Virtual reality is the computer-generated simulation of a real-world environment. For over 20 years, this technology has been used for health-related and rehabilitation purposes. The new generation of wireless gaming consoles has brought low-cost, easily accessible virtual environments to lounge rooms, physiotherapy clinics and aged care facilities. The purpose of this paper is to review the emerging literature on the use of active gaming technology (Nintendo’s Wii™) with older people. The results of a recent qualitative study on the acceptability and feasibility of implementing Wii™ in aged care settings will also be presented. As broadband-enabled healthcare expands and gaming technology advances, gaming consoles could be used for more than recreation. In addition to the potential health benefits, connecting older people to peers or health professionals in this way may be a strategy to counteract the social and physical isolation experienced by a growing number of those living in the community.

BACKGROUND

The NBN is Australia's largest infrastructure project. It has been widely lauded as a landmark Virtual reality (VR) is the computer-generated simulation of a real-world environment (Holden 2005). It has established applications in many diverse fields, including aviation, architecture, medicine and education. In some occupations, real-life training can be dangerous or difficult to monitor. Because of its immersive and interactive properties, VR is commonly used by pilots, surgeons, fire-fighters and soldiers as part of their vocational training. A user interacts with their virtual environment using specially designed computer software and a human-machine interface such as a remote control, a computer mouse, a glove or headgear (Holden 2005).

Virtual reality technology has been used for health related research and clinical purposes since the early 1990s. In the area of rehabilitation of motor impairments, VR systems have been developed for those suffering stroke (Holden 2005; Lam et al. 2006; Merians et al. 2006; Yang et al. 2008) and for people with acquired brain injury (Holden 2005; Thornton et al. 2005) or Parkinson’s disease (Weghorst 1997). Other applications include balance training (Cruz-Neira et al 1993; Keshner 2000; Whitney et al. 2002) and memory rehabilitation (Brooks and Rose 2003). Incorporating virtual environments into rehabilitation has been shown to promote motor learning and transfer to real world tasks, decrease pain, and improve mobility, balance, and enjoyment of therapy (Holden 2005). Therapeutic VR environments
can be as large as an entire room and completely immersive, such as the Computer Assisted Rehabilitation Environment (CAREN) system (van der Eerden et al. 1999) or the CAVETM system (Cruz-Neira, Sandin, and DeFanti 1993). Due to cost and complexity, these VR environments are limited to research or specialised clinical settings.

More recently, the video gaming industry has bridged the gap between the lab and the lounge room with its new generation of wireless gaming consoles and “active gaming”. Advanced VR technology has been coupled with simple user interfaces and controllers. Now these “off the shelf”, low-cost, and easily accessible virtual environments are found in hospitals, physiotherapy clinics and aged care facilities. There is a burgeoning market for the development of “games for health” or “exergames”. To date, Nintendo’s Wii™ (Nintendo Corp., Kyoto, Japan) gaming system has generated the most popular interest.

Since its launch in 2006, Nintendo has sold over 86 million Wii™ systems worldwide (gamrReview 2011), including over two million in Australia (Nintendo Australia 2010). Wii™ consists of a console, a hand-held wireless controller (Wii Remote™) and gaming software (Wii™ Sports). The controller detects changes in acceleration and direction in three dimensions, which enables a player’s hand, wrist and arm movements to interact with the games. Up to four controllers can be used at once and each player creates a virtual self (Mii™) which appears on the monitor or television screen. Players receive feedback on their performance through their Mii™. Wii™ Sports is a package of five simulated sports, including 10-pin bowling, tennis, boxing, golf and baseball. Wii Fit™, released in 2007, is a package that includes yoga, balance, aerobic and muscle conditioning programs. Players stand on a balance board in which pressure sensors have been embedded to monitor centre of balance and shifts in weight/balance.

For older people, Wii™ offers new and entertaining ways of becoming more active. Individuals may ‘virtually’ return to physical activities they once enjoyed but have had to give up due to physical limitations or a lack of local facilities, such as a tennis court, golf course or bowls club. To date, most of the published research using Wii™ has involved younger populations (Deutsch et al. 2008; Graves et al. 2007; Graves, Ridgers and Stratton 2008). In adolescents, energy expenditure playing Wii™ Sports was significantly higher than playing sedentary computer games, but they did not expend as much energy as playing the sport itself (Graves et al. 2007). Clark and colleagues (2010) demonstrated the reliability and validity of the Wii Fit™ balance board (WBB) for measuring balance. In healthy young adults (mean age 23.7±5.6 years), the WBB was found to be comparable to a laboratory grade force plate. Nitz et al. (2010) reported improved balance and lower limb strength in women, aged 30-58 years, who used Wii Fit™ twice weekly for 10 weeks. The purpose of this paper is to review the emerging literature on the use of active gaming technology (Nintendo’s Wii™ Sports and Wii Fit™) to promote rehabilitation and wellbeing amongst older people. The results of a recent qualitative study that examined the acceptability and feasibility of implementing Wii™ in aged care settings across three Australian states will also be presented.

**METHOD**

The following electronic databases were searched for articles published since Nintendo launched Wii™ in 2006: MEDLINE (PubMed), CINAHL, Web of Science and Sport Discus. Key words used in these searches were ‘Nintendo’, ‘Wii’, ‘Nintendo Wii’, ‘Wii Fit’, ‘Wii Sports’, ‘Nintendo Wii AND older adult’ and ‘active video game’. Studies that included adults aged 60 years and older in the sample were selected. Telephone interviews were conducted with staff members from residential aged care facilities (RACF) and community day centre or respite programs that had been using Wii™ with their residents/clients in Victoria, Queensland and New South Wales. With the participants’ consent, the interviews were audiotaped. They were asked about their experiences with Wii™-based activity programs and the reaction of their residents and clients to active gaming (see Appendix 1 for interview questions). Transcriptions from interviews were subjected to content and thematic analysis (Tuckett 2005).
RESULTS

Twenty studies are included in this review: 12 featuring Wii™ Sports and eight examining Wii Fit™. Only one purely qualitative study has been published to date. Studies using Wii™ Sports will be presented first, followed by the published literature on Wii Fit™. Finally, the findings from the new qualitative study on Wii™ will be reported.

WII™ SPORTS

Wollersheim et al. (2010) conducted a pilot study using Wii™ Sports with clients of a Planned Activity Group (PAG). These groups are offered by community health services in Victoria to provide older people who are isolated and/or have physical limitations with social and recreational activities in a supportive environment. The Wii™ games were added to the PAG program twice a week for up to two hours over a six-week period. The majority of participants were seated during play. Eleven women (age range 56-84 years, mean age 73.5 ± 9.0 years) wore an accelerometer (activity monitor) three times for 20 minutes during a six-week baseline period and then whilst playing Wii™ to measure energy expenditure during PAG and gaming activities. The mean duration of play was 51.1 ± 27.1 minutes per session (38 - 660 minutes in total over 12 sessions). Although participants expended more energy whilst using the Wii™, there was no significant increase in energy expenditure compared with baseline. The mean rate of participation was 70.5%. Focus groups were held to explore the psychosocial benefits of playing Wii™. Participants reported that they got to know each other better, they had fun and one woman said that playing Wii™ made her feel more alert. Other benefits mentioned included a stronger connection with grandchildren, self-reported physical effects, and learning to use technology.

Only one study has been conducted to determine whether playing Wii™ can improve lower body strength in community-dwelling older people (Sohnsmeyer et al 2010). Forty, healthy volunteers (age range 70-86 years, mean age 76.9 ± 4.8 years) were assigned to either a Wii™ bowling group or a control group. The intervention consisted of two, 20-minute sessions of bowling for six weeks. At follow-up, the researchers reported a statistically significant increase in maximal isometric strength of the quadriceps muscle (p<0.01), after adjusting for baseline muscle strength, in the intervention group relative to the control group. Leg strength increased 38%, on average, in those who participated in Wii™ bowling.

In an observational study in an assisted living facility, Weybright and colleagues (2010) investigated the effects of Wii™ bowling on attention to task and positive affect in two female residents with mild cognitive impairment. An ABAB design was used; where watching a pre-recorded bowling competition on television was the baseline phase (A) and Wii™ bowling comprised the intervention phase (B). Participants spent 15 minutes (the duration of one game of Wii™ bowling), four times a week for two to three weeks in each phase. Each session was videotaped and then scored by two trained observers. Participants were interviewed at the end of the trial to evaluate the acceptability and practicality of the Wii™. One participant had high attention to task (fixed eye gaze towards the TV screen) across all four conditions whilst large increases were observed from baseline to intervention in the other participant. An increase in positive affect (smiling) was observed between the baseline and intervention phases for both women. Feedback from both participants on their experience with Wii™ bowling was positive. Staff noticed an improvement in one participant’s ability to recall routine tasks and in the attention span of the second participant.

Several studies have focused on the therapeutic use of Wii™ with older people. Rosenberg and colleagues (2010) recruited 19 community-dwelling older adults with subsyndromal depression (age range 63-94 years, mean age 78.7 ± 8.7 years) for a 12-week trial of Wii™ Sports. Participants used the Wii™ three times a week for 35 minutes. After 12 weeks, significant improvements were observed in quality of life and cognitive functioning. A significant reduction in depressive symptoms was also reported and this was maintained up to 24 weeks post-baseline. Participants attended 84% of the total Wii™ sessions. Tennis and bowling were rated as the most enjoyable of the games. In two case reports, playing Wii™
bowling helped a RACF resident improve her balance, mobility and balance confidence (Clark and Kraemer 2009) and it assisted a stroke patient with his fine motor dexterity and hand strength (Drexler 2009). Yong Joo et al. (2010) also reported that Wii™ complemented conventional upper limb stroke therapy.

Saposnik et al. (2010) compared the feasibility, safety and efficacy of Wii™ gaming with recreational therapy (RT, playing cards or bingo) in stroke patients. Twenty-two inpatients at a stroke rehabilitation centre (age range 41-83 years, mean age 61 years) were enrolled within an average of 25 days post-stroke and randomised to each intervention arm. The groups were asked to complete eight, 60-minute sessions over a 14-day period. The total time receiving the intervention was used as an indicator of feasibility and participants completed 76% and 80% of the scheduled time for Wii™ and RT, respectively. There were no serious adverse events in either group. Outcomes for efficacy measured post-intervention and at four weeks after the final intervention session included activities of daily living, arm motor function and quality of life. A statistically and clinically significant improvement in arm motor function was observed in the Wii™ group. In another rehabilitation setting, Mouawad and colleagues (2011) recruited seven stroke patients (mean age 65.3 years) who were in the chronic period post-stroke (mean 15.3 months). They had one hour of supervised Wii™ therapy on 10 consecutive weekdays over a 14-day period. Each participant also progressed to three hours of gaming on a Wii™ system installed in their home. All participants successfully completed this intense protocol. Statistically and clinically meaningful improvements in upper limb functional ability and movement were reported (Mouawad et al. 2011).

Using a cross-over design, Hsu and colleagues (2011) recruited 34 residents (mean age 80 years) with self-reported arm dysfunction (pain, weakness, or stiffness) in two aged care facilities to participate in a standard exercise group (SG) and SG plus Wii™ bowling. The SG was offered two to four times per week and consisted of strength exercises for the upper and lower body and balance and coordination exercises. In addition to the standard exercises, participants in the Wii™ group played the bowling game, in pairs, twice a week for 20 minutes. Outcome measures included a six-item measure of physical performance, pain intensity and bothersomeness, and enjoyment of physical activity. After the first reassessment at four weeks, those who had been randomly assigned to the SG added Wii™ bowling to their regime whilst those in SG plus Wii™ continued with the standard exercises only. Participants were assessed again after the second four-week period. The Wii™ bowling was acceptable to residents, with 92% completing at least six of eight sessions. Only enjoyment of physical activity was significantly greater in the Wii™ group compared with the SG.

In a study conducted in a Singaporean RACF, Jung et al. (2009) randomly assigned 45 residents (age range 56-92 years) to either a Wii™ group or a group that played board games. Activity sessions for both groups took place for 90 minutes, three times a week for six weeks. Participants in the Wii™ group scored significantly higher on measures of affect, self-esteem, and physical activity and lower on the loneliness scale (p≤0.05). However, the results should be interpreted with caution as self-report measures were used and all were translated from English into several dialects.

Staff perceptions of Wii™ and their experiences with implementing it across four settings of an aged care and disability service in Queensland, Australia were explored via structured telephone interviews (Higgins et al. 2010). A total of 53 individuals (78% over the age of 40 years) participated from 29 residential care facilities, 18 respite centres, five day therapy centres and one retirement village. Because the sample of facilities included centres specifically for young clients with disabilities and the authors grouped the results from all the services together, findings particular to older adults could not be ascertained.

Setting up the Wii™ system was not problematic for most services in the Queensland study; however those with staff who were unfamiliar with gaming technology were slower to get it operational. Use of the Wii™ ranged from site to site, however almost all clients/residents at half of the facilities played at least weekly. One high care facility reported infrequent use of the Wii™. A minority of staff interviewed (15%) reported only individual use of Wii™, however most services (83%) provided staff supervision at all times. The most popular
games were bowling, tennis and golf. Seven sites used the Wii™ as an adjunct to physiotherapy and occupational therapy programs. Although not directly measured, staff associated physical benefits with Wii™ use such as distraction from pain and improved mobility. They also mentioned psychosocial benefits including greater social interaction, improved self-confidence and a connection with previous physical activities. Higgins et al (2010) reported that many older participants were hesitant with the technology. Operating the controller was reported as the main difficulty with the Wii™, particularly with clients/residents with dementia. The speed and complexity of some of the games were also frustrating for older players.

**WII FIT™**

Graves and colleagues (2010) conducted a cross-sectional study to measure the energy expenditure and heart rate of young adults whilst engaged in Wii Fit™ activities, inactive video gaming, brisk treadmill walking and jogging. A sample of 13 older adults (mean age 57.6±6.7 years, range 45-70 years) was also recruited for the testing sessions, excluding jogging. The researchers found the energy cost and intensity of the Wii Fit™ activities to be greater than sedentary gaming (p≤0.001), which was similar to their earlier findings (Graves et al. 2007). However, energy expenditure and heart rate measurements were significantly lower than the treadmill walking (p≤0.001). Of note, at 3.2 metabolic equivalents (METs), only Wii™ aerobics was classified as moderate intensity activity (3-6 METs). Older adults enjoyed Wii™ balance more than yoga, muscle conditioning and aerobics.

Two groups of researchers have explored the potential for the WBB to be used for balance testing and falls risk assessment with older people. Young et al. (2011) extended Clark and colleagues (2010) work with the WBB to develop two games for functional balance training and to assess static balance. The games require participants to control their centre of pressure, which is measured by the WBB. Young et al. (2011) pilot tested the games with six healthy older adults (mean age 84.1 ± 5.1 years, none had fallen in the previous year). Participants attended 10 sessions held over a four-week period and played each game for 20 minutes. Anterior-posterior and medial-lateral sway were measured, with eyes open and eyes closed, whilst participants stood on the WBB for 30 seconds. There was a significant decrease in sway in the anterior-posterior plane in the eyes closed condition (p=0.03). All participants enjoyed the gaming experience. However, a limitation of this study is that the researchers inserted the WBB into a larger platform, which is not how it is used in the ‘real world’.

Yamada et al (in press) tested the reliability and validity of two of the Wii Fit™ balance activities, Basic Step and Ski Slalom, as measures of falls risk. The Basic Step involved stepping on and off the WBB at a set pace and Ski Slalom involved weight shifting to navigate through flags whilst downhill skiing. The researchers recruited 45 community-dwelling women (mean age 81.3±7.4 years, 16 had fallen in the previous year) for this trial. Although moderate, yet significant, correlations were found between the Basic Step and two criterion measures (dual-task walking and dual-task Timed Up and Go test), both Wii Fit™ activities were performed with the participant seated (WBB placed in front of feet or beneath buttocks). The researchers did not provide a rationale for why seated activity was chosen over standing when they were particularly interested in dynamic balance.

There has also been research interest in Wii Fit™ as an intervention to ameliorate balance and balance confidence in older people. In three case studies, after playing Wii Fit™ balance games improvements were found in static and dynamic balance in a stroke patient (Brown et al 2009), in an individual with a history of multiple falls (Pigford and Andrews 2010) and in 14 older people with and without balance problems (Bomberger 2010). Williams et al. (2010) recruited 15 community-dwelling fallers (mean age 76.6 ± 5.0 years) for a Wii Fit™ program (individual exercise visits twice weekly for 12 weeks), another six participants received standard care (12-week, physiotherapist-led exercise/education program). Balance and falls efficacy were measured at four weeks and 12 weeks post-baseline. Program adherence and a structured interview provided data regarding the acceptability of the intervention. A significant improvement was reported for one of the two balance measures in the intervention.
group, but only at the four-week assessment. Between-group comparisons were not possible given baseline differences in participant characteristics. Williams et al. (2010) reported that 80% of participants attended 75% or more of the Wii Fit™ sessions and all participants found the program to be enjoyable.

Eight community-dwelling older adults (mean age 75 ± 9.7 years) with a perceived balance deficit were asked to participate in two, 30-minute sessions of Wii Fit™ yoga and balance exercises for six weeks (Bainbridge et al. 2011). Of note, two participants withdrew from the study due to exacerbations of a pre-existing hip problem and low back pain. The outcome measures assessed balance, balance confidence and limits of stability (multi-directional reaching). The researchers did not find any statistically significant improvements.

CAN WII™ WORK IT OUT? A QUALITATIVE STUDY

In the present qualitative study, interviews were conducted with 15 participants from 13 sites. Five of the interviews were with staff in RACF and the remainder were with staff working in day centre programs. Eight participants were located in Victoria, six were in Queensland and one was from New South Wales. The Queensland sites were all managed by the same aged care and disability service provider. All participants were female with an average age of 50.7±10.7 years (range 28-62 years). Six were program coordinators, three were service managers, three were personal carers, two were diversional therapists (DT), and one was a physiotherapist. The period of time that they had been using Nintendo Wii™ Sports with their residents or clients prior to the interview ranged from three months to 20 months.

When asked what prompted them to purchase the Wii™ system, their decision was far from evidence-based. They read positive reports in the grey literature, one DT heard about it at an industry forum, and recommendations came from other staff who had one at home. In Queensland, the Wii™ consoles were given to each site by the service provider. No one reported any problems with installation or set-up, although some interviewees were assisted by colleagues who had a Wii™ at home. One interviewee did report that she found the initial set up burdensome:

‘We didn’t want to set up our clients as individual people in the system...we wanted to basically go straight to a program without all that initial set up.’

Most interviewed offered Wii™ as a group program, however, a DT from a psychogeriatric RACF and a physiotherapist from a day therapy centre provided individualised sessions. At two RACF, high school students were paired with residents and they played the Wii™ together. Typically, Wii™ was played once per week for 30 to 60 minutes, although some of the Queensland respite centres reported only using it once a month as part of an overall activity program. A few of those interviewed said that the novelty wore off after a few months and they were not using Wii™ as frequently.

The researchers were most interested in the feasibility and acceptability of Wii™ in RACF and day care settings. At all locations, staff needed to navigate through the menus to start the games. Up to two people were required for supervision. In the group programs, there were as many as 15 participants plus others just content to watch. The majority of participants were women 80 years of age or older. The games were mostly played whilst people were seated, however some of the day centre clients preferred to stand. Bowling was the most popular program in all the facilities. No injuries were reported. From an evaluation perspective, no one was documenting or measuring any outcomes related to physical functioning or quality of life.

In most settings, participants enjoyed using Wii™ and staff noted increased interaction and engagement between residents/clients and with staff. One program coordinator was able to increase physical activity during Wii™ bowling, for both players and observers, by creating a catch-phrase:

‘Hands in the air for a spare!’
Everyone cheered when someone bowled a spare or a strike. Wii™ became a point of conversation amongst residents/clients and got them talking to people they did not know very well:

“The interaction is just lovely because it’s giving them something apart from…just talking about the weather. It’s opened up a new avenue of friendships…”

After introducing Wii™ into her activity program, one person interviewed realised that her residents still had a healthy sense of competition:

“Win the game or knock over the pins, I don’t know which gives them the biggest satisfaction!”

Staff from only one day-centre reported that the residents did not enjoy the Wii™ or want to use it:

“That’s what they look at it as, watching telly.”

“. . . it was too removed from reality for them.”

Teaching residents/clients how to use the Wii™ controller was the greatest challenge mentioned by each person interviewed. For example in bowling, it was very difficult for them to grasp the concept of releasing the button on the back of the remote whilst they swung their arm to release the ball. This was particularly problematic for cognitively impaired players. In the residential care settings, the staff reported having to fully assist at least half of their participants to use the controller:

“. . . we need something that’s much simpler to operate for them, I think that’s what let us down more than anything else.”

Interestingly, however, one resident became skilled at using the controller whilst playing Wii™ bowling:

“I have a resident who can’t operate the remote control for the TV but by the end of the session she has the A-B button down pat because it’s the repetition.”

In some cases, there was a lack of acceptance of active gaming technology on the part of residents/clients and other staff in the facility, particularly nursing:

“The biggest obstacle is your staff attitude.”

Finally, those interviewed reported less success with tennis, golf, boxing and baseball:

“We did try the tennis, that was probably a lot harder for them, that’s why we ended up back at the bowls.”

“We tried golf one day, but we got lost…they couldn’t hit it [golf ball].”

DISCUSSION

Until recently, VR technology was quite complex, expensive and task oriented. The video gaming industry has brought VR into people’s homes with the current generation of gaming consoles and active gaming software. As it was the first commercially available active gaming system launched, Nintendo’s Wii™ has garnered much media attention and, more recently, research interest. Early studies conducted using Wii™ focused on youth (Deutsch et al. 2008; Graves et al. 2007; Graves et al. 2008). With Wii™ now embraced by managers of retirement communities, seniors’ centres, aged care facilities and rehabilitation centres for recreational and therapeutic purposes, 20 studies have recently been published.

The literature review findings generally support the feasibility of Wii™ as an intervention with older populations, however sample sizes were small, a diverse range of outcomes were investigated and the “dose” of activity (duration and frequency of sessions) varied widely between studies. Further, the longest active intervention period was only 12 weeks. Due to limitations in study design, the evidence of the physical and psychosocial benefits of playing Wii™ must be interpreted with caution. Only three randomised controlled trials have been
conducted to date (Hsu et al. 2011; Jung et al. 2009; Saposnik et al. 2010), but all used another form of activity as the control group (exercise or another form of recreation). In contrast, most researchers reported good adherence to Wii™ interventions and participant enjoyment which supports the acceptability of Wii™ to older adults across the continuum of care.

The findings from our qualitative study and those reported by Higgins et al. (2010) point to increased social interaction amongst residents/clients and engagement with staff during Wii™ sessions. Bowling was by far the most popular program in all the facilities, probably because it was the easiest for residents/clients to learn. This is also the game most research teams selected for their intervention (Clark and Kraemer 2009; Hsu et al. 2011; Sohnsmeyer et al 2010; Weybright et al. 2010). Interestingly, it was only in the qualitative studies that difficulty or frustration with the technology was mentioned (Higgins et al. 2010). There are no established guidelines for the safe and effective use of Wii™. From a safety perspective, this has serious implications given the emerging literature on injuries associated with Wii™ use (Sparks et al. 2009). Wii Fit™ holds promise for balance testing and training to reduce falls risk in older people, without the need for expensive equipment and clinical settings. However, the WBB needs more rigorous testing in real world conditions to determine its reliability, validity and use as an intervention to improve balance abilities. In only two studies has the energy cost of playing Wii™ Sports and Wii Fit™ been measured in older people (Graves et al. 2010; Wollersheim et al. 2010). Further, just the aerobics exergame could be classified as moderate-intensity physical activity. With the exception of aerobics, most games involve sporadic bursts of activity (Graves et al. 2010) or are played whilst seated (Wollersheim et al. 2010). However, finding any of the games enjoyable may change older adults’ attitude towards physical activity and enhance their belief in their capability to be physically active, possibly leading to the adoption of an active lifestyle in other ways.

Since the release of Wii™, there have been further advances in gaming technology. Nintendo developed a new controller, the Wii Remote™ Plus. A gyroscope has been added which determines rotational motion more accurately, thus capturing complex motion. In Wii™ bowling, for example, a player no longer has to release a button on the back of the controller whilst swinging their arm. This improvement may overcome one of the barriers to participation mentioned by aged care staff interviewed in the present qualitative study and also reported by Higgins et al. (2010). Both Sony (Sony Computer Entertainment Inc., Tokyo, Japan) and Microsoft (Microsoft Corporation, Redmond, Washington) have developed hardware and software for the active gaming market.

Sony’s PlayStation® Move is a motion-sensing game controller platform for the PlayStation® 3 video game console. Based on a handheld motion controller wand, PlayStation® Move uses the PlayStation® Eye camera to track the wand's position and inertial sensors in the wand to detect its motion. Microsoft released Kinect™ for Xbox 360 at the end of 2010. Kinect™ has been called a “webcam on steroids” (Wilson 2010). It is equipped with a microphone and video chat software that allows users to interact in real time using their televisions. More importantly, Kinect™ uses invisible infrared light to track the player’s movement. Without the need for a handheld controller, Kinect™ for Xbox 360 may be more suitable for use with older populations than PlayStation® Move and Wii™.

As broadband-enabled healthcare expands and gaming technology advances, gaming consoles could be used for more than recreation. In addition to the potential health benefits, connecting older people to peers or health professionals via broadband may be a strategy to counteract the social and physical isolation experienced by a growing number of those living in the community (Findlay and Cartwright 2002).
CONCLUSIONS

Nintendo’s Wii™ is acceptable to older people and feasible to implement in both rehabilitation and aged care settings. However, there is a need for more rigorous evaluations to assess the functional benefits of active gaming, particularly in the group settings that were found to be common in practice. Research evidence will assist practitioners working with older people to make an informed decision regarding the suitability of the various gaming systems for their residents/clients. Further research will also inform the development of guidelines for safe and effective use of active gaming technology. Games for health represent a growing field in software development. However, given the findings from our qualitative study and the survey conducted by Higgins and colleagues (2010), game developers need to ensure that games for older people are tailored to their physical and cognitive abilities. Within a broadband-enabled society, there is great potential for active gaming technology to play an important role in health promotion initiatives for older people. First, however, the fun and enjoyment of virtual physical activity must be translated to meaningful improvements in function and mobility.

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REFERENCES


Graves, L.E.F; Ridgers, N.D; Williams, K; Stratton, G; Atkinson, G; Cable, N.T. 2010. The physiological cost and enjoyment of Wii Fit in adolescents, young adults, and older adults. *Journal of Physical Activity and Health* 7:393-401.


Saposnik, G; Teasell, R; Mamdani, M; Hall, J; McIlroy, W; Cheung, D; Thorpe, K.E; Cohen, L.G; Bayley, M. 2010. Effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation: A pilot randomized clinical trial and proof of principle. *Stroke* 41:1477-1484.


Sparks, D; Chase, D; Coughlin, L. 2009. Wii have a problem: a review of self-reported Wii related injuries. *Informatics in Primary Care* 17:55-57.


Yamada, M; Aoyama, T; Nakamura, M; Tanaka, B; Nagai, K; Tatematsu, N; Uemura, K; Nakamura, T; Tsunoyama, T; Ichihashi, N. in press. The reliability and preliminary validity of game-based fall risk assessment in community-dwelling older adults. *Geriatric Nursing* In press.


APPENDIX 1 – CAN WII™ WORK IT OUT? INTERVIEW QUESTIONS

1. When did you/your facility purchase the Wii™ system?

2. Did you have any difficulty first setting it up or learning to use it? Probe for: problems with hardware / software, installation problems, finding a suitable location

3. How have you incorporated Wii™ games into your recreational/diversional/therapeutic programmes? Probe for: frequency, duration, group or one-to-one programs, games most/least popular, development of training materials / guidelines for staff

4. How feasible has it been to use Wii™ with residents? Probe for: number of residents participating, seated or standing to play, amount of supervision, any injuries / problems, strengths (positive experiences) and limitations

5. How acceptable has your Wii™ program been to residents? Probe for: any benefits mentioned by residents or noticed by staff, sustainability (still popular or has the novelty worn off), new participants to the program, barriers and enablers