



Ohio Civil Money Penalty Reinvestment Program

Project Application –Reducing Falls with AI; Proactive Approach to Mobility Improvement and Fall Prevention Recommended to CMS on August 27, 2019

1. Purpose and Summary

The Problem: In 2018, there were over 1.4 million adults over the age of 65 living in nursing homes.¹ Each year between 50-75% of these residents experience a fall, which is twice the rate of older adults living in the broader community. It is estimated that 10-20% of these falls result in serious injury and about 1,800 people per year in nursing homes die as a result of a fall. Each year, a typical nursing home of 100 beds will report between 100 and 200 falls.² According to this data, *each* facility of this size can expect healthcare costs in excess of \$279,000 per year as a result of falls with injury.³

For many residents, the repercussions of suffering a fall last well beyond the initial incident and can have a profoundly negative effect on their psychophysical well-being. Residents who experience a fall with injury and have no prior injury history have a 56.3% chance of ever recuperating.⁴ Additionally, when residents fall, even if they are not seriously injured, they become increasingly anxious about falling again. This anxiety often leads to a decrease in a resident's daily activity level. As activity level decreases, so too does overall mobility, leaving residents at an increased likelihood of suffering recurrent falls.⁵

Our Project: *Reducing Falls with AI; Proactive Approach to Mobility Improvement and Fall Prevention.* Our project category is Direct Improvements to Quality of Care.

In 2009, our founder Deepak Gaddipati, lost his own grandmother prematurely due to fall-related injuries. This personal loss led Deepak, who was already partnering on technological advancements with Telemedicine and Advanced Technology Research Center ("TATRC", a division of US. Army) to develop and license technology capable of addressing the

1 Nursing homes, beds, residents, and occupancy rates in the United States provided by the CDC at <https://www.cdc.gov/nchs/data/abus/2017/092.pdf>

2 The Use of a Pre and Post-Fall Checklist to Standardize Inter-professional Communication and Prevent Future Falls
Fashoyin, AdedayoFashoyin, Adedayo et al.

Journal of the American Medical Directors Association, Volume 16, Issue 3, B23

3 Burns EB, Stevens JA, Lee RL. The direct costs of fatal and non-fatal falls among older adults—United States. J Safety Res 2016:58.

4 Gill TM, Murphy TE, Gahbauer EA, Allore HG. The course of disability before and after a serious fall injury. JAMA Internal Medicine. 2013 XXX.

5 Vellas BJ, Wayne SJ, Romero LJ, Baumgartner RN, Garry PJ. Fear of falling and restriction of mobility in elderly fallers. Age and Ageing 1997; 26:189–193.

nationwide fall epidemic. Deepak developed VSTBalance to specifically address several significant factors contributing to falls, including:

1. Lack of protocols in place for proactively identifying resident mobility risk level
2. Wide variance in interrater reliability for establishing baselines and tracking progress
3. Inability to quickly capture and organize data in an actionable format to inform resident need in real-time
4. A lack of effective evidenced-based routing mechanisms to formulate personalized resident care plans. At a broader level, CMS is addressing this through the formation of programs for community-dwelling seniors through the CMS STEADI program.

Our Approach: For this project, we will partner with ten nursing facilities to identify resident risk level through a series of standardized assessments captured by machine vision infrared sensors and analyzed using artificial intelligence (AI). Research shows deficiencies in balance, gait, and/or function are significant factors that contribute to senior falls; therefore, VSTBalance was developed to specifically address each one.⁶ VSTBalance can objectively assess and identify the musculoskeletal and sensory deficiencies—all in less than three minutes. These assessments are wholistic and can cover the range of balance, gait, and function. The analysis of these assessments is undergirded with normative data according to age group as defined in peer reviewed studies, National Institute of Health (NIH), academic journals, and CMS research.^{7 8 9 10 11 12 13 14 15 16 17 18 19}

⁶ Dionyssiotis, Yannis. "Analyzing the Problem of Falls among Older People." *International Journal of General Medicine*, 2012, 805. doi:10.2147/ijgm.s32651.

⁷ Levine DF, Richards J, Whittle M. (2012). *Whittle's Gait Analysis* Elsevier Health Sciences. ISBN 978-0702042652

⁸ Normative Spatiotemporal Gait Parameters in Older Adults John H. Hollman, Eric M. McDade, and Ronald C. Petersen

⁹ Sturnieks DL, St George R, Lord SR (2008). Balance disorders in the elderly. *Clinical Neurophysiology*. 38 (6): 467-478. doi:10.1016/j.neucli.2008.09.001. PMID 19026966.

¹⁰ O'Sullivan, Susan; Schmitz, Thomas (2007). *Physical Rehabilitation* (Fifth ed.). Philadelphia: F.A. Davis Company. pp. 254-259.- Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach:a new clinical measure of balance.J Gerontol 1990; 45: M192-M197

¹¹ Duncan PW, Weiner DK, Chandler J, Studenski S. Functional Reach: a new clinical measure. *J Ger*, 45: M192-197, 1990

¹² Tinetti, M.E.; Williams, T. Frankin; Mayewski, R. (1986). Fall risk index for elderly patients based on number of chronic disabilities. *American Journal of Medicine*. 80 (3): 429-434. doi:10.1016/0002-9343(86)90717-5. PMID 3953620.

¹³ Langley, F.A. & Mackintosh, S.F.H. (2007). Functional balance assessment of older community dwelling adults: A systematic review of the literature. *The Internet Journal of Allied Health Sciences and Practice*, 5(4).

¹⁴ Blum, Lisa; Korner - Bitensky, Nicol(May 2008). Usefulness of the Berg Balance Scale in Stroke Rehabilitation: A Systematic Review.*Physical Therapy*. 88(5): 559-566.doi:10.2522 / ptj.20070205.PMID 18292215.Retrieved 2012 - 08 - 12.

¹⁵ Podsiadlo, D; Richardson, S (1991).The timed Up & Go: A test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society*. 39 (2): 142-8.

¹⁶ "Timed Up and Go' test: Age, gender and cognitive impairment stratified normative values of older adults Azianah Ibrahim, Devinder Kaur Ajit Singh, Suzana Shahar

¹⁷ Bohannon, R.W. (2006).Reference values for the five-repetition sit - to - stand test: a descriptive meta - analysis of data from elders *Percept Mot Skills* 103(1):215-222.

¹⁸ Five-repetition sit-to-stand test performance by community-dwelling adults: A preliminary investigation of times, determinants, and relationship with self-reported physical performance
Bohannon, Richard W. | Shove, Megan E. | Barreca, Susan R.; | Masters, Lisa M. | Sigouin, Christopher S.

¹⁹ Lynch SM, Leahy P, Barker SP. Reliability of measurements obtained with a modified Functional Reach Test in subjects with spinal cord injury. *Phys Ther*. 1998;78:128-133.1

Each assessment offers a personalized comparison with normative data and calculates each resident's mobility level (High, Medium, or Low Mobility) according to the normative data for that assessment.²⁰ The assessments are comprised of the following measurable components:

- Mobility level
- Gait speed
- Sit to stand time

Additionally, for residents over the age of 70, the Gait Assessment will calculate not only the mobility level but also the probability, based on their gait speed for the resident to suffer a fall within the next 12 months.

Following identification of mobility level, the AI engine, along with clinician feedback, will create clinical pathways to route residents appropriately. (Appendix A.)

With the information generated from their assessments, the care team will have specific musculoskeletal movement data to form a plan of care appropriate to the resident mobility level (High, Medium, Low) and their identified movement deficiencies. Following the initial clinical pathway, our AI engine will flag residents with minimal progress and provide the clinician actionable data to formulate an alternate plan of care.

Currently, resident risk level and changes in functional status data are not easily communicable between therapy, nursing, and wellness in a nursing facility. Once clinicians are equipped with this data in real-time, then they can design contingency protocols such as increased rounding, reduced bed heights, and other protocols to prevent falls. Our HIPAA-compliant cloud dashboard is accessible from any browser-based device such as a smartphone, tablet, or computer to all levels of care providers who work in a nursing facility.

Our Outcomes: We have partnered with over 100 senior care organizations nationwide to implement the same processes and procedures with very successful outcomes. Our partners have experienced a significant reduction in falls, increased resident mobility, and improved resident engagement. Below is a sampling of these results:

Western Homes Outcome Data*

After implementing VSTBalance program across their therapy, wellness, and nursing, Western Home Communities was able to improve gait speed significantly among its residents, which correlated to a 43.5% reduction in falls with injury. (Appendix B.)

Bridges at Ankeny Outcome Data

After implementing VSTBalance, Bridges at Ankeny was able to significantly improve resident gait speed between admission and discharge. This increase in gait speed led to a significant reduction in fall risk for residents, and the risk for 30 day readmits by over 7%. Perhaps most significantly, according to CMS data²¹, Bridges at Ankeny had no falls with injury for short- and long-term residents after implanting VSTBalance.

²⁰ Quantitative Gait Markers and Incident Fall Risk in Older Adults Joe Verghese, Roe Holtzer, Richard B. Lipton, and Cuiling Wang

²¹ "Medicare Nursing Home Profile." Medicare.gov - the Official U.S. Government Site for Medicare. Accessed April 17, 2019.

<https://www.medicare.gov/nursinghomecompare/profile.html#profTab=4&ID=165616&Distn=13.3&loc=DES MOINES, IA&lat=41.6005448&lng=-93.6091064&dist=25&name=THE BRIDGES AT ANKENY>.

Short Term Stay Residents	The Bridges at Ankeny	Iowa State Average	National Average
Percentage of SNF residents who experience one or more falls with major injury during their SNF stay. <i>Lower percentages are better.</i>	0%	Data Not Available	0.9%
Rate of successful return to home and community from a short-stay. <i>Higher percentages are better.</i>	58.5%	55.7%	53.9%
Percentage of SNF residents whose functional abilities were assessed and functional goals were included in their treatment plan.  <i>Higher percentages are better.</i>	99.4%	Data Not Available	96.2%

Long Term Stay Residents	The Bridges at Ankeny	Iowa State Average	National Average
Percentage of long-stay residents experiencing one or more falls with major injury. <i>Lower percentages are better.</i>	0%	3.7%	3.4%

United Methodist Communities' Outcomes Data

Using VSTBalance, United Methodist Communities saw 85% of their residents show significant improvement in at least one standardized assessment, in less than three months (Appendix C.), including:

- Gait Speed: 18% to 119% Improvement
- Timed Up and Go: 20% to 90% Improvement
- Sit to Stand: 5% to 100% Improvement

VirtuSense Technologies Website

<https://www.virtusensetech.com/>

Short Overview of VSTBalance

<https://virtusensetech.wistia.com/medias/sfy20jul1x>

Standardized Assessments Included in VSTBalance

1. Balance: Modified Clinical Test of Sensory Interaction on Balance (mCTSIB)²², Functional Reach^{23 24 25}, Sitting Reach²⁶

²² Sturnieks DL, St George R, Lord SR (2008). Balance disorders in the elderly. Clinical Neurophysiology. 38 (6): 467-478. doi:10.1016/j.neucli.2008.09.001. PMID 19026966.

²³ Duncan, P. W., S. Studenski, J. Chandler, and B. Prescott. "Functional Reach: Predictive Validity in a Sample of Elderly Male Veterans." *Journal of Gerontology* 47, no. 3 (1992). doi:10.1093/geronj/47.3.m93.

²⁴ O'Sullivan, Susan; Schmitz, Thomas (2007). Physical Rehabilitation (Fifth ed.). Philadelphia: F.A. Davis Company. pp. 254-259.- Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new clinical measure of balance. *J Gerontol* 1990; 45: M192-M197

²⁵ Duncan PW, Weiner DK, Chandler J, Studenski S. Functional Reach: a new clinical measure. *J Ger*, 45: M192-197, 1990

²⁶ Lynch SM, Leahy P, Barker SP. Reliability of measurements obtained with a modified Functional Reach Test in subjects with spinal cord injury. *Phys Ther*. 1998;78:128-133.1

2. Gait: Gait Analysis^{27 28 29 30}, Timed Up and Go (TUG)^{31 32 33 34}
3. Function: Berg^{35 36}, Tinetti³⁷, Five Times Sit to Stand^{38 39 40}

Sustainability

Our goal for this project is to continue to partner with these nursing facilities to achieve outcomes improvements long after the CMP funding has ended. Ordinarily we operate our technology on a \$1199/month subscription in order to warranty the equipment and continue to provide updates to the software and user interface, but for this project and in the interest of seeing this technology used and maintained in the long-term, we will give the technology permanently to these facilities at the end of the project without what could be a cost-prohibitive subscription. In order to warranty the equipment, and continue to provide updates in software and user interface, we would offer to each facility that for \$200/month we will continue to maintain their VSTBalance system and Cloud Dashboard, so they can continue to use and benefit from the technology for many years to come.

Reporting

Whenever the system is used, data is created, recorded in compliance with HIPAA, organized, and objectively tracked, quickly providing objectively accurate outcome data. All project data will be compiled per facility and submitted quarterly to the Ohio Department of Medicaid. We

²⁷ Verghese, J., R. Holtzer, R. B. Lipton, and C. Wang. "Quantitative Gait Markers and Incident Fall Risk in Older Adults." *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 64A, no. 8 (2009): 896-901. doi:10.1093/gerona/glp033.

²⁸ Levine DF, Richards J, Whittle M. (2012). Whittle's Gait Analysis Whittle's Gait Analysis Elsevier Health Sciences. ISBN 978-0702042652

²⁹ Quantitative Gait Markers and Incident Fall Risk in Older Adults Joe Verghese, Roe Holtzer, Richard B. Lipton, and Cuiling Wang

³⁰ Normative Spatiotemporal Gait Parameters in Older Adults John H. Hollman, Eric M. McDade, and Ronald C. Petersen

³¹ Arnold, Catherine M., and Robert A. Faulkner. "The History of Falls and the Association of the Timed up and Go Test to Falls and Near-falls in Older Adults with Hip Osteoarthritis." *BMC Geriatrics* 7, no. 1 (2007). doi:10.1186/1471-2318-7-17.

³² "Predicting the Probability for Falls in Community-Dwelling Older Adults Using the Timed Up & Go Test." *Physical Therapy*, 2000. doi:10.1093/ptj/80.9.896.

³³ Podsiadlo, D; Richardson, S (1991).The timed Up & Go: A test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society*. 39 (2): 142-8.

³⁴ 'Timed Up and Go' test: Age, gender and cognitive impairment stratified normative values of older adults Azianah Ibrahim, Devinder Kaur Ajit Singh, Suzana Shahar

³⁵ "Berg Balance Scale." *SpringerReference*. doi:10.1007/springerreference_184570.

³⁶ Langley, F.A. & Mackintosh, S.F.H. (2007). Functional balance assessment of older community dwelling adults: A systematic review of the literature. *The Internet Journal of Allied Health Sciences and Practice*, 5(4). Blum, Lisa; Korner - Bitensky, Nicol(May 2008). Usefulness of the Berg Balance Scale in Stroke Rehabilitation: A Systematic Review.*Physical Therapy*. 88(5): 559-566.doi:10.2522 / ptj.20070205.PMID 18292215.Retrieved 2012 - 08 - 12.

³⁷ Tinetti, M.E.; Williams, T. Frankin; Mayewski, R. (1986). Fall risk index for elderly patients based on number of chronic disabilities. *American Journal of Medicine*. 80 (3): 429-434. doi:10.1016/0002-9343(86)90717-5. PMID 3953620.

³⁸ "Jags and Egm Launch Joint Call For Papers on Orthogeriatrics." *Journal of the American Geriatrics Society* 67, no. 4 (2019): 1575-577. doi:10.1111/jgs.15917.

³⁹ Bohannon, R.W. (2006).Reference values for the five-repetition sit - to - stand test: a descriptive meta - analysis of data from elders *Percept Mot Skills* 103(1):215-222.

⁴⁰ Five-repetition sit-to-stand test performance by community-dwelling adults: A preliminary investigation of times, determinants, and relationship with self-reported physical performance
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will provide the Ohio Department of Medicaid a clear, comprehensive report card detailing the project's progress and resident outcomes. This will allow for total transparency in evaluating our progress in improving outcomes and benefitting residents. At the conclusion of this project, a final report will be generated and submitted which shall include all results for the project, plans for continuance, and the lessons learned along the way.

2. Expected Outcomes

- A. Outcome A: A 10% reduction in the score for MDS item I3900 (Hip Fractures).
- B. Outcome B: Each facility will experience a 10% reduction in falls and 10% reduction in falls with injury. This improvement will correlate to a 10% reduction in score for MDS items J1800, J1900 (Any Falls Since Admission/Entry or Reentry or Prior Assessment, whichever is more recent).
- A. Outcome C: Each facility will see an improvement of at least 20% in gait speed for participating residents, correlating to a reduction in falls⁴¹, and improvement in longevity/quality of life.
- B. Outcome D: Residents that were identified to have balance and function deficiencies and were provided treatment will show on average an improvement of at least 15% in balance and function assessment scores.
- C. Outcome E: Resident satisfaction scores will be at least 75% on average according to aggregate data from the voluntary post-assessment survey. This survey will evaluate resident satisfaction and engagement in using the system and is comprised of five questions:
 - 1. Do you enjoy using the VSTBalance system? (Select One)
 - a. Yes, I enjoy using VSTBalance
 - b. Yes, I somewhat enjoy using VSTBalance
 - c. I am not sure
 - d. I do not enjoy using VSTBalance!
 - 2. Does VSTBalance help you understand your risk level? (Select One)
 - a. Yes, VSTBalance helps me understand!
 - b. Yes, it helps me somewhat
 - c. I am not sure
 - d. It doesn't help me at all!
 - 3. Does VSTBalance help you understand what you need to work on? (Select One)
 - a. Yes, VSTBalance helps me understand!
 - b. Yes, it helps me somewhat
 - c. I am not sure
 - d. It doesn't help me at all!
 - 4. Is VSTBalance helping you improve? (Select One)
 - a. Yes, VSTBalance is helping me improve!
 - b. Yes, it helps me somewhat
 - c. I am not sure
 - d. It doesn't help me at all!

⁴¹ Journal of Gerontology: MEDICAL SCIENCES: J Gerontol A Biol Sci Med Sci, 2009. Vol. 64A, No. 8, 896–901
doi:10.1093/gerona/glp033

5. Do you want to continue to use VSTBalance? (Select One)
 - a. Yes, I enjoy using it!
 - b. Yes, I somewhat enjoy using it
 - c. I am not sure
 - d. I do not enjoy using VSTBalance!

3. Results Measurement

A description of the methods by which the project results (outcomes) will be measured.

A. Methodology by which Outcome A will be measured, and how it will be measured.

To establish baseline data for expected outcome A, quarterly MDS scores for participating residents will be obtained from participating nursing facilities for MDS item I3900 for the first quarter proceeding the start date of the project for which data is available and will determine facility and statewide aggregate scores. Throughout the duration of this project, quarterly scores for this MDS item will be obtained for participating residents, and aggregate scores will be compared to baseline data to determine if progress is being made toward achieving the expected outcome. The final aggregate quarterly MDS score will be compared to baseline data to determine if the expected outcome is achieved.

B. Methodology by which Outcome B will be measured, and how it will be measured.

To establish baseline data for expected outcome B, quarterly MDS scores for participating residents will be obtained from participating nursing facilities for MDS items J1800, J1900 for the first quarter proceeding the start date of the project for which data is available and will determine facility and statewide aggregate scores. Additionally, at the beginning of this project, baseline data on falls and falls with injury from the year prior to the project implementation according to CMS data will be obtained for participating facilities. Throughout the duration of this project, quarterly scores for this MDS item as well as data for falls and falls with injury will be obtained for participating residents, and aggregate scores will be compared to baseline data to determine if progress is being made toward achieving the expected outcome. The final aggregate quarterly MDS score along with the percentage of falls and falls with injury will be compared to baseline data to determine if the expected outcome is achieved.

C. Methodology by which Outcome C will be measured, and how it will be measured.

To establish baseline data for outcome C at the beginning of this project, baseline data on gait assessment will be obtained for participating residents from participating facilities. Throughout the duration of this project, quarterly scores for gait assessment will be obtained for participating residents, and aggregate scores will be compared to baseline data to determine if progress is being made toward achieving the expected outcome. The final aggregate quarterly score for gait assessment will be compared to baseline data to determine if the expected outcome is achieved.

D. Methodology by which Outcome D will be measured, and how it will be measured.

To establish baseline data for outcome D at the beginning of this project, baseline data on balance and function assessment scores will be obtained for participating residents from participating facilities. Throughout the duration of this project, quarterly scores for balance and function assessment scores will be obtained for participating residents, and aggregate scores will be compared to baseline data to determine if progress is being made toward achieving the expected outcome. The final aggregate quarterly score for balance and function assessments will be compared to baseline data to determine if the expected outcome is achieved.

E. Methodology by which Outcome E will be measured, and how it will be measured.

Following baseline assessment and subsequent reassessments, residents will be asked to participate in a concise five question survey. This survey will be used to assess the level of resident engagement VSTBalance is able to generate. Throughout the duration of this project, a quarterly aggregate score will be calculated to evaluate the level of resident engagement, and to determine if the outcome is being met. At the conclusion of this project, all aggregate quarterly scores will be averaged to determine average level of engagement achieved for this project to determine if the expected outcome is achieved.

4. Benefits to Nursing Home Residents

Currently in many nursing facility settings, residents are unaware of their limitations, and are passive participants in their plan of care. The residents seldom have a clear picture of their level of risk and subsequently, they lack tangible goals associated with reducing their risk and increasing their mobility. This knowledge, along with an understanding of how increased levels of mobility directly correlate with increased independence in daily living activities, is critical in cultivating resident buy-in.⁴² VSTBalance fosters such engagement by immediately providing residents with an easy-to-read summary (Appendix D) of how they are doing, alongside of normative data that establishes a goal for where they need to be in order to greatly reduce their risk and increase their independence. By increasing a resident's mobility level, and decreasing the number of falls they are suffering, they will lead healthier and happier lives for longer with a greater degree of independence.

Driving engagement ever further, VSTBalance gamifies the rehabilitation plan of care through a series of bio-feedback training modules. These 10 different bio-feedback trainings are specifically tailored to improve impaired musculoskeletal and cognitive capabilities.

Physical Bio-feedback:

⁴² Borrell L, Lilja M, Sviden, GA, Sadlo G.. Occupations and signs of reduced hope: An explorative study of older adults with functional impairments. American Journal of Occupational Therapy 2001;55(3):311-16.

1. Ski Lean: Training designed at teaching residents how to transfer weight following knee and hip replacements.
2. Veggie Ninja: Interactive game that encourages upper body mobility working on the supraspinatus, subscapularis, infraspinatus, and teres minor muscles.
3. Limits of Stability: Bio-feedback training designed to improve overall balance and teach residents how far they can reach in multiple directions safely without falling.
4. Ski Reach: Movement in the transverse plane about the vertical axis to increase range of motion for upper and lower limbs, and to work on asymmetry issues between the left and right side of the body.
5. Hand Eye Coordination: Interactive training designed to help stroke residents to re-learn how to reach across their midline (can be performed seated).
6. Aerobics: Senior tailored aerobic training that utilizes guided motions to improve control of muscular movements, specifically that of the upper body.
7. Ski Speed: Movement in the sagittal plane about the front axis improving range of motion for shoulder core and upper body.

Cognitive Training:

8. Sequence: Refresher for cognitively impaired residents on how to do Activities of Daily Living (ADLs).
9. Simon Says: Combination of physical and cognitive challenges to remember and repeat mirrored movements with upper and lower limbs.
10. Memory game: Focused on the Limbic system of brain to improve cognitive recall.

(Example Snapshot of Ski Reach Bio-feedback training)



5. Non-Supplanting

This project will in no way supplant the responsibilities of participating Nursing Facilities to meet existing Medicare/Medicaid regulations or other statutory and regulatory requirements.

6. Consumer and Other Stakeholder Involvement

Our project, *Reducing Falls with AI; Proactive Approach to Mobility Improvement and Fall Prevention*, will involve both care staff, and the residents themselves.

Engaging Direct Care Staff: In each facility, we will provide extensive, in-person training to all appropriate care staff. With this training, we will ensure user proficiency, work with the facility in establishing the optimal location for the system, and a plan of action in how to coordinate resident assessments. Additionally, we will work the care team in educating residents on the purpose of VSTBalance, how the system works, and understanding the data it provides.

In addition to training the direct care team on the system, we will provide access and training for the Cloud dashboard where all data is compiled and can be quickly reviewed by the Director of Rehabilitation, and other appropriate personnel. Included on the Cloud is a risk dashboard from which the direct care team can review each individual resident's risk level, monitor outcome progress, and evaluate plans of care based on real-time data.

Engaging Residents: For resident assessments, the system will voice prompt the clinician on the protocol of the assessment and will generate a printable report that can be immediately provided to the resident. With subsequent assessments, the system will generate a comparison report showing any improvement or regression from the prior assessment, keeping residents informed and engaged throughout the entire process. When a resident performs any bio-feedback training therapy, clear video and audio prompts will instruct the resident on the specific training module. The clinician is also able to provide feedback and coaching to the resident throughout this training.

7. Funding

Every effort will be made to schedule multiple onsite training trips, whenever possible to reduce flight costs and travel expenses. The tv is required versus a monitor for compatibility with the software.

Budget Table

Item and Description	Quantity and Cost Per Unit	SFY 2020 (9 months)	SFY 2021 (12 months)	SFY 2022 (12 months)	SFY 2023 (3 months)	Total Cost (total 36 months 10 facilities)
TRAINING						
On Site Live Training	1 in-person training @ \$980 per site	\$9,800	\$0	\$0	\$0	\$9,800
Virtual Live Training	Unlimited Trainings @ \$685 per site	\$5,138	\$6,850	\$6,850	\$1,712	\$20,550
Cloud-Portal Training	Unlimited Trainings @ \$198 per site	\$1,485	\$1,980	\$1,980	\$495	\$5,940

TOTAL TRAINING		\$16,423	\$8,830	\$8,830	\$2,207	\$36,290
PERSONNEL						
Included in Training Costs N/A		\$0	\$0	\$0	\$0	\$0
TOTAL PERSONNEL		\$0	\$0	\$0	\$0	\$0
INFORMATION TECHNOLOGY						
TV	1 tv per site @ \$400 ea.	\$4,000	\$0	\$0	\$0	\$4,000
Sensor	1 sensor per site @ \$380 ea.	\$3,800	\$0	\$0	\$0	\$3,800
Laptop	1 laptop per site @ \$1,000 ea.	\$10,000	\$0	\$0	\$0	\$10,000
Stand	1 stand per site @ \$80 ea.	\$800	\$0	\$0	\$0	\$800
Shipping	1-time shipping per site @ \$200 ea.	\$2,000	\$0	\$0	\$0	\$2,000
Software	VSTBalance Software, maintenance and updates per site @ \$8,231 ea.	\$61,733	\$82,310	\$82,310	\$20,577	\$246,930
TOTAL INFORMATION TECHNOLOGY		\$82,333	\$82,310	\$82,310	\$20,577	\$267,530
TRAVEL						
Flights	1 Round trip flight per site @ \$300 ea.	\$3,000	\$0	\$0	\$0	\$3,000
Hotel	1 Night per site @ \$98 ea.	\$980	\$0	\$0	\$0	\$980
Vehicle Rental/Gas	1 Vehicle Rental per site @ \$57 ea.	\$570	\$0	\$0	\$0	\$570
TOTAL TRAVEL		\$4,550	\$0	\$0	\$0	\$4,550
DATA COLLECTION, ANALYSIS, AND REPORTING						
VirtuSense Cloud Dashboard	1 Cloud Dashboard per site @ \$2909ea.	\$21,818	\$29,090	\$29,090	\$7,272	\$87,270
TOTAL DATA COLLECTION, ANALYSIS, AND REPORTING		\$21,818	\$29,090	\$29,090	\$7,272	\$87,270
FACILITY & ADMINISTRATIVE						

		\$0	\$0	\$0	\$0	\$0
TOTAL FACILITY & ADMINISTRATIVE		\$0	\$0	\$0	\$0	\$0
TOTAL FUNDING REQUESTED		\$155,180	\$120,230	\$120,230	\$0	\$395,640

8. Involved Organizations

VirtuSense Technologies will lead this project without any third-party contractor involvement and will work with the Ohio Department of Medicaid to identify facilities who could benefit most from this project.

9. Contacts

Names, phone numbers, and email addresses for the persons who are the primary contacts for the project.

Contact Name: Caleb York
 Organization: VirtuSense Technologies
 Phone Number: 734-395-1125
 Email Address: caleby@virtusensetech.com

Contact Name: Deepak Gaddipati
 Organization: VirtuSense Technologies
 Phone Number: 309-495-7325
 Email Address: deepakg@virtusensetech.com

Training & Screening Day

How it Works

Morning

During our initial VSTBalance™ in-service, we will train your team to capture objective balance, gait, and functional assessments, generate outcomes reports, and go over actionable interventions, including routing to therapy, wellness, or in-home exercises.

Afternoon

As part of training, we work with your team to help run your initial community screening. Therefore, by the time our trainer leaves, you will have balance, gait, and functional measures for **20-30 residents** and gain valuable experience using VSTBalance™.

Clinical Pathways

Low Risk

Recommend in-home exercises through our companion app, VSTWell™, to low risk residents to stay active and independent longer.

Medium Risk

Route medium risk residents to your wellness programs to help them improve their mobility and balance to lower their fall-risk.

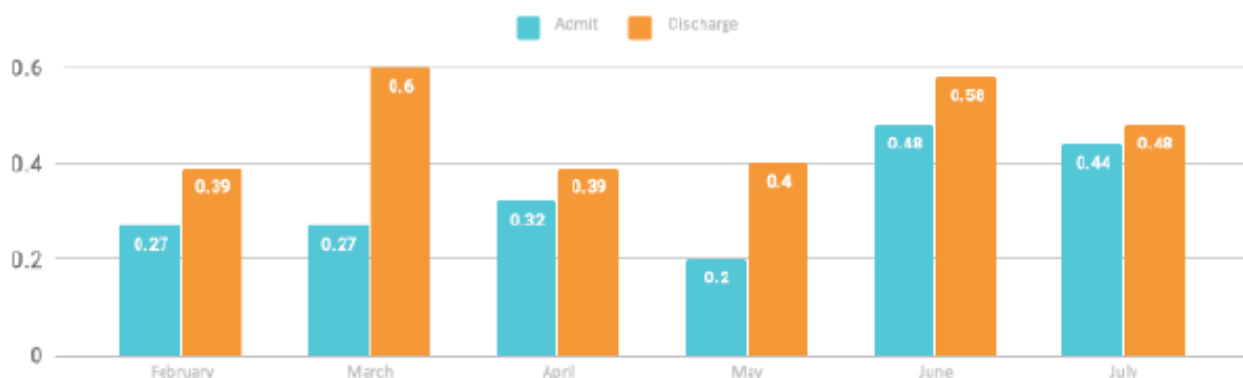
High Risk

Identify and develop a plan of care. Statistically, 15% to 29% of screened residents who are not in therapy show a need for therapy.

Outcomes

VSTBalance™ | Data from Western Home Communities

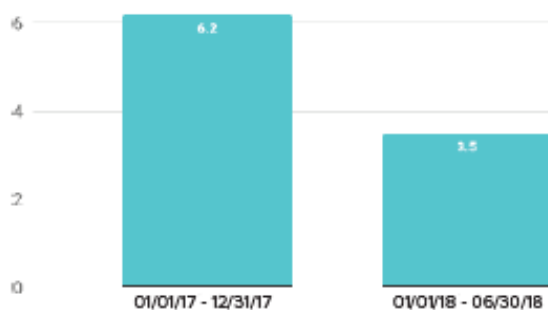
Gait Speed Improvement (m/s)



Optimizing 3D motion analysis, the VSTBalance system facilitates gathering of evidence-based, comprehensive kinematic data. Gait analysis and balance assessment compare performance to standardized norms and offer resident-specific intervention strategies.

The National Institute of Health indicates that an increase in gait speed of .08 m/s or greater will significantly impact gait performance and associated fall risk. Western Home Communities' overall gait analysis and treatment intervention became highly sensitive with the addition of 3D motion analysis. The data reflected above indicate that Western Home Communities' residents frequently exceed the .08 m/s threshold.

Falls with Injury per 1,000 Patient Days Based On Quality Measure Analysis



Falls with Injury per 1,000 Patient Days

Introduction of the VSTBalance System has enabled comprehensive evaluation of individuals at risk for falls. Evidence-based assessments and individualized training programs have resulted in a **43.5% reduction** in the number of reported falls with injury.

Data collected is based upon percentage of Falls with Injury from data gathered through Casper Reporting and Quality Measure

85% of Residents Showed Significant Improvement in Less Than 3 Months

Case Study: United Methodist Communities

"Our residents get excited when we use data to show how much they have improved. It's such a great message. Working with VirtuSense has really exceeded our expectations!"
- Carol McKinley, Chief Operating Officer | United Methodist Communities

Assesements

The most common assessments were Gait Speed, Timed Up and Go (TUG), and 5X Sit to Stand (5xSTS).

Significant Improvements

34 out of 40 of residents showed significant improvement in at least one measure related to fall risk.

116% Improvement

Two residents completed the functional reach assessment and showed over **116% improvement** in 3 months.

Outcomes Data from 34 Residents

Gait Speed

18-119%
Improvement

Sit to Stand

5-100%
Improvement

Timed Up & Go

20-90%
Improvement

Appendix D: Example Summary Report Following Assessment

Logo

3D Kinematic Gait Analysis

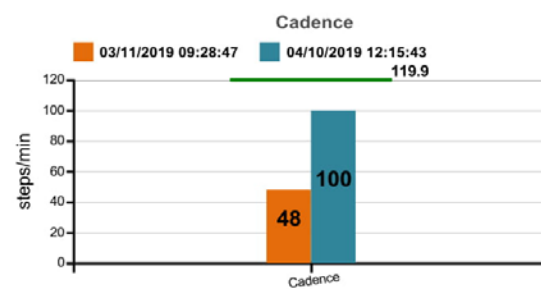
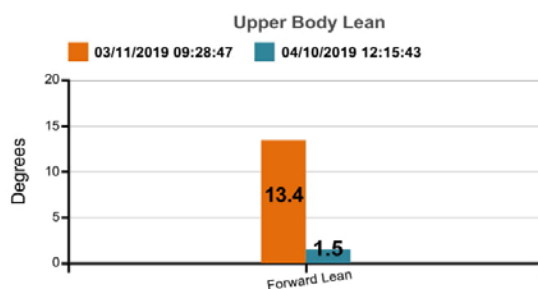
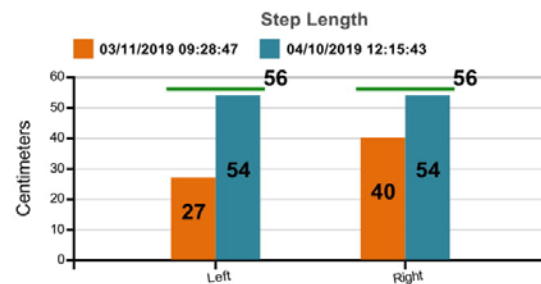
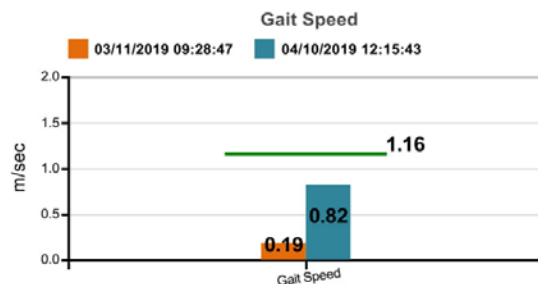
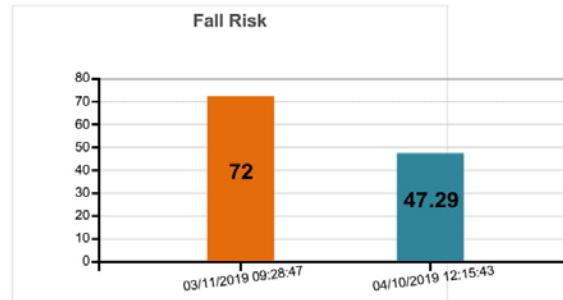
Patient Name: Test Patient

DOB: 01/10/1949

Description: Gait analysis is the systematic study of human motion for measuring body movements, body mechanics, and the activity of the muscles. Gait analysis is used to assess and treat individuals with conditions affecting their ability to walk.¹

Overall Patient's fall risk has decreased by 24.71% from 72¹ to 47.29¹.

Mobility: This change occurred from 03/11/2019 to 04/10/2019.

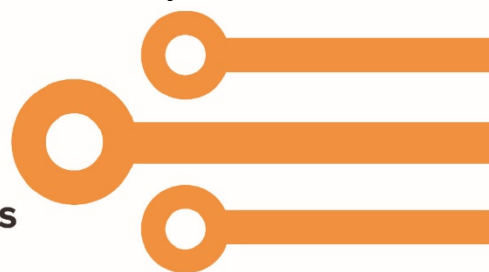


References:

1. Levine DF, Richards J, Whittle M. (2012). Whittle's Gait Analysis Whittle's Gait Analysis Elsevier Health Sciences. ISBN 978-0702042652
2. Normative Spatiotemporal Gait Parameters in Older Adults John H. Hollman, Eric M. McDade, and Ronald C. Petersen
3. Quantitative Gait Markers and Incident Fall Risk in Older Adults Joe Verghese, Roe Holtzer, Richard B. Lipton, and Cuiling Wang

VSTBalance

Outcomes from over 4,000 Medicare Residents



The Cost of Falls Adds Up Fast

Every year, one in three seniors fall, resulting in well over \$50 billion in annual medical costs.¹ Over 3 million seniors are treated in Emergency Departments each year for fall-related injuries.²

Falls Cost More Than Just Money

Falls are the leading cause of injury-related deaths for seniors. In 2016, nearly 30,000 people ages 65+ died from a fall. As the U.S. population ages rapidly, the number of falls occurring each year continues to rise. From 2007 to 2016, the rate of fall-related deaths rose 31%.²

Reducing Falls with Artificial Intelligence

At VirtuSense, our mission is to revolutionize care for seniors by reducing adverse events using artificial intelligence (AI). The first product we developed is an AI system called VSTBalance, which uses predictive analytics based on balance and gait analysis to identify deficits and forecast risk. By implementing VSTBalance, partners of ours have seen a reduction in falls in excess of 43% across the continuum of care.

Measurable, Actionable Results

Skilled Nursing Case Study: 4,000 residents in 37 SNFs across three years according to CMS data. In 2017, when VSTBalance was implemented, these communities averaged 12.7% of their residents falling each year. In 2018, after a year of using the system, the average fell to 3.3%—an improvement of 74.3%. This resulted in 380 fewer falls compared to 2017. The cost savings from the reduced falls equates to \$11.4 million across these communities.

Avg. % of Falls		Avg. % Improvement 2017–2018	Avg. Yearly Savings
2017	2018		
12.7%	3.3%	74.3%	\$11.4 Million (Based on \$30,000 per fall)

Highly Improved Facilities

Chautauqua Rehabilitation and Nursing Center, FL

Avg. % of Falls	
2017	2018
7.1%	3.7%

The Pavilion at Sunny Hills, CA

Avg. % of Falls	
2017	2018
11%	2.5%

Fountain Circle Care & Rehab Center, KY

Avg. % of Falls	
2017	2018
16.9%	3.3%

¹Florence CS, Bergen G, Atherly A, Burns ER, Stevens JA, Drake C. Medical Costs of Fatal and Nonfatal Falls in Older Adults. Journal of the American Geriatrics Society, 2018 March, DOI:10.1111/jgs.15304

²Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Accessed August 5, 2016.

CCH Healthcare has the following locations in Ohio they would like to participate in this grant opportunity to reduce falls and improve outcomes.

The sites they would like to participate with are:

Sunrise Manor: Amelia OH
Locust Ridge: Williamsburg OH
Cedars of Lebanon: Lebanon OH
Cedarview: Lebanon OH
Lincoln Crawford: Cincinnati OH
Scarlet Oaks: Cincinnati OH
Harrison Pavilion: Cincinnati OH
Clovernook: Cincinnati OH
Northcrest: Napoleon OH
Park Terrace: Toledo OH
Countryside: Fremont OH
Westbrook: Westlake OH
Westlake: Westlake OH

"We are very interested in refining the overall resident outcomes in reducing falls and integrating new technology that will improve/enhance the quality of life for the residents we serve."

Cindy Moore, Vice President of Operations
CCH Healthcare