Priority:

Regional

SW SHA Priorities framework 2008-11 (please note this has not yet been updated for 2012)

- Expand the use of telecare, telemedicine and assistive technology in three or more health communities

Local

- NHS Devon strategic plan 2010-2015 supporting the most vulnerable children and young people including children with additional needs
- Plymouth and Torbay PCTs both highlight improved self reported experience of patients and users as a key priority

QIPP

- Adopting best practice care pathways for long-term conditions

Existing Research:

Published research

The searches conducted for this briefing found three systematic reviews that had reviewed the literature on interactive computer play in the rehabilitation of children with sensorimotor disorders[1,2,3]. One review published in 2009 found 16 includable studies three of which were randomised controlled trials. Most of the studies reported positive effects on movement quality, spatial orientation and mobility. However, two of the RCTs reported no significant improvements. The authors suggest that the quality of the research in this area needs to improve before confirming the utility of interactive computer play for rehabilitating children with motor disorders. A more recent (2012) but brief systematic review found only four studies which looked at the use of virtual reality interventions on physical activity in children and adolescents with early brain injuries including cerebral palsy[2]. This review also reported generally positive results but that the quality of

research needs to be improved. A further review of the literature was published in 2010[3] which found very similar results to the 2009 review.

Since these reviews 22 studies have been conducted on this topic mostly looking at the use of computer games in children with cerebral palsy (two studies look at rehabilitation of motor function in children with Downs Syndrome). Three RCTs[4,5,6], one non-randomised controlled trial[7], eight before and after studies, seven case studies and three studies with no control were found in these searches. Most of the studies had small sample sizes between one and 18 children with only one with a sample of more than 100 children[5]. Most of the research suggests there are some improvements in children's motor capacity, and that the children find the activity engaging and fun. However, there is uncertainty about the significance of the improvements with the main message being that larger scale and more controlled studies need to be conducted to really prove or disprove the utility of these games.

The focus of the computer games may also be an area to explore as different games are likely to concentrate on different areas of mobility. Also research identifying the key components of interventions and understanding how the interventions work is needed[8]. Further research in this area may also help to develop future iterations of games and allow the interaction to be more beneficial for the children using them.

Ongoing research
No ongoing research in this specific area was identified in the search despite seeming to be a fast growing and increasing area of interest. We identified one ongoing trial of the use of computer games for rehabilitation in the elderly.

Feasibility:
This question was raised and has been discussed and developed by members of the PenCRU (Peninsula Cerebra Research Unit) Family Faculty. It appears to be an area of interest for many parents and carers.

There is interest and involvement from two consultant paediatricians at the RD&E; a senior paediatric physiotherapist in Barnstaple; two paediatric occupational therapists in Torbay; and two paediatric physiotherapists at Vranch House in Exeter.

References:

1. Sandlund, M., S. McDonough, et al. (2009). "Interactive computer play in rehabilitation of children with sensorimotor disorders: a systematic review." Developmental Medicine & Child Neurology **51**(3): 173-179.
The aim of this review was to examine systematically the evidence for the application of interactive computer play in the rehabilitation of children with sensorimotor disorders. A literature search of 11 electronic databases was

conducted to identify articles published between January 1995 and May 2008. The review was restricted to reports of intervention studies evaluating the impact of interactive computer play on motor rehabilitation in children. For each study the quality of the methods and the strength of the evidence were assessed by two independent reviewers using the guidelines of the American Academy for Cerebral Palsy and Developmental Medicine. A total of 74 articles were identified, of which 16 met the inclusion criteria. Three studies were randomized controlled trials (RCTs) and half were case series or case reports. Areas investigated were movement quality, spatial orientation and mobility, and motivational aspects. Thirteen studies presented positive findings. Two of the three RCTs investigating movement quality and one level III study examining spatial orientation showed no significant improvements. Interactive computer play is a potentially promising tool for the motor rehabilitation of children but the level of evidence is too limited to assess its value fully. Further and more convincing research is needed.

2. Mitchell, L., Ziviani, J., Oftedal, S. and Boyd, R. (2012) The effect of virtual reality interventions on physical activity in children and adolescents with early brain injuries including cerebral palsy. Developmental Medicine and Child Neurology. doi: 10.1111/j.1469-8749.2011.04199.x

3. Snider, L., A. Majnemer, et al. (2010). "Virtual reality as a therapeutic modality for children with cerebral palsy." Developmental neurorehabilitation **13**(2): 120-128.
Objective: The evidence for using virtual reality (VR) with children with cerebral palsy (CP) was examined. Methods: A search of 13 electronic databases identified all types of studies examining VR as an intervention for children with CP. The most recent article included was published in October 2008. For each study, the quality of the methods was assessed using the appropriate scale. A total of 19 articles were retrieved. Thirteen studies from 11 articles were included in the final analysis. Results: Outcomes documented brain reorganization/plasticity, motor capacity, visual-perceptual skills, social participation and personal factors. Two studies were randomized controlled trials. These reported conflicting results regarding motor outcomes. Twelve of the 13 studies presented positive outcomes in at least one domain. Conclusions: VR has potential benefits for children with CP. However, the current level of evidence is poor and empirical data is lacking. Future methodologically rigorous studies are required. 2010 Informa UK Ltd All rights reserved.

4. Wade, W. and D. Porter (2012). "Sitting playfully: does the use of a centre of gravity computer game controller influence the sitting ability of young people with cerebral palsy?" Disability & Rehabilitation Assistive Technology **7**(2): 122-9.
PURPOSE: An investigative study to examine whether sitting ability could be improved through the use of a suite of computer games operated by leaning in one of four directions in a seated position. MethOD: Young people with cerebral palsy played with a suite of computer games controlled using a sitting platform that can detect changes in the distribution of pressure. A randomized cross-over

trial with two periods of three months involving intervention or no intervention was used. Sitting ability was measured at the beginning and end of each period with participants acting as their own controls. RESULTS: Statistically significant improvements were seen in two elements of box sitting using the Chailey levels (shoulder girdle position and spinal profile) and in five elements of the Sitting Assessment for Children with Neuromotor Dysfunction across both reach and rest phases of the assessment. CONCLUSIONS: The study provides evidence to suggest that a meaningful and engaging therapeutic activity, such as using computer games controlled by leaning the upper body, can help to improve sitting ability in children with neuromotor dysfunction. Further work is required to understand fully what effects such activities have on the various components of sitting ability.

5. Wuang, Y. P., C. S. Chiang, et al. (2011) Effectiveness of virtual reality using Wii gaming technology in children with Down syndrome. Research in developmental disabilities 312-21
This quasi-experimental study compared the effect of standard occupational therapy (SOT) and virtual reality using Wii gaming technology (VRWii) on children with Down syndrome (DS). Children (n = 105) were randomly assigned to intervention with either SOT or VRWii, while another 50 served as controls. All children were assessed with measures of sensorimotor functions. At post-intervention, the treatment groups significantly outperformed the control group on all measures. Participants in the VRWii group had a greater pre-post change on motor proficiency, visual-integrative abilities, and sensory integrative functioning. Virtual reality using Wii gaming technology demonstrated benefit in improving sensorimotor functions among children with DS. It could be used as adjuvant therapy to other proven successful rehabilitative interventions in treating children with DS.

6. Jannink, M. J. A., G. J. Van Der Wilden, et al. (2008). "A low-cost video game applied for training of upper extremity function in children with cerebral palsy: A pilot study." Cyberpsychology and Behavior **11**(1): 27-32.
The aim of the present study was to determine the user satisfaction of the EyeToy for the training of the upper limb in children with cerebral palsy (CP). User satisfaction was measured in 12 children with CP, using a postexperience questionnaire, primarily based on a presence questionnaire. In general, children with CP were satisfied with and motivated by the EyeToy training. In addition, a first evaluation study was performed to determine the effect of this training method on the upper limb function. Ten children with CP were randomly assigned to the intervention (mean age 11 years, 9 months; SD 2,3) and the control group (mean age 12 years, 3 months; SD 3,2). After a treatment period of 6 weeks, the intervention group completed a user satisfaction questionnaire. Functional outcome was measured using the Melbourne Assessment scores. Percentage scores of the Melbourne Assessment of 7 of the 10 children were the same or changed only 1% to 2% from baseline to followup. However, in the experimental group, two children improved more, 9% and 13% respectively. In

conclusion, it can be said that the EyeToy is a motivational training tool for the training of children with CP and has the potential to improve upper extremity function.

7. Brutsch, K., T. Schuler, et al. (2010). "Influence of virtual reality soccer game on walking performance in robotic assisted gait training for children." Journal of neuroengineering and rehabilitation **7**: 15.
BACKGROUND: Virtual reality (VR) offers powerful therapy options within a functional, purposeful and motivating context. Several studies have shown that patients' motivation plays a crucial role in determining therapy outcome. However, few studies have demonstrated the potential of VR in pediatric rehabilitation. Therefore, we developed a VR-based soccer scenario, which provided interactive elements to engage patients during robotic assisted treadmill training (RAGT). The aim of this study was to compare the immediate effect of different supportive conditions (VR versus non-VR conditions) on motor output in patients and healthy control children during training with the driven gait orthosis Lokomat*. METHODS: A total of 18 children (ten patients with different neurological gait disorders, eight healthy controls) took part in this study. They were instructed to walk on the Lokomat in four different, randomly-presented conditions: (1) walk normally without supporting assistance, (2) with therapists' instructions to promote active participation, (3) with VR as a motivating tool to walk actively and (4) with the VR tool combined with therapists' instructions. The Lokomat gait orthosis is equipped with sensors at hip and knee joint to measure man-machine interaction forces. Additionally, subjects' acceptance of the RAGT with VR was assessed using a questionnaire. RESULTS: The mixed ANOVA revealed significant main effects for the factor CONDITIONS ($p < 0.001$) and a significant interaction CONDITIONS x GROUP ($p = 0.01$). Tests of between-subjects effects showed no significant main effect for the GROUP ($p = 0.592$). Active participation in patients and control children increased significantly when supported and motivated either by therapists' instructions or by a VR scenario compared with the baseline measurement "normal walking" ($p < 0.001$). CONCLUSIONS: The VR scenario used here induces an immediate effect on motor output to a similar degree as the effect resulting from verbal instructions by the therapists. Further research needs to focus on the implementation of interactive design elements, which keep motivation high across and beyond RAGT sessions, especially in pediatric rehabilitation.

8. Levac, D., L. Rivard, et al. (2012). "Defining the active ingredients of interactive computer play interventions for children with neuromotor impairments: a scoping review." Research in developmental disabilities **33**(1): 214-23.
Rehabilitation researchers who investigate complex interventions are challenged to describe the "active ingredients" of their interventions: the reason(s) why a treatment is expected to be effective. Interactive Computer Play (ICP) is an emerging complex intervention in rehabilitation practice and research. The purpose of this scoping review is to identify the active ingredients of ICP interventions that are designed to improve motor outcomes in children with neuromotor impairments. Eleven potential active ingredients were identified with

the following foci: ICP system or game properties; intervention effects on the user; and therapist roles. However, few studies explicitly evaluate the impact of particular ingredients on outcomes. Identification of active ingredients in ICP interventions can inform trial design and clinical decision-making. Research and clinical practice will benefit from studies that utilize a framework such as motor learning theory to guide hypotheses and measurement of the active ingredients of complex interventions.