Research Square

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Beyond the Visit: Longitudinal Outcomes of a Falls Prevention Shared Medical Appointment

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Abstract

Background: Falls are a leading cause of injury-related morbidity among older adults, yet real-world durability of fall prevention interventions remains understudied. We previously reported the feasibility of a Falls Prevention Shared Medical Appointment (SMA) integrating STEADI-based screening with group behavioral counseling. This study assesses long-term sustainability of behavior change and explores predictors of clinically relevant chart-documented falls following SMA participation.

Methods: This study was a retrospective cohort study of 96 unique patients who attended the SMA at an academic medical center (November 2021-January 2026). Chart review captured demographics and documented fall risk factors. Longitudinal analysis was restricted to patients with confirmable chart data who were not deceased (n=86). Falls outcomes were identified via structured free-text chart review. A long-term follow-up survey was sent in July 2026 to surviving patients. Associations between baseline STEADI Staying Independent Brochure (SIB) score, 30-second chair stand (30SCS), timed up and go (TUG), and subsequent documented falls were assessed using negative binomial regression adjusted for age, sex, and months of follow-up from the SMA.

Results: Defined by SIB ≥4 for greater fall risk, the higher-risk group had slower TUG times (p=0.036), fewer chair stands (p<0.001), lower self-reported strength scores (p=0.001). 61 (70.9%) patients had a fall-related chart mention, and 48 (55.8%) patients had a fall-related clinical encounter. Fall risk categorized independently by SIB category (p=0.012), abnormal 30SCS test (p=0.010), and by abnormal TUG test (p<0.001) significantly predicted documented fall mentions. In a combined model with performance metrics considered continuously and self-reported SIB categorically, 30SCS became the dominant predictor (p=0.034) while SIB (p=0.21) and TUG (p=0.45) lost significance. In the follow-up survey with 42 respondents (48.8%), many report continued regular exercise (59.5%), changes to reduce home hazards (57.1%), and participation in fall-prevention programs (57.1%). Most respondents found the SMA helpful (75.6%) and would recommend it to other patients (85.7%).

Conclusion: A substantial number of the responding patients participating in the Fall Prevention SMA reported sustained engagement in fall-prevention behaviors. The SIB questionnaire, a low resource self-administered screening tool, offers a reasonable alternative when functional assessment is not practical in clinical settings.

Clinical Trial Number: Not applicable.

Background

Falls are the leading cause of injury-related morbidity and mortality among older adults in the United States [1]. The US Preventive Services Task Force (USPSTF) recommends exercise interventions for community-dwelling adults 65 years and older at increased fall risk (Grade B), and individualized multifactorial interventions (Grade C) [2]. Despite strong guideline support, the implementation of

systematic fall risk screening, prevention counseling, and sustained behavioral adherence in primary care remain inconsistent.

In November 2021, we implemented a Falls Prevention Shared Medical Appointment (SMA) within an academic internal medicine clinic to integrate STEADI-based screening and group-based behavioral counseling into routine care [3]. Between November 2021 and February 2023, fifteen sessions were conducted with fifty-two participants (mean age 77), demonstrating high feasibility, strong completion rates (96%), and excellent patient acceptability [4].

Although the initial evaluation demonstrated successful integration and high short-term satisfaction, the durability of behavioral change and long-term fall outcomes following participation remain unknown. While exercise and multifactorial interventions reduce fall rates in clinical trials [2], pragmatic studies show variable real-world effectiveness and challenges in sustained patient engagement [5]. Furthermore, adherence to fall-prevention recommendations vary widely across healthcare systems, and maintenance of behavior change after a single intervention is uncertain [6].

Therefore, building on this pilot work, we conducted a retrospective chart review with a cross-sectional follow-up survey of the full SMA cohort. Our objectives were to characterize baseline demographics of the participants, determine the incidence and severity of falls documented in the electronic health record (EHR) after SMA participation, assess long-term patient-reported outcomes, and explore associations between baseline risk characteristics and documented post-SMA falls.

Methods

Patients in the cohort include those who attended the Falls Prevention SMA at UCSD Health between November 2021 to January 2026.

SMA Attendance and Initial Usability Survey

Methods for the SMA structure, assessment, and initial survey distribution have been previously described [4]. In brief, patients were referred to the SMA by their primary care physicians to identify and address modifiable, evidence-informed behavioral risk factors for falls. With a nurse, patients completed a pre-visit assessment using CDC STEADI-endorsed measures [3], including completion of the *Staying Independent Brochure* (SIB) survey and physical performance tests of the Timed Up and Go (TUG) and 30-Second Chair Stands (30SCS). Subsequently, they attended a 2-hour SMA session with 3–6 total patients.

Clinic SMA sessions were led by a single physician with expertise in fall-risk assessment and mitigation. A registered nurse assisted on a small number of occasions, reflecting a staffing change from the original pilot format, which was co-led by two physicians [4]. Regionally specific and online resources, relative to the patient's residence, were provided after the encounter based on shared discussion and clinically assessed risk. Approximately 2–4 weeks after attendance, patients were invited via email (sent

to the address linked to their MyChart account) to complete an initial survey on the usability and feedback of the SMA. Usability was measured with an appropriately worded System Usability Scale (SUS) [7]. Despite being designed for a single-assessment model, one patient attended the program twice. Only their first visit was included in the study to ensure that each patient was represented once in the analysis.

Retrospective Chart Review (Completed July 2026)

Chart review captured demographic information at the time of the SMA, documented fall risk factors, and falls documented in the EHR after SMA participation. Fall risk factors included SIB score, TUG time, 30SCS count, osteoporosis history, polypharmacy, Snellen visual acuity results, orthostatic vital results, and self-rated strength. Individuals with an SIB score greater than or equal to 4 are considered at risk [3], and patients were categorized into lower (SIB = 0–3) and higher fall risk (SIB ≥ 4) categories. Methods to interpret an abnormal TUG time, 30SCS count, orthostatic vitals, and Snellen eye screens were similarly based on guidance from CDC guidelines [3]. Polypharmacy was defined as a prescription of 5 or more medications [8]. Before analysis, the TUG scores for 4 patients were excluded for missing results (n = 1) or falling outside a plausible range (n = 3 total; one of 3 seconds, two exceeding 60 seconds). Each was confirmed via chart review to reflect actual nurse documentation from the screening assessment rather than a data entry error.

To abstract documented falls, a free-text search for the term “fall” was performed across the patient chart using the EHR’s “Chart Search” function. Medical record review does not depend on participant recall, which declines as the recall period lengthens [9]. Falls were identified using clinician documentation consistent with accepted definitions of an unintentional change in position resulting in coming to rest on the ground or lower level [10]. The reviewer kept a tally of each unique documentation for falls, and two outcome variables were defined. First, the “total number of falls” included any documented falls in the note, regardless of context for the appointment. If the provider used a non-numerical term suggesting more than one fall (such as “multiple” or “several”), it was recorded as 3 additional falls. A second category, the “number of falls with encounters”, was made up of unique instances such as an emergency department visit, urgent care, or outpatient appointment for which a fall was the primary reason for the encounter.

Cross-sectional Follow-Up Survey (Completed July 2026)

A follow-up survey focused on longitudinal outcomes was sent to the study population, assessing self-reported falls since SMA participation, current engagement in fall-prevention behaviors, confidence in mobility, and perceived usefulness and lasting impact of the SMA. Patients were first contacted via a secure patient portal to complete the survey through a Qualtrics link. One follow-up telephone call was made approximately 1–2 weeks after the initial message was sent, which either directed the patient to the survey Qualtrics link or provided the option to complete the survey with the caller over the phone.

Depending on the time of their initial SMA appointment, this survey ranged between approximately 0.5 to 5 years of follow-up.

Statistical Analysis

Descriptives for continuous variables were reported as mean and standard deviations, and categorical variables were reported as frequency and percentage. Adjusting for age and sex as covariates, baseline fall-risk factors were compared between low and high fall-risk groups, defined by SIB score, using analysis of covariance (ANCOVA) for continuous variables or logistic regression for categorical variables. To update usability findings defined by SUS scores from the initial survey, independent t-tests were performed to compare findings between the responses previously reported [4] and the newer responses since then. Associations between baseline risk characteristics (SIB Score, TUG time, and 30SCS count) and the falls documented after SMA participation (falls mentioned and falls with clinical encounters) were assessed using negative binomial regression, adjusting for age and sex as covariates and using months since SMA participation as an offset. Analyses were performed using IBM SPSS Statistics, Version 31.

Results

Participant Characteristics

A total of 97 patients completed the nurse pre-visit appointment and attended the Fall Prevention SMA. After excluding one duplicate visit, 96 patients were included in the analytic cohort (Fig. 1). The average age of patients was 78 (± 6.8) years and ranged from 64–94 years. The majority of patients were female (75%), white or Caucasian (80.2%), and non-Hispanic (92.7%). Participants took an average of 5.1 (± 3.3) medications, and 29 (30.5%) used at least one potentially high-risk medication based on the Beer's Criteria, Table 1. 61 (69.3%) had osteoporosis or osteopenia (Table 1).

Table 1
Demographics.

Demographics (n = 96)	N (%) or mean ± SD
Age	
Mean	78.0 ± 6.8, range 64–94
64–70	12 (12.5%)
71–80	54 (56.3%)
81–90	24 (25.0%)
90+	6 (6.3%)
Sex	
Male	24 (25.0%)
Female	72 (75.0%)
Race	
White/Caucasian	77 (80.2%)
Black/African American	2 (2.1%)
Asian/Pacific Islander	13 (13.5%)
Other	4 (4.2%)
Ethnicity	
Hispanic	7 (7.3%)
Medications (n = 95)	
# of Medications	5.1 ± 3.3, range 0–19
High Risk (Beer's Criteria)	29 (30.5%)
Bone Density (n = 88)	
Osteoporosis or Osteopenia	61 (69.3%)

Baseline Fall Risk and Physical Performance

The chart review was conducted for a total of 94 patients, excluding 2 two patients due to missing medical record numbers (MRN). The average SIB score was 6.2 (± 3.5) and ranged from 0–13. Defined by SIB score, 23 (24.5%) patients were considered lower fall risk, while 71 (75.5%) were considered higher fall risk. After adjusting for age and sex, the higher-risk group had slower mean TUG times (13.2

vs. 8.7 seconds, p = 0.036), completed fewer chair rises during the 30SCS test (10.2 vs. 15.0 stands, p < 0.001), and reported lower strength scores than the lower-risk group (5.2 vs. 6.5, p = 0.001). Polypharmacy was also more common in the higher-risk group (p = 0.004). Differences in abnormal orthostatic vital signs and visual acuity were not different statistically (Table 2).

Table 2
Association Between Fall Risk Group.

Physical Performance Score	**n**	**N (%) or mean ± SD**	**Lower Fall Risk**	**Higher Fall Risk**	**p-value**
Timed Up and Go (sec)	90**	12.1 ± 6.7	8.7 ± 2.2	13.2 ± 7.3	0.036
Abnormal TUG Score			3 (9.4%)	29 (90.6%)	
30 Second Chair Rise (#)	94	11.4 ± 5.6	15.0 ± 3.5	10.2 ± 5.7	< 0.001
Abnormal 30SCS Score			1 (3.8%)	25 (96.2%)	
Self-Rated Strength (1–10)	85	5.5 ± 1.7	6.5 ± 1.3	5.2 ± 1.7	0.001
Polypharmacy (≥ 5 Rx)	93	47 (50.5%)	5 (10.6%)	42 (89.4%)	0.004
Abnormal Orthostatic Vitals	91	27 (29.7%)	3 (11.1%)	24 (88.9%)	0.072
Abnormal Snellen Acuity	81	12 (14.8%)	1 (8.3%)	11 (91.7%)	0.265

* Analysis performed: ANCOVA for continuous variables and Logistic Regression for categorical variables

** 4 patients were excluded from TUG score (see methods)

In total, 28 patients completed the initial survey deployed immediately after the SMA, of which 25 patients fully answered the SUS. The average SUS score was 85.4 (± 11.5) and ranged between 62.5–100 with a significant difference between cohorts (p = 0.016). No significant differences were found between the earlier and newer respondents in their reported likelihood of enrolling in a fall-prevention program, accessing online fall-prevention resources, or learning from the appointment (Table 3).

Table 3
Usability Survey Results.

SUS (> 68 considered usable/feasible)	**n**	**Total Responses**	**n**	**Newer Responses**
	25	**85.4 ± 11.5**	**13**	**90.6 ± 9.9**
How much more likely to... (0-100)				
Have or plan to enroll in a fall-prevention program	22	65.1 ± 36.1	12	64.7 ± 38.3
Have or plan to visit web-based content for fall-prevention	21	75.0 ± 25.0	10	81.4 ± 22.4
I learned something from the clinical assessment/appointment.	24	76.2 ± 28.5	14	85.5 ± 20.0

86 patients were eligible for long-term follow-up after 9 patients were excluded due to death. 42 completed the survey, resulting in a response rate of 48.8%. 24 respondents (57.1%) reported at least one fall after attending the SMA. 25 (59.5%) reported exercising regularly, 25 (59.5%) had made changes to reduce home hazards, and 24 (57.1%) had participated in a fall-prevention program. Half (50.0%) reported greater confidence in their balance. Most respondents agreed that the SMA was helpful to them (31, 75.6%), that they would recommend it to other patients (36, 85.7%), and reported that something from the visit had a lasting impact on their daily activities (26, 61.9%; Table 4).

Table 4
Longitudinal Survey Results.

N = 42	N (%)
Fallen Since SMA Appointment (self-reported)	
Yes	24 (57.1%)
1 time	11 (45.8%)
2–3 times	9 (37.5%)
4–5 times	3 (12.5%)
> 5 times	1 (4.2%)
Engagement in Fall Prevention Activities	
Current exercise	
Yes, regularly	25 (59.5%)
Yes, occasionally	15 (35.7%)
Made changes to decrease home hazards	25 (59.5%)
Participated in fall-prevention program	24 (57.1%)
Confidence in Balance	
Less Confident	15 (35.7%)
About the Same	6 (14.3%)
More Confident	21 (50.0%)
Perceived Impact of SMA	
The SMA was helpful to me.	
Agree	31 (75.6%)
Neutral	8 (19.5%)
Disagree	2 (4.9%)
The resources provided after the visit were useful.	25 (61.0%)
I would recommend this appointment to other patients.	36 (85.7%)
Something from the visit had a lasting impact on my daily activities.	26 (61.9%)

Among the 86 patients included in the long-term follow-up and fall-related outcome analysis, 61 (70.9%) had at least one documented mention of a fall in the EHR. The average number of falls mentioned was 2.9 (± 3.5) and ranged from 0–15 falls. 48 (55.8%) patients had an encounter dedicated to a fall. The

average number of dedicated fall encounters was 1.0 (± 1.1) and ranged from 0–5 falls. Defined by SIB score, the lower fall risk group had a lower rate of fall-mentions compared to the higher risk group (IRR = 0.46, 95%CI [0.25–0.85], p = 0.012). Using the cut offs defined by the CDC for physical function tests to create binomial risk category, a similar pattern was observed, for both an abnormal TUG (IRR = 0.43, 95%CI [0.27–0.71], p < 0.001) and abnormal 30SCS (IRR = 0.48, 95%CI [0.28–0.84], p = 0.010). In a combined model using the SIB risk category alongside TUG time and 30SCS count as continuous measures, the rate of fall mentions did not differ significantly by SIB classification or TUG time. However, a higher 30SCS count demonstrated a slightly lower rate of fall mentions (IRR = 0.95, 95%CI [0.90-1.00], p = 0.034).

Finally, sensitivity analyses evaluating clinical encounters related to a fall, rather than a documented mention of a fall, applied the same individual models (SIB risk category, abnormal TUG, abnormal 30SCS) and did not show statistically significant differences for the SIB (IRR = 0.70, 95%CI [0.39–1.28], p = 0.246), the TUG (IRR = 0.81, 95%CI [0.50–1.33], p = 0.412), or 30SCS (IRR = 0.75, 95%CI [0.45–1.26], p = 0.281).

Discussion

This study expands upon our pilot 2023 SMA study [4] by examining the sustainability of fall-prevention behaviors and exploring the relationship between baseline assessments and subsequent documented falls. Overall, the findings suggest that the SMA may support continued engagement in fall-prevention behaviors beyond the initial appointment.

Compared to the original pilot cohort previously described [4], the characteristics of this expanded cohort were generally similar, particularly in age and racial composition. The current cohort included a lower proportion of women and had a higher average SIB score, suggesting that the expanded program continued to reach older adults with substantial fall risk. The initial survey findings continued to demonstrate high usability. Newer respondents had a significantly higher average usability score than the original respondents, reflecting iterative improvements to the program over time.

Among the 2026 follow-up survey respondents, nearly all reported exercising at least occasionally, approximately 60% had made changes to reduce hazards in their homes, and more than half had participated in a fall-prevention program. Most respondents also found the SMA helpful, would recommend it to other patients, and reported that something from the appointment had a lasting impact on their daily activities. These findings suggest that the combination of clinical assessment, education, and individualized resources offered through the SMA may help reinforce fall-prevention behaviors beyond the initial appointment. While promising, because these outcomes were self-reported and there was no comparison group, this isn't to be interpreted that the SMA caused behavioral change.

Agreement between SIB questionnaire scores and other fall-risk indicators suggest that the SIB questionnaire identifies meaningful differences in patient risk. Participants classified as higher risk generally showed poorer physical performance, lower self-rated strength, and greater medication burden.

For longitudinal fall outcomes, functional measures may be a stronger predictor than SIB classification. In the combined model with physical performance metrics and SIB score, 30SCS had the strongest association with subsequent documented fall mentions. This provides some evidence supporting existing literature that lower-extremity strength is a meaningful fall-risk factor [11]. However, classification by SIB questionnaire independently was still significantly associated with the rate of fall mentions. Given this, the SIB questionnaire may offer practical advantages in routine clinical care compared to physical functional measures. Performance-based assessments such as the TUG and 30SCS take a standardized approach, additional clinical time, and physical space to complete. In comparison, the SIB questionnaire is self-administered and requires fewer clinical resources. Its associations with objective performance measures and later fall documentation support its use as a fall-risk screening tool [4] and its utility to provide information on fall risk when performance-based testing is not feasible [13].

Notably, these results were not consistent when considering fall-related clinical encounters, which may suggest that documented mentions of falls were less likely to be injurious or require further clinical intervention. The exact reasons remain beyond the scope of this study given the limited number of patients and relatively few fall-related encounters. However, one potential hypothesis that bears further exploration is that the SMA taught and encouraged preventive actions that reduced fall-related morbidity, resulting in less clinical encounters for falls. While additional research is needed, these findings may mirror the findings of the STRIDE study, which was a comprehensive fall-prevention trial that did not find significant differences in the rate of serious fall injuries through intervention [14]. Although a multitude of factors influence fall-prevention behavior and outcomes, one possible contributing factor is that increased awareness of fall-risk may have lowered serious injuries in both groups, diminishing the impact of the intervention [14].

To our knowledge, while prior work has evaluated STEADI implementation in research contexts [12] and specifically the SIB's concurrent validity in clinical settings [13] and its predictive validity against future falls in research cohorts [15], this represents one of the first evaluations of the SIB's predictive utility against subsequent chart-documented falls evaluated through manual review of free-text clinical documentation within a real-world, routine clinical implementation [16]. The use of a free-text chart search may have identified falls recorded within clinical narratives that would have been missed by relying only on diagnosis codes or chief complaints.

Limitations

This was a relatively small sample within one academic healthcare system, which may limit statistical power and generalizability. Additionally, the observational design and lack of a comparison group prevent causal conclusions about the effects of the SMA.

The follow-up survey's higher response rate relative to the initial survey (48.8% vs. 28.9%) may partly reflect its delivery channel: secure Epic MyChart portal messaging with telephone follow-up versus email

for the initial survey, rather than a genuine difference in patient engagement over time. Follow-up survey participation was also incomplete, creating the possibility of response and survivorship bias. Patients who remembered the program, continued fall-prevention activities, or had favorable experiences may have been more likely to respond.

Fall count by chart review may also been subject to variation in clinical documentation. Because patient chart records were generated for clinical rather than research purposes, they may both overcount falls mentioned in passing without clinical significance and undercount falls that were never documented. This count is also dependent on the physician asking about or patients raising the fall during a clinical encounter, leaving it subject to recall limitations and underreporting, especially for a population of older adults [17]. In addition, the use of a single reviewer may have introduced errors. Having an independent second reviewer could have increased reliability in the fall count.

Notably, several data quality issues should also be explicitly mentioned, given that some documented findings were improbable. Three TUG scores fell outside a plausible range (see methods). Given their potential to disproportionately influence model estimates, these three values were excluded from the regression analyses. Their presence in the underlying data nonetheless illustrates a meaningful contrast with controlled research settings: a trial protocol with dedicated, standardized data collection would likely flag and exclude implausible values before they were ever recorded, whereas routine clinical documentation, generated amid competing time-sensitive demands, carries no equivalent safeguard. However, this serves as a reminder that real-world clinical data collection reflects genuine constraints of staffing, time, and workflow that a research protocol is designed to control for however external translation to clinics may fall short. As such, the data that have been generated here are particularly promising and warrant further exploration in a more controlled context.

Conclusion

Ultimately, our findings suggest that the fall-prevention SMA may support continued engagement in fall-prevention behaviors, and categorization by STEADI's SIB questionnaire could potentially capture a clinically meaningful difference in fall risk and outcomes.

Abbreviations

CDC Center for Disease Control and Prevention

USPSTF United States Preventive Services Task Force

SMA Shared Medical Appointment

STEADI Stopping Elderly Accidents, Deaths, and Injuries

EHR Electronic Health Record

SIB Staying Independent Brochure

TUG Timed Up and Go

30SCS 30-Second Chair Stands

SUS System Usability Scale

MRN Medical Record Number

ANCOVA Analysis of Covariance

IRR Incidence Rate Ratio

STRIDE Strategies to Reduce Injuries and Develop Confidence in Elders

Declarations

Ethics approval and consent to participate

This study was reviewed and determined exempt (Exempt, Non-Committee Review) by the UC San Diego Institutional Review Board (IRB 814736).

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

RM conceptualized the study, led implementation of the clinical workflows, contributed to data collection, assisted with drafting the manuscript, and assisted in statistical support. JF assisted with data management,conducted chart review, performed data cleaning and aggregation, performed statistical analysis, and drafted the manuscript. BS contributed to manuscript generation. DW provided

manuscript input and facilitated programmatic launch. HH and GW facilitated health system implementation. All authors contributed to interpretation of results, critically revised the manuscript, and approved the final version

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Figures

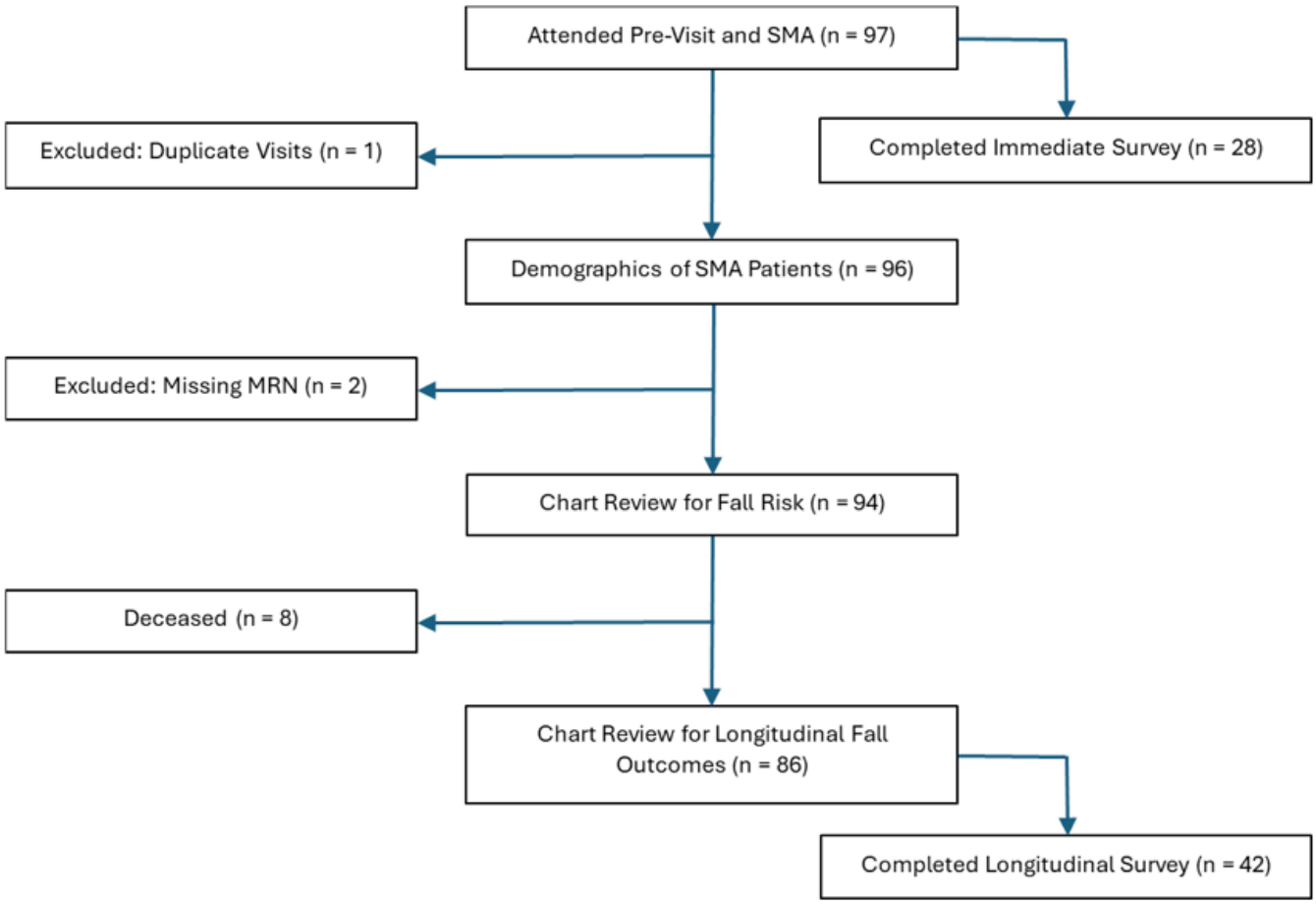


Figure 1

Consort Flow Diagram.