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Efficacy of Steady Strides: A Structured Physiatrist-Led Intervention for Reducing Falls in High-Risk Ambulatory Community-Dwelling Older Adults: An Observational Cohort Study

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ABSTRACT

Introduction: *Though physiatrists are trained in functional gait analysis, studies are lacking on effectiveness of physiatrist management on fall prevention in older adults. Steady Strides is a structured physiatrist-led, functional, goal-directed multifactorial intervention to help reduce falls. Our objective was to assess the effect of Steady Strides intervention on reducing falls in older adults at high fall risk.*

Methods: *A retrospective observational cohort study of 124 community dwelling older adults at risk of falls seen at outpatient clinic were identified to be at high risk of falls and included in the study if they reported: i) at least one fall in 3 months at baseline; and ii) limited improvement with prior physical therapy. All patients in this cohort had an initial evaluation with physiatrist and all were offered the Steady Strides physiatrist-led intervention. Patients who followed up with the physiatrist for the intervention, participants, were compared to those who did not, i.e., non-participants. All patients were called and number of falls within six months after the initial evaluation (primary outcome variable) was recorded. Demographic, clinical and participation (e.g., number of visits with physiatrist, physical and occupational therapists in 2-months after the initial presentation) data was extracted from medical records and analyzed in univariate, then multivariate analyses.*

Results: *Steady Strides participants had statistically lower number of falls at 6 months compared to non-participants (mean 4.59 vs 1.89, $p<0.004$). Univariate analysis demonstrated that participation in Steady Strides physiatry*

intervention (incidence rate, [IR], 0.41, 95% Confidence Interval [CI] 0.24-0.67, p<0.001) as well as attending physical therapy sessions (IR 0.59, 95% CI 0.36-0.96, p=0.034) was correlated with reduced number of falls at 6 months. Steady Strides participation remained significant in the multivariable analysis (IR 0.31, 95% CI 0.15-0.61 p<0.001).

Discussion/Conclusion: *This is a first reported effective structured physiatrist-driven fall prevention intervention that may have significant effect on fall reduction in older adults.*

Keywords
Fall prevention, Older adults, Physiatry, Steady Strides.

Introduction
Falls are the leading cause of preventable morbidity and mortality in community dwelling older US adults (65 years old and older) [1,2]. Annual physicians fall screening assessment for older adults is recommended by the American Geriatrics Society [3] and comprises an integral part of the annual Medicare wellness visit [4]. To help facilitate a structured approach for a physician led fall prevention intervention, the Centers for Disease Control and Prevention's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) have developed an algorithmic approach for identifying, risk stratifying, and managing older adults at risk of falls intended for primary care providers [5,6]. STEADI algorithm includes inquiries on frequency of falls and fear of falling, assessment for postural hypotension and foot deformities, visual and cognitive deficits, as well as a basic functional balance/gait deficits screen and review for use of medications that may be associated with increased fall risk [5]. Notably, STEADI algorithm sees physicians as leaders in fall prevention management and utilizes physical therapy referral only as a part of a comprehensive multifactorial intervention protocol [5]. Overall, limited, non-randomized data supports that the STEADI strategy implemented in the primary care setting reduced fall-related hospitalizations [7].

Though role of primary care providers in managing falls in older adults should not be underestimated, fall prevention management should primarily be undertaken by physician providers trained in functional medicine since "medical reasons" are far from being the most common causes of falls. Syncope, for instance, has been shown to be responsible for not more than 5% of falls in this patient population [8]. Similarly, there is lack of positive association between falls and urinary tract infections [9]. "Mechanical falls" (a term loosely utilized for "non-medical" etiologies), on the other hand, have been shown to account for over 62% of falls in older adults presenting to the emergency department [10]. Most commonly patient-reported causes of falls were slips, trips, and loss of balance [11]. Factors commonly associated with falls include poor balance and impaired activities of daily living [11]. It's no surprise, therefore, that systematic reviews of fall prevention interventions repeatedly demonstrate efficacy of functional multifactorial interventions including exercise and environmental assessment and modification [12-14]. Given the preponderance of evidence for efficacy of functional medicine for fall prevention, as well as complexity of neurological systems involving control of balance and gait [15], biomechanical/functional assessment and treatment of older patients at risk of falls is preferred [16].

Since physiatry bridges functional and traditional medical approaches to patient management, it appears to be a natural fit for managing falls in older adults. Steady Strides is a structured physiatrist-led multifactorial functional assessment and management intervention. Steady Strides combines a biomechanics-based functional physiatrist approach to diagnosis and treatment with a comprehensive orthopedic, vestibular, podiatric, psychological, and neurological assessment to help identify and treating the specific underlying biomechanical conditions that increase the risk of falls in older adults. Unfortunately, there are no prior physiatry-led structured fall prevention interventions published. In this retrospective chart review observational cohort study, we report results of our structured biomechanics-based physiatrist led fall prevention intervention. It was hypothesized that Steady Strides participation would reduce the number of falls compared to non-participation.

Methods
Our study on the efficacy of the Steady Strides intervention satisfies the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for an observational cohort study [17]. Retrospective chart review of de-identified information already available in the electronic medical record consistent with the US Department of Health and Human Services Exempt criteria 45 CFR 46.101(b)(4) was conducted.

Study Design
Board-certified physiatrist with training in biomechanics of human mobility conducted the Steady Strides multifactorial medical and functional assessment and educated patients on how their specific biomechanical/functional deficits contribute to increased risk of falls and the suggested treatment plan. Patients were advised to follow up with a physiatrist every two weeks for up to 2 months (duration of the intervention, see Figure 1) to closely manage the response to the prescribed interventions, overcome barriers to therapy participation or goal progression, and adjust home exercise program and/or therapy interventions/goals as needed. If patient had a recurrent fall, failed to participate in home exercise program or did not improve with therapy as expected, he or she was asked to follow up in one week instead of in two weeks. As part of the ongoing general quality improvement process, baseline number of falls to assess baseline fall burden, number of visits with physiatrist, physical and occupational therapists in 2-month after the initial presentation to assess patient participation, and total number of falls 6 months after the first visit to assess success

of fall reduction efforts regardless of participation were recorded (Figure 1). Falls were classified as self-reported unintentional events when patient did or would have hit the floor/another lower level if not for the presence of barrier to break the fall (e.g., couch or wall). Events attributed to intoxication, acute disorders (e.g., seizures, drop-attacks, strokes) or overwhelming environmental hazards (e.g., being struck by a moving object) were not classified as falls. Falls data was extracted based on follow-up telephone surveys as well as based on number of falls reported in the medical record. Demographic and clinical comorbidities were extracted from the medical records to assess their correlation with outcomes. We sought to analyze the effect of Steady Strides participation on preventing falls. Total number of falls 6 months after the first visit was selected as the main outcome.

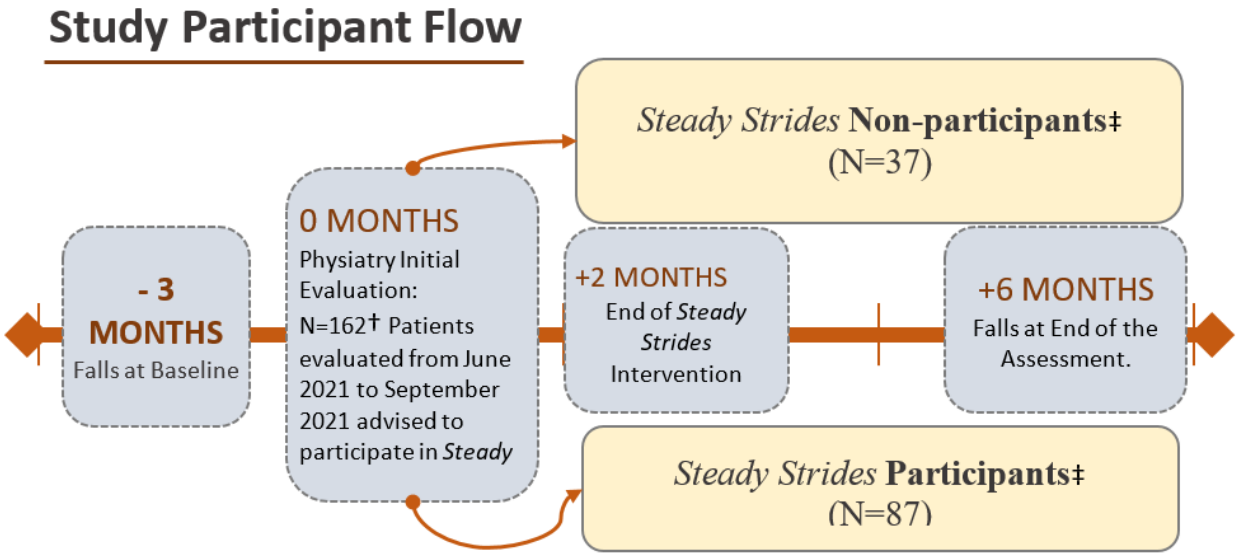

Figure 1: Steady Strides is a physiatrist led two-month long structured intervention to help reduce falls in older adults. See manuscript for detail.

†Only 124 (77%) of the original 162 patients were included in study since 38 were excluded due to incomplete process, clinical, demographic or outcome data in the electronical medical records database. Steady Strides intervention was recommended to all patients who reported: i) at least one fall in the 3 months prior to the initial evaluation; and ii) failure to improve with physical therapy in the past.

‡ Patients who followed up with physiatrist for the Steady Strides intervention, participants, were compared to those who did not, i.e., non-participants. Baseline clinical, demographic and clinical variables were documented at the time of the initial evaluation. Number of falls reported and visits with physiatrist (for participants), physical and occupational therapists within six months after the initial evaluation in both groups was documented.

Participants

All ambulatory non-institutionalized (e.g., not living in assisted living facilities, nursing homes) outpatient older adults presented to the outpatient multispecialty clinic were eligible for the study. Charts were included for analysis if patients a) visited physiatrist who routinely utilized the Steady Strides protocol; b) reported at least one fall in three months at baseline; c) had history of completing prior physical therapy treatment; and d) had full clinical/demographic initial exam as well as telephone falls data for 6 months after the first visit.

All patients received initial in person evaluation and were offered Steady Strides physiatrist-based intervention if they reported i) at least one fall in 3 months at baseline; and ii) limited improvement with prior physical therapy. Patients who followed up at least once with physiatrist within two months of the initial evaluation for the recommended intervention were deemed as intervention participants, and those who did not follow up were deemed as not participants (Figure 1). The number of falls within the 6 months of the initial evaluation was documented.

Intervention

Steady Strides is a novel physiatrist-led structured diagnosis and treatment protocol for managing older adults at risk of falls. The protocol is based on four general principles: close care coordination between physiatrist and the rehabilitation therapy team, value-based medicine, patient-centered care and biomechanics-driven multifactorial medical and rehabilitation diagnosis and treatment plan (see Supplement 1 for detail).

Survey Method

Charts from patient visits from June 2021 to September 2021 were surveyed. Part of the ongoing quality improvement process clinic protocol was to conduct follow up phone calls with patients deemed at high risk of falls and document any falls in 6 months after the first physiatrist visit. Visit data of patients with a record of falls documented in the medical chart was also utilized to help corroborate patient reports. Data in the chart documented the number of falls at 6 months.

Quantitative variables

Total initial falls and total final falls data were calculated for each

patient over a six-month period. Patients who did not follow up with the physiatrist after the initial evaluation, regardless of their participation with physical or occupational therapy were deemed to be non-participants with the Steady Strides intervention; those who followed up after their first physiatrist visit were deemed as Steady Strides intervention participants. The number of visits with physiatrist, physical and occupational therapists were measured to assess how participation with these disciplines correlates with fall prevention outcomes. Physiatry, PT, and OT participation were only counted if the visit was during the two-month period after the first visit with the physiatrist. Physical and occupational therapy participation was recorded as initial visit with no follow up vs initial as well as follow up visits. Demographic and clinical variables including age, sex, number of falls, presence of myelopathy, peripheral neuropathy, vestibular deficits, spasticity, cognitive impairment, and leg weakness were extracted from the electronical medical record and documented. The number of falls at 6 months after the initial evaluation was utilized as the primary outcome measure.

Statistical Methods

Descriptive statistics were used to analyze the survey results, and univariate and multivariate logistic models were used to analyze our additional measures. Statistical analysis was performed using R: A Language and Environment for Statistical Computing, version 3.6.3, available at http://www.R-project.org (The R Foundation for Statistical Computing). Two-sided p-values were computed, and significance was assessed at the 0.05 level. A test of homogeneity was conducted using Fisher's exact tests to detect a significant difference in demographics between participant groups. A Welch's t-test was utilized to consider differences in the numeric demographics between participant groups. Univariate (marginal relationships) and multivariate negative binomial regression model (conditional relationships) were used to analyze the data to ensure no confounding factors or predictors contributed significantly to the fall incidence outcomes. Multivariate analysis including all variables was performed and compared with the reduced model based on the a priori hypothesis that the baseline rate of falls and follow-up with physiatrist will correlate with reduced number of falls. To measure the goodness of fit for the reduced multivariate negative binomial regression model, McFadden's R2 and Cox-Snell R2 were computed.

Results

Baseline Clinical and Demographic Characteristics

124 (77%) patients of 162 were included in this study (38 patients were excluded due to incomplete process, clinical, demographic or outcome data in the electronic medical records database) (Figure 1). The average baseline number of falls in 3 months prior to the initial evaluation was 10.8. The average age was 74 years old. 35% (44) of the patients were male. Overall prevalence of clinical diagnoses noted was as follows: 24 (19%) of these patients had myelopathy, 70 (63%) had neuropathy, 20 (16%) had vestibular deficits, 24 (19%) had spasticity, 29 (23%) had cognitive impairment, and 73 (59%) had lower extremity weakness. Overall, 63 (51%) of all these patients reported at least 50% fall rate reduction from baseline, 44 (35%) patients had no falls, 20 (16%) had one, 20 (16%) had two, and 40 (32%) had more than 2 falls in the 6-month period following program completion. During the two-month timeframe studied, 65 (52%) and 63 (51%) of the patients in this cohort had at least one visit with PT and OT respectively.

Variables	Non-Participants (n=37)	Participants (n=87)	P Value	SD
Demographics				
Sex (Male), % (n)	45.9 (17)	(31.0) 27	0.151	
Age, mean	73	74.3	0.615	13.0
Clinical Conditions, % (n)				
Myelopathy	27.0 (10)	16.1 (14)	0.213	
Neuropathy	43.2 (16)	62.1 (54)	0.0744	
Vestibular Deficit	18.9 (7)	14.9 (13)	0.6	
Spasticity	18.9 (7)	19.5 (17)	1	
Weakness	55.5 (10)	58.6 (19)	1	
Initial number of falls, mean	10.2	11.4	0.834	30.1

Table 1: Demographic and Clinical Characteristics and Tests of Homogeneity.

Overall demonstrates that patients who chose to participate with the Steady Strides intervention and those that did not did not differ from each other in the measured clinical and demographic characteristics.

† Fisher's exact tests, rather than χ^2 tests, were utilized for categorical data except for initial number of falls and age to provide more accurate p-values for small samples. χ^2 tests were conducted for appropriate situations for comparison, but the conclusions did not change. A Welch's t¬-test for numerical data and a subsequent Wilcoxon Rank Sum Tests were used to address to avoid the Welch's normality assumption. Both methods yielded significant results.

‡ Patients who followed up after the initial evaluation for physiatrist-led Steady Strides intervention were deemed as participants, those who did not follow up even once were deemed as non-participants.

All patients in this cohort had an initial evaluation with physiatrist and all were offered the Steady Strides physiatrist-led intervention. 87 (70%) patients followed up with the physiatrist for the recommended Steady Strides intervention (study participants), and 37 (30%) did not follow up and were deemed as intervention non-participants (controls). There was no statistical difference in the baseline demographic, clinical variables studied between the participants and non-participant patient groups (see Table 1). Therefore, it is reasonable to assume that there is no interaction or possible confounding from these variables with intervention participation.

Variables	Incidence Rate	Confidence Interval (95%)	P Value
Steady Strides Participation	0.41	0.24-0.67	0.00057
PT Visits	0.59	0.36-0.96	0.034
OT Visits	0.65	0.39-1.07	0.088
Sex (Male)	1.88	1.15-3.15	0.014
Baseline falls	1.01	1.00-1.03	0.00029
Myelopathy	0.72	0.38-1.41	0.31
Neuropathy	0.95	0.57-1.57	0.83
Age	1.00	0.98-1.02	0.82
Vestibular Deficit	0.83	0.43-1.72	0.60
Spasticity	0.77	0.41-1.51	0.42
Weakness	0.94	0.56-1.57	0.83
Impaired Cognition	0.90	0.50-1.67	0.73

Table 2: Negative Binomial Regression Analysis for all Univariate Models.

Patients who followed up after the initial evaluation for physiatrist-led Steady Strides intervention were deemed as participants, those who did not follow up even once were deemed as non-participants.
† Physical Therapy (PT)
‡ Occupational Therapy (OT)

Incidence Rate

The average number of falls amongst the participants in Steady Strides intervention was 4.59 compared to 1.89 [p<0.004], among the non-participants. Participants demonstrated 62.9% [95% CI 40.68%-85.43%], of fall rate reduction compared to 0.33% in non-participants [95% CI 0.040%-0.58%, p=0.02]. 25.79% of participants showed at least 50% fall rate reduction [95% CI 7.87%-122.87%] compared to 1.08% in non-participants [95% CI 1.02-1.18, p=0.0000018]. Univariate regression (see Table 2) showed that Steady Strides intervention participation, (IR =0.41, 95% CI 0.24-0.67 p<0.001) and follow up with physical therapy (IR =0.59, 95% CI 0.36-0.96 p<0.05) were correlated with reduced number of falls. Baseline number of falls (IR =1.01, 95% CI 1.00-1.03 p<0.0005) showed a statistical, but not clinically significant association with outcomes since incidence rate was so close to 1.0. Male sex (IR =1.88, 95% CI 1.15-3.15 p=0.014) was significantly correlated with increased number of falls. Multivariable model (see Table 3) showed that Steady Strides intervention (IR =0.31, 95% CI 0.15-0.61 p<0.0005) was associated with reduced number of falls (Table 3).

Variables	Incidence Rate	Confidence Interval (95%)	P Value
Steady Strides Participation	0.31	0.15-0.61	**0.0003**
Sex (Male)	1.70	0.95-3.07	**0.039†**
Baseline Falls	1.01	1.00-1.03	**0.000072‡**
Impaired Cognition	8.2	0.45-1.5	0.50
Weakness	1.38	0.84-2.27	0.20
Spasticity	0.55	0.27-1.11	0.07
Vestibular Deficits	0.84	0.44-1.65	0.60
Myelopathy	1.00	0.50-2.03	0.99
Neuropathy	1.52	0.90-2.61	0.12
Age	1.00	0.98-1.02	0.92
PT Visits	1.08	0.51-2.28	0.83
OT Visits	1.11	0.55-2.22	0.77

Presents data for the non-reduced multivariable regression model although similar data was noted in the reduced model (see text).

† Male sex (IR =1.88, 95% CI 1.15-3.15 p<0.05), though has p-value under the 0.05 significance level, had negative binomial regression coefficient of 0.53 with confidence interval containing 0 [95% CI -0.05 to 1.12]. This seeming inconsistency is due to using "profile confidence intervals" based on profile likelihood rather than the standard error-based intervals that rely on normality. This is a standard approach for more reliable and accurate confidence intervals for parameters in generalized linear models such as negative binomial regression model. Due to the insignificant profile confidence interval at 95% confidence level, we will not consider male sex as a significant predictor of falls in this model.

‡ Baseline number of falls (IR =1.01, 95% CI 1.00-1.03 p<0.0001) does not appear to be clinically significant due to incidence rate close to 1.0.

Based on the tests of homogeneity and univariate regression models regarding the demographic/condition variables, there was not much evidence of any interaction between those variables and our main covariates of interest. Thus, it is reasonable to consider a reduced model with only the variables/effects of interest. The final analysis in the reduced multivariable logistic regression showed that patients who followed up with physiatrist had significantly lower falls compared to those who did not (IR 0.35, 95% CI 0.22-0.57 p<0.0005) and the baseline number of falls had a very modest, clinically insignificant effect on falls at 6 months after the initial evaluation (IR 1.02, 95% CI 1.01-1.03 p<0.0001). To measure the goodness of fit for the reduced multivariate negative binomial regression model, McFadden's R2 (0.0456) and Cox-Snell R2 (0.1763) were computed and although significant variables were noted, the model does not explain the variability in the final total falls. F-Test for Model Comparisons on nested reduced model vs the full model showed a p-value of 0.6639 indicating that the full model with all variables is not significantly better at modeling the outcome variable compared to the reduced model.

Discussion

Current estimates of annual rate of falls in older adults (65 years old and older) in the United States are alarming: one in three to one in four older adults experience a fall [18,19]. Falls are the number one cause of non-fatal injury leading to emergency room visits as well as the number one cause of unintentional death in older adults [20]. Falls cause significant functional deficits with over 95% of

hip fractures attributed to falls [21]. Falls are the most common cause of traumatic brain injuries [22]. Following a fall, fear of falls develops in up to a third of older adults, resulting in reduced overall activity and quality of life [23]. Falls cause enormous economic burden as well with about $50 billion spent on medical costs related to non-fatal fall injuries and $754 million spent related to fatal falls annually [24]. Since evidence is available that falls can be prevented [12-14, 16], the Centers for Medicare & Medicaid Services considers fall prevention a high value intervention to fill the gap in quality of healthcare delivery (especially considering falls' astronomical overall societal impact), and lists fall risk assessment among the high priority measures in its Merit-based Incentive Payment System [25].

Data supports [12-14], and experts agree [16] that effective fall prevention interventions are primarily functional in nature and focus on gait and balance improvement. Notably, even community-based fall prevention interventions utilizing exercise protocols not conducted by professional physical or occupational therapists were found to be successful and are commonly deployed throughout the country [26-28]. Physiatrists, as physicians trained to conduct biomechanical gait and balance assessment and provide functional interventions, are arguably the ideal medical specialists to claim fall prevention as part of their expertise domain and play a dominant role in helping the Centers for Medicare & Medicaid Services fill the open gap in quality patient care.

Steady Strides is the first documented structured physiatrist led fall prevention protocol. Results of our retrospective chart review demonstrate that patients that followed up with physiatrist for fall prevention management utilizing the Steady Strides approach had statistically lower incidence of falls at 6 months compared to those who did not (mean 1.89 vs 4.50, $p<0.004$). Notably intervention group had > 50% fall reduction compared to the control group. For the sake of comparison, exercise as a single intervention can be expected to produce only around a 20% reduction of falls [29]. If the results of our findings are generalizable, and assuming linear correlation of number of falls with cost of fall-related care, one may project over 50% reduction in overall fall-related healthcare costs.

Remarkably, though physical therapy (IR, 0.59, 95% CI, 0.36-0.96, $p=0.04$) was significantly correlated with falls in univariate study; only follow up with physiatry remained clinically and statistically significant in the multivariable analysis (IR 0.31, 95% CI 0.15-0.61 $p<0.001$). It should be noted that patients in our study have completed prior physical therapy intervention for fall prevention before participating with the Steady Strides protocol. This explains why physical therapy alone did not predict outcomes in the multivariable regression in this patient population: our patient population has already been resistant to physical therapy as a solitary intervention. Fortunately, however, even those patients who did not sufficiently gain from physical therapy alone, were able to improve with the Steady Strides intervention.

Patients in our cohort reported a particularly high baseline rate of falls (Table 1), which may limit applicability of this study to other patient populations. Furthermore, though baseline number of falls influenced falls at 6 months after the initial evaluation [in multivariable regression (IR 1.01, 95% CI 1.00-1.03 $p<0.0001$), its clinical effect based on the estimated incidence rate appears to be limited. It's also noteworthy that even patients in the control group also showed a marked improvement from the baseline. This finding may indicate that either i) baseline rate of falls reported was significantly impacted by recall bias in our study or that ii) patients were presenting during acute bout of falls which gradually improved even without the Steady Strides intervention. Even despite this gradual improvement however, as noted above patients in the intervention group showed significant benefit compared to those in the control group.

Overall, clinical, and demographic variables, including baseline rate of falls, did not have a statistically significant impact in the final multivariate study, showing that Steady Strides intervention can be successfully conducted amongst older adults of different ages and sexes, and regardless of medical diagnoses present. Measure of goodness of fit of our model shows that likely other variables that were not assessed in our study may have significant effects on explaining the variability of the data. It has been shown for instance that psychosocial effects can be meaningful in fall prevention, including factors like living alone, depression, fear of falls, and poor subjective health rating [30]. Perhaps including these variables in future studies can be helpful as well.

It should be noted that our patient population was comprised of independently living, non-institutionalized (e.g., not living in assisted living facilities, nursing home facilities) outpatient ambulatory older adults, and findings may not generalize to patients with higher severity of medical diagnoses present. For instance, presence of cognitive impairment in our cohort does not equal to presence of advanced dementia, and therefore our findings may not extend to advanced dementia patients.

Limitations of our study include follow-up and recall bias inherent in retrospective studies. Certainly, conducting prospective randomized trials with larger number of participants can help ascertain our current results. Similarly, lack of standardization for study variables, absence of multiple outcome measures that might better reflect impact of falls (e.g., hospitalization, hip fractures, brain injury rates, ensuing fear of falling], possible investigator bias, and other flaws inherent in retrospective analyses should also be listed as limitations. Steady Strides protocol was only performed by one physician. Assessing the effect of Steady Strides intervention performed by different physicians should be performed in future studies.

Conclusion

In summary Steady Strides, is a first documented physiatrist-driven structured functional fall reduction protocol. Results show that a significant effect on fall reduction in older adults can be accomplished and physiatrists may have a significant stake in helping reduce fall related morbidity and mortality. Further research is needed to determine whether combinations of

demographic, social, and clinical variables can be used to improve candidate selection. These goals can best be accomplished by large, well-designed, randomized trials.

Statement of Ethics

Ethics approval, as well as written informed consent were not required based on national guidelines as outlined for retrospective chart review of de-identified information already available in the electronic medical record consistent with the US Department of Health and Human Services Exempt criteria 45 CFR 46.101(b)[4].

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Supplement 1

Value-based medicine principle promotes goal directed care with close physiatrist oversight to help increase intervention efficiency and avoid unnecessary imaging, blood work, clinician visits or procedures not directly contributing to accomplishing the stated functional goals. Patient-centered care principle to foster patient engagement includes: i) allocating extra time to help answer patient questions; ii) using colored markers on white board and predesigned handouts to facilitate patient education; iii) explaining specifically how patient's functional deficits translate into patient-reported fall patterns; iv) explaining only up to top three key contributors for increased fall risk; v) minimizing number of home exercises; vi) explaining why the tailor-made rehabilitation treatment plan is anticipated to help the patient; and other similar considerations. Biomechanics-driven multifactorial management includes: i) providing comprehensive fall-risk assessment by one physician, physiatrist, instead of referring to neurology, orthopedics, otolaryngology and rehabilitation professionals; ii) differentiating acute triggers of falls e.g. tripping over a mechanical barrier, urinary tract infection, vs chronic underlying biomechanical conditions predisposing patient to be at risk of falls e.g. neuropathy or lower extremity spasticity; iii) explicitly identifying the exact fall risk factors present in the patient instead of using generic terms like "mechanical" or "multifactorial fall"; iv) using biomechanics to help prioritize those predisposing fall risk factors that contribute most to patient risk of falls based on history and exam, and preferentially focusing rehab management plan on those factors; v) setting specific time bound functional goals; vi) utilizing occupational therapy for sensory re-integration, functional reach with dual tasking and/or safety with activities of daily living in additional to using physical therapy interventions; vii) frequent physiatrist follow up with patients to re-calibrate rehabilitation goals as needed, improve rehabilitation efficiency and proactively eliminate barriers to therapy progress; viii) providing only one patient-specific home exercise program by physiatrist and closely monitoring patient success with this program; ix) prioritizing progressive balance training, safe dual tasking with functional reach and mobility, improvement in single leg stance time, hip power, gait speed and dynamic gait index vs focusing on strength training; x) utilizing templated history, standardized exam for assessment and fine-tuning standardized functional-deficit based rehabilitative interventions.

Structured history taken includes questions on frequency of falls/balance deficits, contributing factors (e.g., reaching forward, tripping, head turns), past medical and social history. Structured physical exam performed includes neurological, musculoskeletal, and vestibular exam as well as transfers, gait, and balance exam. History and exam findings were grouped into predefined gait and balance functional deficit categories including sensory or central ataxia, vestibular, movement disorder, impaired sustained visual attention and lower extremity deficits including decreased or increased range of motion, tone, deformity/amputation, and/or weakness. These conditions were prioritized and treated based on their contribution to the individual biomechanical problems exhibited by the patient.