

# Piloting an Immersive Treatment Room to Promote Early Therapeutic Activity After Stroke

Amelia K Tenberg, MSN, AGNP-C<sup>1</sup>, Sandra Deluzio, MS, OTR-L<sup>2</sup>, Kelly Jordan, MS, OTR-L<sup>2</sup>, Elizabeth K Zink, PhD, CNS<sup>1,3</sup>, Mona N Bahouth, MD, PhD<sup>1</sup>

<sup>1</sup> Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, USA; <sup>2</sup> Department of Physical Medicine and Rehabilitation, Johns Hopkins Hospital, Baltimore, MD, USA; <sup>3</sup> Department of Nursing, Johns Hopkins Hospital, Baltimore, MD, USA

## Introduction

Stroke is a leading cause of adult disability and associated with high financial and human cost. Early physical activity at the right dose can maximize recovery and reduce long term disability. Hospitalized stroke patients spend the majority of time in bed and alone.

The acute hospitalization has historically focused on diagnosis and medical management. The prescription of therapeutic exercise is limited by systems factors such as staffing availability and competing clinical priorities. We sought to change this problem.

## Objectives

- To promote early therapeutic activity through the deployment of an immersive treatment room on the inpatient stroke unit incorporating a neurorestorative gaming system
- To measure the safety and feasibility of using the immersive treatment room in a group of hospitalized stroke patients

## Methods

- Location: urban inpatient stroke unit and rehabilitation unit
- Population: hospitalized acute stroke patients with upper limb impairment within 14 days of stroke onset
- Interprofessional collaboration to develop standardized protocols, screening procedures, and measures for safety
- Protocol: Patients receive standard therapy plus up to 60 minutes of additional time on task training in the immersive treatment room daily during the hospital stay
- Primary Outcomes:
  - Feasibility: number of sessions completed
  - Safety: Prespecified safety events including vital sign change outside prescribed parameters, new neurologic symptoms, acute pain, line dislodgement, fall
- Efficacy: Exploratory Outcome:
  - Upper limb impairment score measure with Fugl-Meyer Assessment - Upper Extremity Impairment Scale (FMA-UE)

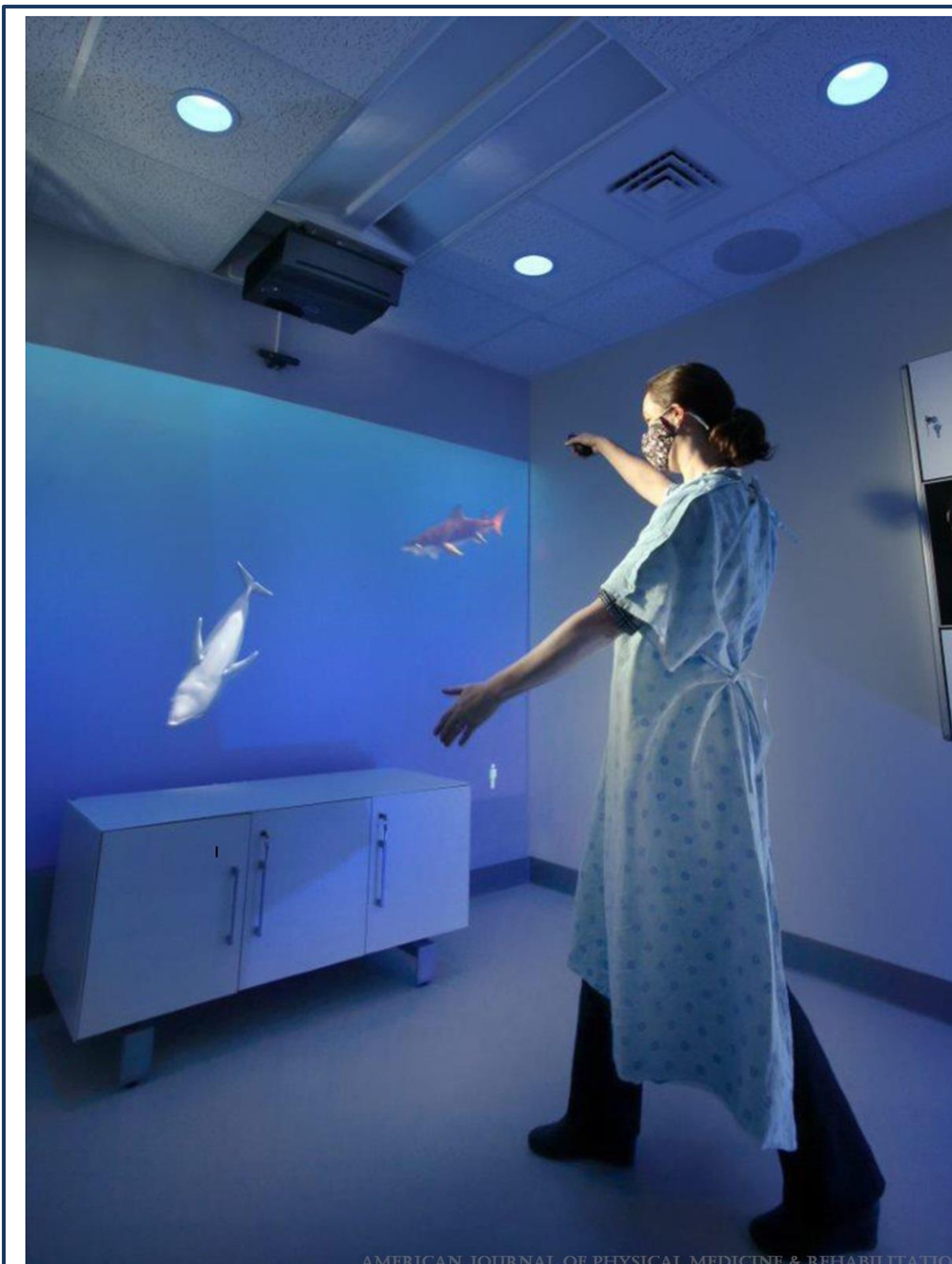
## Results

Total Participants N=21	
Age (yrs)	66 ± 10
Gender (male)	12 (57%)
Race	
White	6 (28%)
African American	14 (67%)
Other	1 (5%)
Baseline NIHSS Score, mean	7 ± 6
Stroke Type	
Ischemic	16 (76%)
Hemorrhagic	5 (24%)
Baseline FMA-UE Score, mean	54.6 ± 9.1

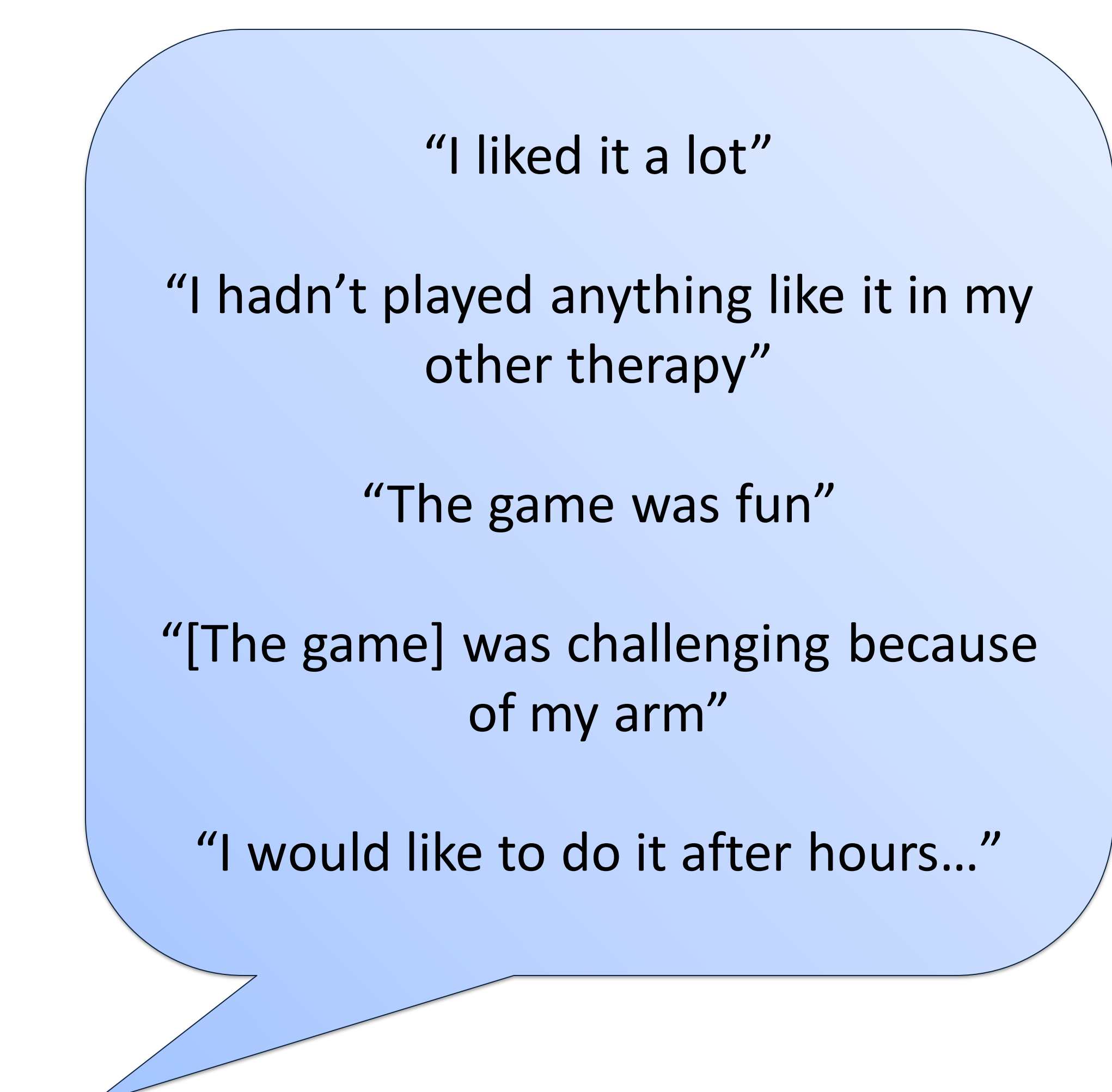
**Table 1 – Participant Demographics**  
 NIHSS = National Institutes of Health Stroke Severity;  
 FMA-UE = Fugl-Meyer Assessment - Upper Extremity

Treatment Sessions	
Attempted, total	90
Completed, total	77 (86%)
Total Time per Session, mean (min)	63 ± 24
Time on Task per Session, mean (min)	27 ± 14
Major Safety Events	0
Other events	1 (1%)*
FMA-UE Score, Post-Intervention, mean	60.6 ± 5.4 **

**Table 2 – Feasibility and Safety Outcomes**  
 \* Symptomatic lightheadedness/ orthostatic hypotension; game stopping criteria initiated.  
 \*\* Post-intervention FMA-UE collected in 15 patients



**Figure 1 - Immersive Treatment Room**  
 Immersive gaming room using our neurorestorative gaming system. Photo credit: Keith Weller. Reprinted with permission



**Figure 2 – Select Participant Feedback**  
 Qualitative informal comments from patients after using the neurorestorative game

## Conclusions

- Use of the immersive treatment room is feasible and safe for hospitalized stroke patients
- The immersive treatment room is an interprofessional initiative with potential to improve outcomes for stroke patients
- Standardized treatment and safety protocols guide non-specialized staff (and potentially family members) to safely implement the neurorestorative game
- Patients responded positively
- The next phase of study includes a randomized controlled trial to evaluate efficacy of the intervention compared to usual care

## Clinical Implications

- An immersive treatment room may increase the frequency and repetitions of therapeutic post-stroke activities needed to reduce impairment
- Use of technology and motivational gaming may reduce the need for specialty therapists to deliver therapeutic activity
- Immersive gaming spaces have the potential to extend the hours available for therapeutic gaming beyond traditional rehabilitation hours
- These modalities could easily be translated to other stroke hospitals, rehabilitation centers, or home spaces if proven effective
- Such therapeutic gaming systems offer a high-value platform to increase therapeutic activity and standardize the delivery of meaningful activity to both high and low resource stroke centers

## References

Bernhardt, J, et al (2004). Inactive and alone: physical activity within the first 14 days of acute stroke care. *Stroke*

Krakauer, JW, et al (2012). Getting Neurorehabilitation Right. *Neurorehabilitation and Neural Repair*.

Krakauer, JW, et al (2020). Comparing a novel neuroanimation experience to conventional therapy for high-dose, intensive upper-limb training in subacute stroke: The SMARTS2 randomized trial. *Neurorehabilitation and Neural Repair*

Bahouth, MN, et al (2023). Bringing High-Dose Neurorestorative Behavioral Training Into the Acute Stroke Unit. *American Journal of Physical Medicine and Rehabilitation*.