Statistical Analysis Plan

A Randomized Controlled Trial of Visual Cues, Signage, and Spaced Retrieval Education within Long Term Care Communities to Assist with Wayfinding

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Management and Analysis. The data will be entered into the study database, cleaned and assessed for completeness. Then the data will be de-identified and transferred into SAS 9.4 statistical software for analysis.

Preliminary analysis. The distributions of outcomes and control variables will be summarized. For continuous outcomes, normalizing transformations will be applied as needed. If they are not successful, then the modeling approach will involve generalized linear models with the appropriate error distribution (e.g., gamma or beta). Since the level of randomization is facility and the unit of analysis is individual, the appropriate random effects will be specified in all statistical models to account for nesting of individuals within facilities.

Analysis of feasibility measures. Attrition rates and reasons and baseline measures of the dropouts will be compared by trial arm to ensure absence of attrition bias. Resident responses to the acceptance of cues questionnaire and staff responses to the interview questions will be summarized overall, by trial arm (cues only versus cues + spaced retrieval education), and by care community. The staff focus group data will be transcribed into *Atlas Ti* and analyzed using constant comparison analysis. Text will be chunked into common units and assigned a code. Codes will be grouped into like categories (axial coding) and then like categories will be assigned themes[60]. Similarities and differences of themes among the arms and care communities will be summarized.

Primary analysis. The primary analysis will follow the intent to treat approach and will include all participants as randomized.

Specific Aim 1 *examines the effect of salient cues with and without spaced retrieval education on wayfinding ability*. The statistical model #1 for the repeated measures of wayfinding ability at 1, 3, 6, and 12 months will include the following explanatory variables: wayfinding ability at baseline, time (with levels 1, 3, 6, 12 months), trial arm, and control variables measured at baseline (see the measures section). Time will be included as categorical variable with the above mentioned levels to model potentially non-linear (polygonal) changes in outcomes over time. For the first measure of wayfinding ability, average speed calculated as described in the measures section, this model will be implemented as a linear mixed effects (LME). It will also include random effect indicating facility as will all other statistical models. The LME model generalizes classical analysis of repeated measures and allows for data missing at random, time-varying covariates, and structured covariance matrix. The participants who completed at least one post-baseline assessment will be included in the analysis following the intent to treat principle. The second measure of wayfinding ability, the proportion of wrong turns, by definition takes values from the [0, 1] interval and will be analyzed using generalized LME with beta distributed errors. Beta distribution supported on [0, 1] interval is particularly suitable to this measure.

The essential parameter of interest in the statistical model #1 is associated with the trial arm variable. The least square (LS) means corresponding to this variable will be output from the model, and differences among them will be tested. The test of significance of the differences between LS means for cues versus control and cues + spaced retrieval education versus control will yield the formal test of hypothesis H01. The test of the significance of the differences between cues + spaced retrieval education versus cues alone will yield the formal test of hypothesis H02. After testing the main trial arm effects, time by trial arm interaction will be added to the statistical models to explore whether intervention effects change as time progresses. The significance of the interaction term will be assessed, and differences in LS means by trial arm at each time point will be tested to determine the immediate and sustained effects.

Specific Aim 2 *tests the effect of the active trial arms on the secondary outcome of life space*. Statistical model #1 will be modified to include the repeated measures of life space as the

dependent variable, and hypothesis H03 will be tested by comparing the LS means for the two active arms. This will first be done using *Tinetti's Nursing Home Life-Space Diameter* measure for all participants.

Handling of missing data and alternative analytical approaches. The patterns of missing data will be evaluated using SAS PROC MI to determine if the assumption of missing at random (MAR) is reasonable [61]. The analysis techniques for Aims 1-3 allow for MAR mechanism. If patterns of missing data indicate potential missing not random (MNAR) mechanism, then models describing missing mechanisms will be considered (e.g. pattern-mixture models)[62,63]. Since MNAR or MAR assumptions are not directly testable, we will employ sensitivity analyses to investigate how the results would or would not change under pattern-mixture or other models for the missing mechanism.

Strategies for Multiple Inferences. Because the study hypotheses were stated a-priori, adjustments for multiplicity are not necessary in the analyses for the main study Aims 1 and 2. In additional analyses for the exploratory Aim 3, false discovery rate will be controlled using Hochberg or Benjamini-Hochberg procedures[64,65.] Since adjustments for multiplicity are controversial, the results will be presented both unadjusted and adjusted.