INTRODUCTION
Declines in functional mobility that increase fall risk are a serious problem for older adults. Reduced medial-lateral (ML) control of movement has been consistently observed during balance tests in older and fall risk populations [1,2]. The purpose of the present study was to potentially improve functional assessment of fall risk in older adults by developing a clinical test of rapid stepping that challenges ML control. A rapid, repeated Step Up test was developed, since speed of movement is lower for those with higher fall risk [3] and a rapid step up is challenging for ML control [4]. It was hypothesized that participants who performed better on the Step Up test would be faster and able to achieve higher acceleration magnitudes with less variability and better rhythmicity.

METHODS
With a triaxial accelerometer taped to the skin overlaying L4, healthy, self-ambulatory participants (mean age: 80.3 (SD 6.5) years, n = 39) completed a Step Up test involving rapid ML shifts by tapping each foot alternately onto a 15 cm step placed anteriorly as many times as possible for 20 s. Steps were counted (# of steps), and were identified from acceleration signal events. Signal processing was performed in Matlab R2013a using custom-written code. Acceleration (ACC) magnitude and variability were quantified as the ML ACC root-mean-square (ML RMS) and the mean and standard deviation (SD) of the per-stride peak-to-peak ML ACC (PP ACC and PP ACC SD, respectively). Temporal variables included the mean step time (MST) and rhythmicity of stepping (step time SD, STSD). All variables but MST were non-normally distributed and log transformed. The association between Step Up performance (# of steps) and the ACC and temporal variables was analyzed using Pearson correlations and forward stepwise linear regression (FSLR) in SYSTAT 13. Repeatability was tested 1-2 weeks later in 11 participants using Pearson correlations and dependent t-tests.

RESULTS AND DISCUSSION
Participants completed an average of 21.0 steps (SD 5.0). The # of steps was highly related to MST (r = -0.959, p < 0.001), and moderately correlated with PP ACC, PP ACC SD (Figure 1), and ML RMS (r = 0.533 - 0.560, p = 0.001) and STSD (r = -0.573, p < 0.001). FSLR identified MST and PP ACC SD as nearly perfectly predicting # steps (R^2_adj = 0.934, p = 0.005), but since MST is simply the inverse of # steps per second, this reveals little. Thus, MST was eliminated as a predictor to reveal variables that may underlie its effect, and FSLR determined ML RMS, PP ACC SD, and STSD to predict number of steps (# of steps = 21.980 + 3.113(RMS) + 2.678(PP ACC SD) - 4.600(STSD) (R^2_adj = 0.624, p < 0.001), revealing that better Step Up performance is related to ACC magnitude, ACC variability and temporal rhythmicity. Higher ACC magnitude (PP ACC, RMS) and lower STSD in participants with better Step Up performance indicates an ability to shift weight side-to-side aggressively while maintaining rhythmicity [3,5]. Larger ACC variability (PP ACC SD) in the higher performing participants may indicate an ability to adapt to balance disturbances without slowing down, perhaps representing more robust physiological complexity and functional capacity [6].

CONCLUSIONS
The Step Up test has potential as a clinical test of ML control, since participants who completed more steps in 20 s were able to shift their weight in the ML direction aggressively while maintaining rhythmicity. Modifications to the test are necessary to improve its repeatability before it can be clinically useful.

REFERENCES