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Training Advanced Practice Providers to Collect Functional Outcomes After Fragility Fractures

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Abstract

Objective: The objective of this study was to determine whether advanced practice providers could learn to collect objective functional assessment data accurately and efficiently with commercially available devices that measure kinematics and kinetics (Nintendo Wii Balance Board [WBB] and Level Belt [LB]) to aid in the assessment of fall risk and outcomes after fragility fractures. **Methods:** Nine advanced practice providers participated in a 1-hour clinical assessment tools (CATs) training session on equipment use, providing standardized instructions, and practice of the testing procedures. Afterward, they participated in a skills demonstration evaluation and completed a postsession survey. **Results:** Participants successfully achieved a mean of 18.22 (standard deviation 1.56) of 20 performance measures. Of the incomplete or omitted tasks, the majority (10 of 16) occurred within the first of 3 CATs activities. Postsession survey results revealed that 9 of 9 participants reported that the 1 hour provided for training on the CATs was sufficient. All participants reported that after the training, they felt confident they could reliably carry out the tasks to test patients on both the WBB and the LB. The majority of participants reported that they believed that the WBB (7 of 9) and LB (8 out of 9) would be good assets to clinics in assessing patient functionality after fragility fractures. **Conclusion:** These results indicate that advanced practice providers can confidently learn and effectively test patients with the WBB and LB within 1 hour of training. In the future, adoption of CATs in the clinical setting may allow for objective, easy-to-use, portable, noninvasive, and relatively inexpensive measures to assess functional outcomes in patients with fragility fracture.

Keywords

clinical assessment tool, Nintendo Wii Balance Board, Level Belt, advanced practice provider, fragility fracture

Introduction

The health care field is undergoing major paradigm shifts in an effort to develop and improve practices supported by evidence-based research. Overarching goals include optimizing patient safety, improving patient care, and reducing health care costs. The Affordable Healthcare Act in particular has emphasized the importance of preventative medicine and primary care. These topics have become increasingly important, as the medical field continues to strive to provide quality and efficacious care for patients.

In addition, there has been an interest in moving some aspects of health care out of the hospitals and into outpatient clinics or even the patient's own home. In these settings, the use of advance practice providers (including nurse practitioners, physician assistants, and nursing staff) will become even more important. Advanced practice providers will need to be trained on the use of new technologies introduced to enhance patient care, and the development of efficacious training programs will be an integral part in ensuring the successful implementation of these new technologies in clinical settings. However, a review of the literature reveals that there is currently limited data on the optimal methods to train clinicians to use these technologies effectively. Thus, there is need for additional research to best understand the components of an effective training program for providers learning to use new health care technologies.

The orthopedic surgery field in particular has seen an increase in the incorporation of new technologies and the

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development of evidence-based clinical assessment tools to evaluate treatment outcomes for musculoskeletal injuries. This motivation arises from the need to provide improved care for focused populations, including patients with fragility fracture.[1] Fragility fractures are those that result from minimal trauma, that is, falling from a standing height. The burden of fragility fractures in the United States is impressive, with lifetime risk of fragility fracture estimated to be at least 40% in females and 13% in males.[2] In the United States, there are approximately 547 000 inpatient hospitalizations, 2 634 000 physician visits, 807 000 emergency department encounters, and 179 000 nursing home residents each year due to osteoporosis-related fractures.[3] The health outcomes of fragility fracture may include complete recovery or may instead lead to chronic pain, functional disability, psychological burdens, and even death.[4] The major morbidity and mortality implications for patients with fragility fracture—along with the substantial costs of surgery, hospitalization, and rehabilitation—make the socioeconomic impact of caring for these patients with orthopedic trauma profound.[5] Prior fragility fracture is one of the strongest predictors for future fracture risk. In fact, a previous hip fracture is associated with a 2.5 times increased risk in having a future fragility fracture.[6] Thus, it is of paramount importance that orthopedic clinics focus on both preventing and treating fragility fractures.

Identifying functional deficits that put patients at risk of future falls and fragility fractures could have substantial medical and economic benefits. Thus, it is paramount that clinicians develop evidence-based, inexpensive, noninvasive, and user-friendly clinical assessment tools (CATs) that predict, monitor, and assess clinical outcomes for patients with fragility fracture. It is also necessary for health care workers to be properly trained in using these clinical tools, so patient outcomes for musculoskeletal injuries can be accurately and reliably measured.

The 2 CATs utilized in this study were 2 commercially available devices that measure kinematics and kinetics, namely, the Nintendo Wii Balance Board (WBB) and Level Belt (LB).

The WBB (Figure 1) is an accessory to the Nintendo Wii console designed for use in fitness gaming activities. However, researchers and clinicians have recognized the use of the WBB as a force plate that reliably and accurately measures center of pressure.[7,8] The LB (Figure 2) is a commercialized mobile device application and lumbopelvic belt setup that users wear around their waist; the application measures anterior/posterior (A/P) and medial/lateral tilt during functional activities such as walking or functional sports movements.[9,10] The CATs such as the WBB and LB are increasingly being recognized as potential utilities for the treatment, rehabilitation, and assessment of patients with fragility fracture.[11] Along with the introduction of new CATs, it is of great importance that clinicians are properly trained on the use of these tools in order to continue to provide the highest quality of care to patients. We hypothesized that advanced practice providers could learn to collect objective functional assessment data accurately and efficiently with commercially available devices that measure kinematics and kinetics (WBB and LB) to aid in the assessment of fall risk and outcomes after fragility fractures. This study was approved by the institution's Biomedical Sciences Institutional Review Board.

Methods

Participants

A total of 9 advanced practice providers (1 registered nurse, 3 nurse practitioners, 2 physical therapists, and 3 physician assistants) were recruited for voluntary participation in this study. These individuals were selected because they had previous experience working with patients having fragility fracture in the outpatient clinic setting and would thus be able to provide effective feedback regarding the clinical utility of the CATs. No participants had prior training on the use of the WBB or LB specifically as a CAT, although several participants did note previous recreational experience with the WBB.

Site Selection

Once participants expressed interest in participating in the study, each selected a date, time, and clinic site to complete the study. Three orthopedic outpatient clinics were selected because these sites had both examination rooms and office space to conduct the study and are staffed by physicians and other health care professionals who have experience seeing patients with fragility fracture (Table 1). These locations were selected in order to demonstrate that the CATs could be utilized in space-limited areas and whether advanced practice providers felt comfortable using the CATs in these conditions.

Clinical Assessment Tools Exercises

The CATs exercises selected included the Torso Twists and Single Leg Stand activities on the WBB and ambulating forward 20 ft while wearing the LB. These exercises were carefully chosen to reflect functional everyday tasks, such as reaching for objects (Torso Twists), balancing (Single Leg Stand), and walking (ambulating with the Level Belt).

The Torso Twists activity, an exercise included as part of the WBB game console, consists of the participant abducting both arms to be parallel to the floor, then reaching one hand to the opposite knee, and then alternating sides for approximately 30 seconds. Participants were told to try and follow the pace of the WBB character but to go at their own pace if needed. Participants thus completed approximately 4 to 5 full twists (left and right side as 1 full twist) during the 30 seconds.

The Single Leg Stand activity performed during this study was modified from the original Single Leg Stand activity that was part of the WiiFit Plus game. The WBB program asks the player to first perform a single leg stand, then to alternatively extend and flex the opposite hip and knee. This additional extension and flexion was not performed during this study because it was decided that this task may be too difficult for patients with fragility fracture and also offered no additional level of functional assessment for patients. Instead, participants were asked to simply hold the single leg stand for the duration

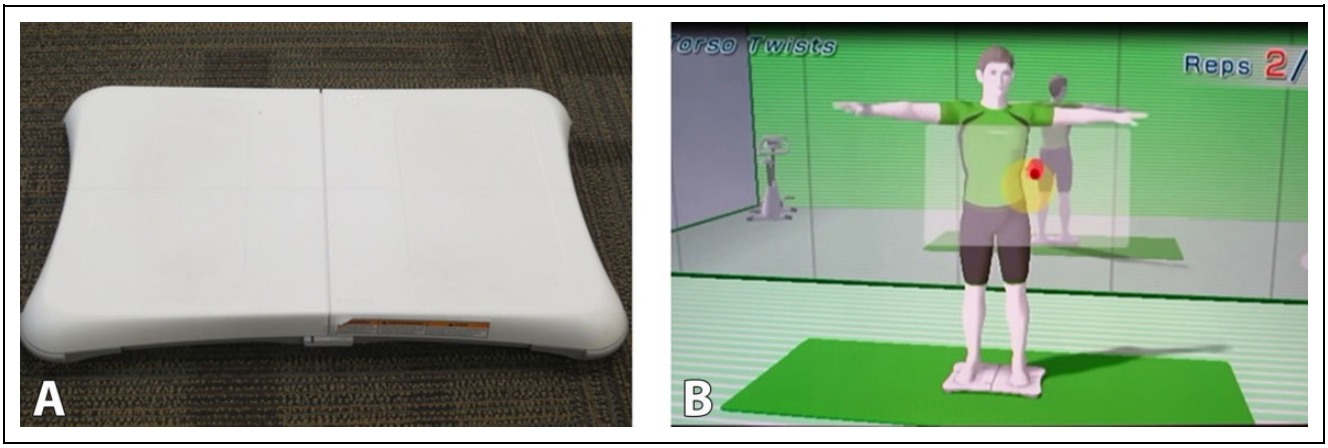

Figure 1. Nintendo Wii Balance Board. A: Picture of balance board. B: Screen shot of the WiiFit program for side to side movement.

Figure 2. Level Belt. The Level Belt is a commercialized iPod application and lumbopelvic belt setup that measures anterior/posterior and medial/lateral tilt during functional activities. A, Level Belt setup with iPod in pocket. The belt is placed over bilateral anterior superior iliac spines and the iPod is centered in the midline of the patient's spine. B, Example screen of data capture using the Level Belt iPod application.

Table 1. Advanced Practice Providers Recruited From Orthopaedic Outpatient Clinic Sites.[a]

Site	Registered nurse	Nurse practitioner	Physical therapist	Physician assistant
Clinic site #1	1	1	0	1
Clinic site #2	0	1	2	0
Clinic site #2	0	1	0	2

[a]Nine advanced practice providers (1 registered nurse, 3 nurse practitioners, 2 physical therapists, and 3 physician assistants) from the recruited to participate in this study at 3 select orthopedic outpatient clinic sites.

of the time that the on-screen player would be performing the additional movements (30 seconds). The exercise thus consisted of balancing 30 seconds on the right leg, followed by 30 additional seconds on the left leg.

Finally, for the last exercise, participants were asked to walk forward 20 ft while wearing the Level Belt at their own pace. For each of these exercises, 3 trials each were conducted.

Clinical Assessment Tools Training and Evaluation Sessions

During the study, the advanced practice providers completed a 45-minute CATs training session and a 45-minute evaluation session. Both the training and the evaluation sessions took place directly in the outpatient examination rooms or office space settings (Figure 3). See Table 2 for an overview of the CATs training and evaluation sessions and Figure 4 for the training packet and patient instructions.

Results

There were a total of 9 advanced practice providers (1 registered nurse, 3 nurse practitioners, 2 physical therapists, and 3 physician assistants) who participated in this study. Three participants each were assessed in each of the 3 outpatient clinic settings selected for this study (Table 1).

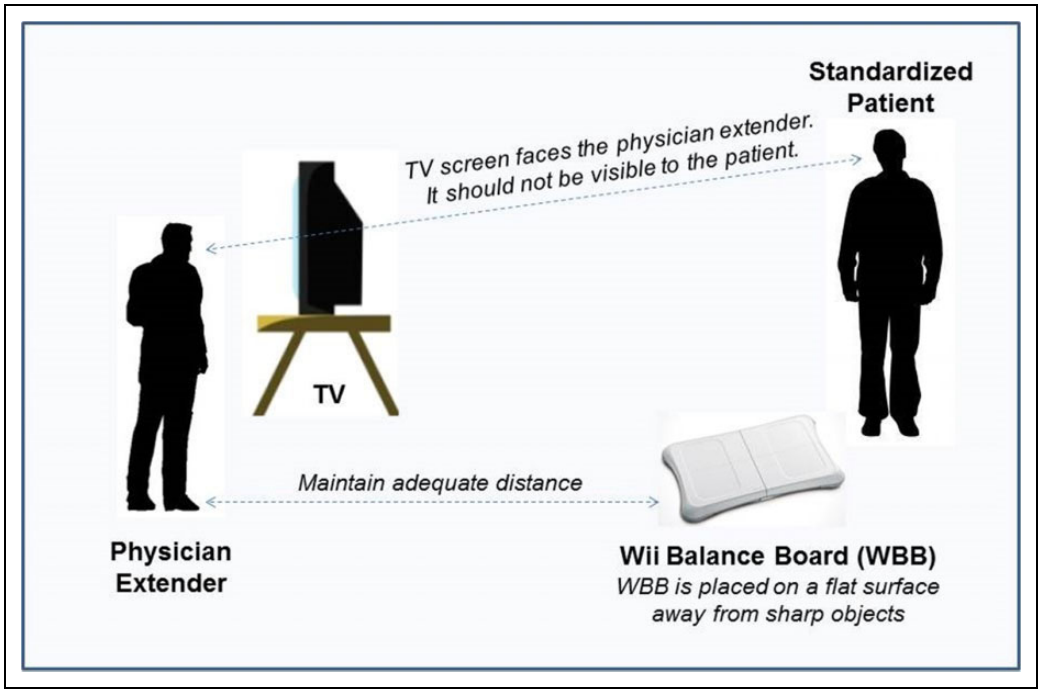

Figure 3. Room and equipment setup during the clinical assessment tools (CATs) posttraining skills demonstration evaluation. The advanced practice provider stood behind the television screen setup and led a standardized patient (a young, healthy research assistant) through the CATs assessment activities. This diagram was provided to the participants as part of the CATs training packet and was also available for their use during the skills demonstration evaluation.

Table 2. CATs Training and Evaluation Session.[a]

Training (45 minutes)	
15 minutes	• Introduction to the study • Review and sign consent forms
15 minutes	• Watch a pre-recorded training video and follow-along with script that reviewed: ○ Room and equipment set-up ○ Navigation through the WBB and LB menu options ○ Providing standardized instructions for patients ○ Demonstration of the CATs exercises
15 minutes	• Review video or script • Answer questions
Evaluation (45 minutes)	
15 minutes	• Practice with the WBB and LB equipment • Time for feedback and answering additional questions
20 minutes	• The advanced practice providers participated in a posttraining skills demonstration evaluation, a video-recorded evaluation of their proficiency using the WBB and LB as CATs in the orthopaedic clinic setting. The advanced practice providers demonstrated how they would lead a standardized patient through performing the CATs exercises
10 minutes	• Completion of postsession survey • Time for feedback and answering additional questions

Abbreviations: CATs, clinical assessment tools; LB, Level Belt; WBB, Wii Balance Board.
[a]Advanced practice providers completed a CATs training and evaluation session that totaled 90 minutes.

Posttraining Skills Demonstration Evaluation

The posttraining skills demonstration evaluation was completed by a trained member of the research team. An item was marked as "correct" if the participant successfully completed all elements of the task in accordance with the CATs training session, marked as "incorrect" if the task was performed improperly in any manner or marked as "omitted" if either part of all elements of the task was not completed. In the posttraining skills demonstration evaluation (Table 3), participants successfully achieved a mean of 18.2 (standard deviation 1.56) of 20 performance measures, with 10 of 16 incomplete or omitted tasks occurring during the interval prior to beginning the 3 CATs activities or during the first CATs activity, Torso Twists. Several errors that occurred included not introducing oneself to the standardized patient, omitting the demonstration to the standardized patient of how to perform the 3 CATs activities, incorrectly navigating through the Wii menu options, not recording patient scores from the activities, and not performing enough trials for each activity. Several of these errors were rectified by the participant later in the study. All participants correctly performed all tasks in the instructed order, and all demonstrated consideration for patient safety as well as professional respect for the patient.

Postsession Survey

The postsession survey (Table 4) provided feedback regarding the training video, training packet, and the participants'

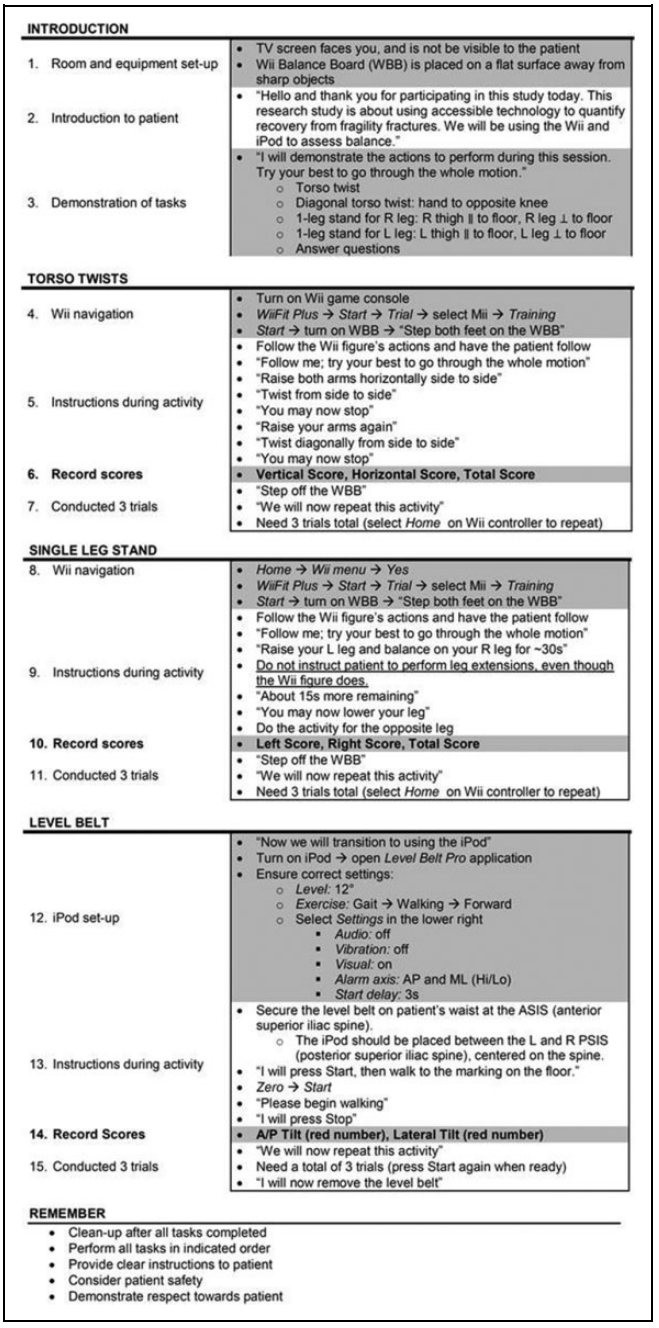

Figure 4. Clinical assessment tools (CATs) training packet script. This script provides a guideline for the tasks to perform during an evaluation of patients using the Wii Balance Board (WBB) and Level Belt (LB) as CATs. This script parallels the instructions provided in the CATs training video. Participants were provided a handout of this script to follow along while watching the CATs training video, and this script was also available to participants to use during the skills demonstration evaluation.

assessment of the WBB and LB as CATs. Survey results revealed 9 of 9 participants reported that the 1 hour provided for training on the CATs was sufficient to learn the required tasks. The CATs training video and packet were rated with majority "excellent" and "good" ratings regarding quality of

Table 3. Posttraining Skills Demonstration Evaluation.[a]

Task	Correct	Incorrect	Omitted
1. Room and equipment set-up	9	0	0
2. Introduction to patient	8	0	1
3. Demonstration of tasks	5	1	3
4. Wii navigation (Torso Twists)	8	1	0
5. Instructions during activity (Torso Twists)	7	2	0
6. Recorded scores (Torso Twists)	9	0	0
7. Conducted 3 trials (Torso Twists)	7	1	1
8. Wii navigation (Single Leg Stand)	9	0	0
9. Instructions during activity (Single Leg Stand)	9	0	0
10. Recorded scores (Single Leg Stand)	6	2	1
11. Conducted 3 trials (Single Leg Stand)	9	0	0
12. iPod set-up (Level Belt)	9	0	0
13. Instructions during activity (Level Belt)	9	0	0
14. Recorded Scores (Level Belt)	7	0	2
15. Conducted 3 trials (Level Belt)	8	0	1
16. Clean-up after all tasks completed	9	0	0
17. Performed tasks in indicated order	9	0	0
18. Clear instructions to patient	9	0	0
19. Consideration for patient safety	9	0	0
20. Demonstrate respect towards patient	9	0	0
Total	164	7	9
Mean (SD) per Participant	18.2 (1.56)	1.4 (2.22)	1.8 (2.82)

Abbreviations: CATs, clinical assessment tools; SD, standard deviation.
[a]Participants were evaluated on 20 different measures to assess their performance on the CATs devices following the training session. For each performance measure, participants were assessed as having performed the task correctly, incorrectly, or whether the task was omitted.

instructions provided and majority "sufficient" ratings regarding time allotted for review and practice. All participants also "strongly agree[d]"or "agree[d]" that the skills demonstration evaluation after the CATs training session provided a good opportunity to simulate the tasks on a standardized patient.

All participants "strongly agree[d]" or "agree[d]" that after the training, they were knowledgeable about and felt confident that they could reliably carry out the tasks to test patients on both the WBB and the LB. The majority of participants had favorable reviews of both the WBB and the LB being good assets to clinics in assessing patient functionality after fragility fractures. Additional comments were collected at the end of the survey, and the comments received indicated that points for improvement in the CATs training session would be to include a live demonstration of equipment use and recording scores, along with further clarification regarding shoe wear, placement

Table 4. Postsession Survey.[a]

	Poor	Fair	Good	Excellent
1. The instructions provided in the *training video* were	0	0	3	6
3. The instructions provided in the *training packet* were	0	1	3	5

	Too short	Somewhat short	Sufficient	Somewhat long	Too long
2. The length of the *training video* was	0	1	8	0	0
4. The amount of time to review the *training packet* was	0	0	9	0	0
5. The amount of time to practice on the equipment was	0	0	9	0	0
6. The *total* length of time for the training (watching the video, reviewing the packet, practicing on the equipment) was	0	0	9	0	0

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
7. After the training, I know how to properly carry out the tasks to test patient on the *Wii Balance Board*.	0	0	0	3	6
8. After the training, I know how to properly carry out the tasks to test patients on the *Level Belt*.	0	0	0	4	5
9. After the training, I feel confident that I can reliably carry out the tasks to test patients on the *Wii Balance Board*.	0	0	0	4	5
10. After the training, I feel confident that I can reliably carry out the tasks to test patients on the *Level Belt*.	0	0	0	4	5
11. The skill demonstration session provided me a good opportunity to simulate the tasks on a standardized patient.	0	0	0	2	7
12. The *Wii Balance Board* would be a good asset to clinics in assessing patient functionality after fragility fractures.	0	0	2	3	4
13. The *Level Belt* would be a good asset to clinics in assessing patient functionality after fragility fractures.	0	0	1	5	3

Abbreviations: CATs, clinical assessment tools.
[a]Following the CATs training, participants were asked to complete a brief survey on their experience during the study, specifically regarding the training session, their perceived abilities to use the CATs, and the use of the CATs in clinic settings for fragility fracture patients.

of the feet on the WBB, and an interpretation of the numerical scores from each exercise.

Discussion

Clinical Assessment Tools Training Session

The CATs training session utilized several different methods to deliver the instructions for utilizing the CATs to the participants. The 1-hour session consisted of a 15-minute video accompanied by an instructions script and a diagram on room and equipment setup, followed by time to practice on the equipment and to clarify questions related to the setup and testing. Individuals have different preferred learning styles,[12] and the development of this CATs training session took into account these needs while maintaining a comprehension level that is readily understandable by all levels of health care professionals. In addition, the development of a video and script allowed this CATs training session to be reliably administered in a standardized fashion across multiple study sites, participants from different health care backgrounds, and for a diverse patient population in the future. The use of a prerecorded training video also allows for the delivery of training sessions online or as an electronic resource.

The 3 different sites chosen represented a spectrum of available outpatient clinic spaces, including small examination rooms, larger examination rooms, and office space settings. The CATs used in this study were relatively small and easily transported from 1 study site to the next, with the equipment being easy to setup in both examination rooms and office space settings. Holding the CATs sessions successfully in these different outpatient areas demonstrates the portability and adaptability of the CATs equipment, training, and patient assessment for their use in many settings.

The CATs training session was overall well received by the participants. All participants found 1 hour to be sufficient time for training on the WBB and LB. Thus, these CATs show a distinct advantage over other research-grade equipment currently used for functional assessment of patients. Reduced time to train advanced practice providers on the use of these tools will allow for a greater number of individuals to be trained in a shorter amount of time, thus conserving resources for the training institution as well as facilitating the integration of these CATs into the clinical setting. In addition, the postsession

survey revealed that participants had positive remarks about their training session, specifically regarding the quality of instructions and length of the training video, the quality of instructions and time to review the instructions script, and the time to practice on the CATs equipment prior to evaluation. Participants also found value in using the standardized patient to assess their ability to carry out tasks on the CATs prior to future patient assessment with the CATs.

Participants did, however, note several areas of possible improvement for future CATs training sessions. Future CATs training sessions will incorporate instructions on patient shoe wear and placement of the feet on the WBB, an explanation of the functional value of each score from the exercises, along with a live demonstration by the research assistant on equipment use, including a real-time demonstration of navigation through the Wii menu and recording scores for each patient on the score record sheet. Other changes to future CATs training sessions will be made after analysis of the most commonly made errors and omissions by participants during their skills demonstration evaluation. These changes include an emphasis on physically demonstrating the tasks to the patients at the beginning of the session before proceeding to the testing phase, instructing patients to follow the pace of the advanced practice provider, and a discussion on the importance of performing 3 full trials of each task for testing reliability. These changes will likely improve performance by the advanced practice providers and cultivate a better experience for patients being assessed by the CATs.

The literature reveals limited information regarding the effective methods for training health care providers on the use of new health care technologies. A review of the literature at the time of writing this manuscript reveals no studies analyzing different approaches to training providers on the use of new health care technologies. However, the design of the CATs training session and evaluation utilized in this study proved itself to be adaptable to various clinical settings, considerate to individual different learning styles, and well received by advanced practice providers. Overall, the approach used in this study—a combination of a video didactic session and hands-on practice, with written and graphic supplemental material provided—demonstrates utility and capability to effectively train advanced practice providers to use CATs in orthopadic settings. We recommend that those interested in implementing new CATs training programs consider using this integrated approach. Additional studies specifically focused on developing the most effective provider training program and evaluation system will be beneficial as new technologies continue to be introduced to the field of medicine.

Participant Performance and Experience With the CATs

After just 1 hour of training on the CATs equipment, participants demonstrated competence and reported confidence in using the CATs equipment. Participants achieved a mean of 18.2 of 20 performance measures, with the majority of mistakes occurring during the interval prior to beginning any of the CATs tasks or during the first CATs activity, followed by improvement throughout the rest of the CATs session. For example, 1 participant omitted instructions to the patient on how to perform the single leg stand in the correct sequence. However, the individual did remember to include this prior to the end of the demonstrations section. Another participant incorrectly navigated through the Wii menu for the Torso Twists activity during the first trial but was able to make adjustments and navigate the menu correctly during the rest of the trials, along with the rest of the WBB activities. These individuals demonstrated that they were able to effectively troubleshoot any errors made during the CATs activities. There were no incorrect or omitted actions during the room and equipment setup, indicating that the CATs setup was well understood by participants from the training session.

Of note, all participants ''strongly agreed'' or ''agreed'' that they could confidently and reliably carry out the tasks to test patients on both the WBB and the LB. This is an important metric to consider because having confidence in one's ability to perform these tasks is an important self-esteem factor and can influence one's surrounding environment in a positive manner. Having advanced practice providers who are confident in their ability to perform accurate and reliable testing of patients on the CATs will promote a better clinic experience for both the advanced practice provider and the patient and likely leads to efficient data collection in busy clinic settings.

Finally, the majority of study participants reported that they believed that the WBB (7 of 9) and LB (8 of 9) would be good assets to clinics in assessing patient functionality after fragility fractures, with the LB being slightly more favored than the WBB as an orthopedic CAT. Thus, these 2 CATs have high potential for acceptance by health care professionals for use in the orthopedic clinic setting. Combined with favorable assessments of the CATs training session and performance during the skills demonstration session, this study suggests that the WBB and LB will likely be easily integrated as CATs in the orthopedic clinic setting.

Limitations

There are several limitations to our study. First, we had a limited sample size of 9 participants who were chosen by convenience methods rather than randomized sampling. In addition, our participants represented just 3 advanced practice provider fields—nursing, physician assistant, and physical therapy. There are a multitude of other health care fields involved in care of orthopedic patients, including occupational therapy, occupational therapy assistants, physical therapy assistants, athletic trainers, and more. Therefore, it may not be justified to generalize conclusions regarding the CATs training and use of the CATs in patient assessment to all advanced practice provider fields. Additional studies with a larger participant pool representing other clinical providers will have to take place in order to make these conclusions.

In addition, this study only utilized 2 potential CATs, namely, the WBB and the LB. There are many other commercially

available devices available on the market today that could potentially be used as CATs. These devices include the Sony PlayStation, Xbox Kinect, and more. Other devices used for the functional assessment of patients, such as the MicroFET handheld dynamometer, were also not assessed as CATs in this study. A review of the current literature suggests that the WBB and Xbox Kinect are rapidly emerging as balance and training tools in the field of orthopedics.[8] It is likely that other similar devices will similarly be studied for their potential application in the field of orthopedics as well as in other fields of medicine.

Several questions from participants arose during this study regarding the interpretation of scores from the CATs activities, including scores from the Torso Twists and Single Leg Stand activities from the WBB, and the A/P and Lateral Tilt scores from the LB. Currently, it is not possible to make a universal generalization regarding the reliability and validity of CATs assessments in the field of orthopedics.[8] Additionally, there are limited data on the reliability and validity of individual games and activities on these gaming devices. However, the use of the WBB as a force plate has been shown to be able to collect reliable and valid center of pressure measurements, which is a measure of postural control and thus has functional value when evaluating patients with fragility fracture.[8] As interest in the use of commercially available gaming devices grows, additional data will shed light on the reliability and validity of these devices as CATs.

Role of CATs in the Clinical Setting

The use of these CATs in the clinical setting will of course be different than the research setting of this study. Assessing patients who have injuries and functional impairments, such as from fragility fractures, may change the way that the advanced practice providers carry out the CATs tasks and assessments. There may need to be additional considerations for fall prevention and/or adaptations in performance of the physical maneuvers for some patients. These considerations speak to the need to be appropriately trained on the use of the CATs equipment and protocol to allow for flexible adaptation to occur with each new patient interaction. Additionally, it will be important to know about patients' experiences and attitudes regarding the use of CATs in their health care plan. Besides acceptance from the health care community, it is of great importance to also have patient support for the sustainable use of the CATs.

There is also potentially a role for CATs in the treatment and rehabilitation after musculoskeletal injuries including fragility fractures. The CATs activities in this study were chosen for their ability to assess functional ability in patients with fragility fracture. For example, the trunk rotation motion in the Torso Twists activity is a maneuver that is performed in many activities of daily living, including reaching. Lower scores on the WBB Torso Twists activity have been identified in patients with fragility fracture compared to healthy controls, highlighting the potential of this WBB to be used in the evaluation and rehabilitation of patients with fragility fracture. Other CATs including the LB and MicroFET hand-held dynamometer were also able to identify deficits in hip abduction strength and postural sway in patients with fragility fracture compared to controls, identifying potential roles for these CATs in the evaluation of fall risk in patients.

Although the CATs in this study were used in outpatient clinical settings, it is also highly likely that these same CATs would be able to be easily utilized in a patient's own home. The WBB is a device that many individuals already own for recreational purposes; the device can otherwise be easily obtained at a reasonably low cost. The LB is a relatively inexpensive application on an iPod or other mobile device that allows for immediate biofeedback to the patient as well as real-time data collection on function that can be sent to a care provider immediately after completion of a task by the patient.[9,10] Again, many individuals already own such devices, and it would be quite easy for patients to download the LB application and obtain a LB belt for use in their own homes. The integration of these CATs into home care has the potential to further reduce costs and other health care burdens for both patients and health care providers.

Besides the uses of CATs in the assessment and rehabilitation of balance, gait, and fitness, other clinicians have also been increasingly interested in the use of commercially available gaming devices in their respective fields. For example, the WBB has been studied in applications including the assessment and treatment for neurological diseases including Parkinson disease,[13-16] multiple sclerosis,[17-20] and stroke.[21-25] The LB has been used in the sports medicine field to study potential factors related to performance or injuries.[9-10] Radiologists have also been interested in the motion-capturing capabilities of the Xbox Kinect for breast imaging[26] and hepatic lesion imaging.[27] Research has also been conducted on the use of the Nintendo Wii and Playstation to improve laparoscopic surgical technique.[28-34] The use of CATs in the field of medicine is continuing to grow, highlighting the importance of continued research on the use of CATs in the clinical setting.

Conclusion

These results indicate that advanced practice providers can confidently learn and effectively test patients with the WBB and LB within 1 hour of training, that an integrated approach to training advanced practice providers is an efficacious approach, and that CATs show a high probability of acceptance by health care providers for patient assessment in clinical settings. In the future, adoption of CATs in the clinical setting may allow for objective, easy-to-use, portable, noninvasive, and relatively inexpensive measures to assess functional outcomes in patients with fragility fracture. As the Affordable Healthcare Act continues to evolve, and pay for performance measures begin to take place, it is paramount that clinicians have tools to objectively measure functional outcomes in an accurate but timely manner to provide immediate feedback to the patient as well as guide rehabilitation strategies. It is also highly important that providers are effectively trained on the

use of these tools so that they may be used effectively in the clinical setting. The WBB and LB may afford the opportunity for many orthopedic clinic settings to identify functional deficits in patients which can be easily addressed during the rehabilitation process and improve long-term patient outcomes.

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Declaration of Conflicting Interests

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References

1. Bouxsein ML, Kaufman J, Tosi L, Cummings S, Lane J, Johnell O. Recommendations for optimal care of the fragility fracture patient to reduce the risk of future fracture. *J Am Acad Orthop Surg*. 2004;12(6):385-95.
2. Melton LJ III, Chrischilles EA, Cooper C, Lane AW, Riggs BL. Perspective. How many women have osteoporosis? *J Bone Miner Res*. 1992;7(9):1005-1010.
3. US Department of Health and Human Services. Bone health and osteoporosis: a report of the Surgeon General. 2004.
4. National Osteoporosis Foundation. America's bone health: The state of osteoporosis and low bone mass in our nation. 2002.
5. Burge R, Dawson-Hughes B, Solomon DH, Wong JB, King A, Tosteson A. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005-2025. *J Bone Miner Res*. 2007;22(3):465-475.
6. Colón-Emeric C, Kuchibhatla M, Pieper C, et al. The contribution of hip fracture to risk of subsequent fracture: data from two longitudinal studies. *Osteoporos Int*. 2003;14(11):879-883.
7. Clark RA, Bryant AL, Pua Y, McCrory P, Bennell K, Hunt M. Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance. *Gait Posture*. 2010;31(3):307-310.
8. Ruff JM, Wang TL, Quatman-Yates CC, Phieffer LS, Quatman CE. Commercially available gaming systems as clinical assessment tools to improve value in the orthopaedic setting: a systematic review. *Injury*. 2015;46(2):178-183.
9. Chaudhari AM, McKenzie CS, Borchers JR, Best TM. Lumbopelvic control and pitching performance of professional baseball pitchers. *J Strength Cond Res*. 2011;25(8):2127-2132.
10. Chaudhari AM, McKenzie CS, Pan X, Oñate JA. Lumbopelvic control and days missed because of injury in professional baseball pitchers. *Am J Sports Med*. 2014;42(11):2734-2740.
11. Fung V, So K, Park E, et al. The utility of a video game system in rehabilitation of burn and nonburn patients: a survey among occupational therapy and physiotherapy practitioners. *J Burn Care Res*. 2010;31(5):768-775.
12. Prithishkumar IJ, Michael SA. Understanding your student: using the VARK model. *J Postgrad Med*. 2014;60(2):183-186.
13. Esculier JF, Vaudrin J, Tremblay LE. Corticomotor excitability in Parkinson's disease during observation, imagery and imitation of action: Effects of rehabilitation using Wii Fit and comparison to healthy controls. *J Parkinsons Dis*. 2014;4(1):67-75.
14. Gonçalves GB, Leite MA, Orsini M, Pereira JS. Effects of using the Nintendo Wii Fit Plus Platform in the sensorimotor training of gait disorders in Parkinson's disease. *Neurol Int*. 2014;6(1):5048.
15. Herz NB, Mehta SH, Sethi KD, Jackson P, Hall P, Morgan JC. Nintendo Wii rehabilitation ("Wii-hab") provides benefits in Parkinson's disease. *Parkinsonism Relat Disord*. 2013;19(11):1039-1042.
16. Holmes JD, Jenkins ME, Johnson AM, Hunt MA, Clark RA. Validity of the Nintendo Wii® Balance Board for the assessment of standing balance in Parkinson's disease. *Parkinsonism Relat Disord*. 2013;19(11):1039-1042.
17. Brichetto G, Spallarossa P, de Carvalho ML, Battaglia MA. The effect of Nintendo® Wii® on balance in people with multiple sclerosis: a pilot randomized control study. *Mult Scler*. 2013;19(9):1219-1221.
18. Kalron A, Frid L. Nintendo Wii virtual reality game improves short term balance capabilities in multiple sclerosis patients: a pilot quasi-experimental study. *J Phys Ther*. 2012;5(5):54-62.
19. Nilsagård YE, Forsberg AS, von Koch L. Balance exercise for persons with multiple sclerosis using Wii games: a randomised, controlled multi-centre study. *Mult Scler*. 2013;19(2):209-216.
20. Plow M, Finlayson M. Potential benefits of Nintendo Wii Fit among people with multiple sclerosis: a longitudinal pilot study. *Int J MS Care*. 2011;13(1):21-30.
21. Barcala L, Grecco LA, Colella F, Lucareli PR, Salgado AS, Oliveira CS. Visual biofeedback balance training using Wii Fit after stroke: a randomized controlled trial. *J Phys Ther Sci*. 2013;25(8):1027-1032.
22. Celinder D, Peoples H. Stroke patients' experiences with Wii Sports® during inpatient rehabilitation. *Scand J Occup Ther*. 2012;19(5):457-463.
23. Deutsch JE, Brettler A, Smith C, et al. Nintendo Wii sports and Wii Fit game analysis, validation, and application to stroke rehabilitation. *Top Stroke Rehabil*. 2011;18(6):701-719.
24. Hung JW, Chou CX, Hsieh YW, et al. Randomized comparison trial of balance training by using exergaming and conventional weight-shift therapy in patients with chronic stroke. *Arch Phys Med Rehabil*. 2014;95(9):1629-1637.
25. Kim EK, Kang JH, Park JS, Jung BH. Clinical feasibility of interactive commercial Nintendo gaming for chronic stroke rehabilitation. *J Phys Ther Sci*. 2012;24(24):901-903.
26. Henseler H, Kuznetsova A, Vogt P, Rosenhahn B. Validation of the Kinect device as a new portable imaging system for three-dimensional breast assessment. *J Plast Reconstr Aesthet Surg*. 2014;67(4):483-488.
27. Chao C, Tan J, Castillo EM, Zawaideh M, Roberts AC, Kinney TB. Comparative efficacy of new interfaces for intra-procedural imaging review: The Microsoft Kinect, Hillcrest Labs Loop Pointer, and the Apple iPad. *J Digit Imaging*. 2014;27(4):463-469.
28. Badurdeen S, Abdul-Samad O, Story G, Wilson C, Down S, Harris A. Nintendo Wii video-gaming ability predicts laparoscopic skill. *Surg Endosc*. 2010;24(8):1824-1828.

29. Bokhari R, Bollman-McGregor J, Kahoi K, Smith M, Feinstein A, Ferrara J. Design, development, and validation of a take-home simulator for fundamental laparoscopic skills: Using Nintendo Wii for surgical training. *Am Surg*. 2010;76(6): 583-586.
30. Boyle E, Kennedy AM, Traynor O, Hill ADK. Training surgical skills using nonsurgical tasks-can Nintendo Wii™ improve surgical performance? *J Surg Educ*. 2011;68(2):148-154.
31. Giannotti D, Patrizi G, Di Rocco G, et al. Play to Become a Surgeon: Impact of Nintendo Wii Training on Laparoscopic Skills. *PLoS One*. 2013;8(2):e57372.
32. Jalink MB, Goris J, Heineman E, Pierie JP, ten Cate Hoedemaker HO. Construct and concurrent validity of a Nintendo Wii video game made for training basic laparoscopic skills. *Surg Endosc*. 2014;28(2):537-542.
33. Ju R, Chang PL, Buckley AP, Wang KC. Comparison of Nintendo Wii and PlayStation2 for enhancing laparoscopic skills. *JSLS*. 2012;16(4):612-618.
34. Middleton KK, Hamilton T, Tsai PC, Middleton DB, Falcone JL, Hamad G. Improved nondominant hand performance on a laparoscopic virtual reality simulator after playing the Nintendo Wii. *Surg Endosc*. 2013;27(11):4224-4231.