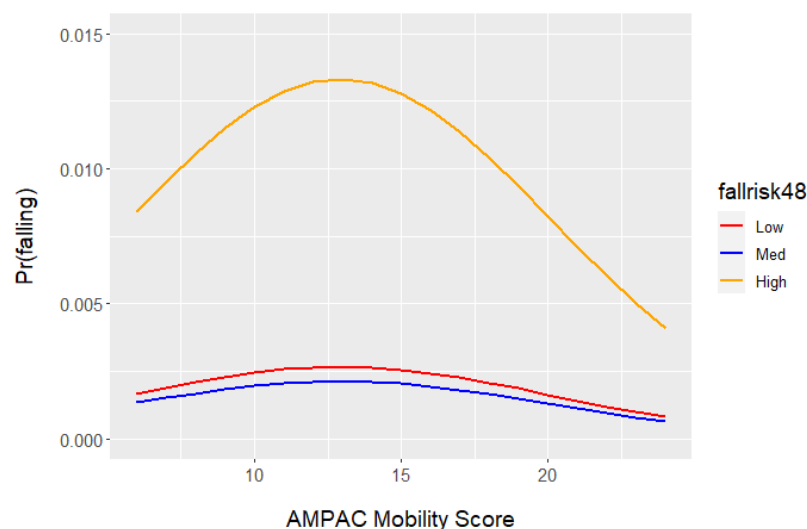


Summary

- Hypothesis: patient fall risk is affected by their mobility patterns over time.
- Observation: Falls seem to occur more often inside the AM-PAC danger zone (DZ).
- Logic of our work:
 - Define danger zone based on fall risk (JH-FRAT)
 - Compare between fallers and non-fallers, both groups' time spent inside DZ.
 - Explore the effects of DZ on fall-risk: does continuous exposure inside DZ indicate exponentially/logarithmically increasing fall risk.
 - Similar analysis on JHLM 7-8 to determine fallers and non-fallers behaviors on high-mobility regions.

1. Define Danger Zone based on JH-FRAT fall risk score



- Methods
 - Using all patients (47,478 Non-Fall, 138 Fall), computed logistic model for injurious falls using Firth's Penalized Likelihood (Firth's Regression)
 - Covariables: Centered value (value - mean) of lowest AM-PAC mobility in first 48 hours, the centered value of AM-PAC mobility squared, highest JH-FRAT score in first 48 hours, comorbidity count and LOS
 - Calculate probability of fall based off log odds from model

- Observations

- Risk of fall peaks around AM-PAC mobility score between 12 and 13

2. Comparison of time spent inside the danger zone between fallers and non-fallers.

- Methods

- Population: Matched patients [7,21]
 - Conducted T-test and K-S test to determine the significance of difference in mean and difference in distribution, respectively, between fallers and non-fallers.

- Observations

welch Two sample t-test

```
data: Propdz1317 by FallInjuryYN
t = -3.6525, df = 64.541, p-value = 0.0005222
alternative hypothesis: true difference in means
95 percent confidence interval:
 -0.20987439 -0.06148164
sample estimates:
mean in group 0 mean in group 1
 0.1488278      0.2845058
```

○

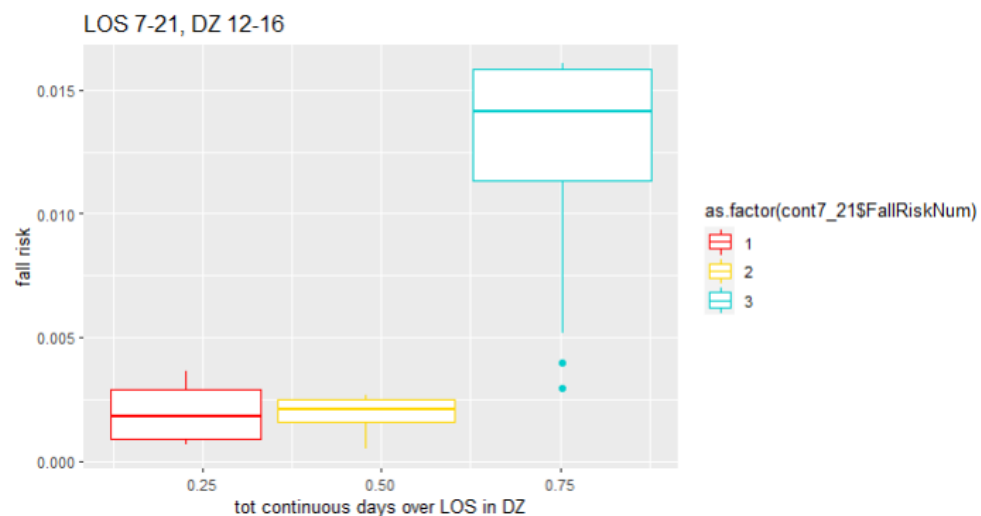
3. Exploration of continuous exposure to danger zone:

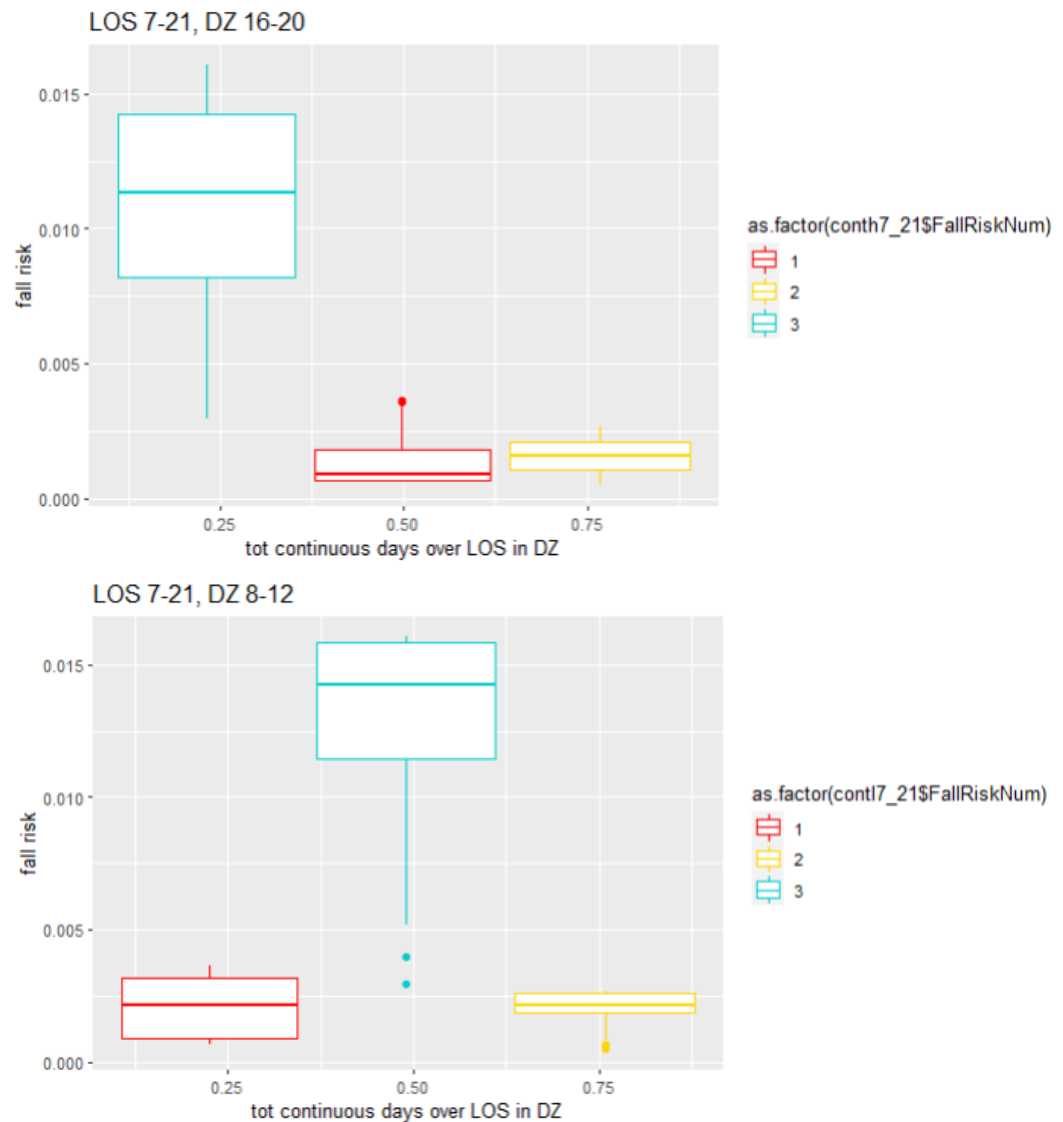
i) Comparison of continuous time spent inside different danger zones (low, medium, high) between different JH-FRAT risk groups (1,2,3)

• Methods

- Defining continuous days:
 - Raw continuous days (ie. 0-1-1-0-1 would be 2 continuous days; and 0-1-1-1-0-1-1 would be 5 continuous days)
 - Proportion of continuous days over LOS (ie. raw continuous days / LOS of specific patient)
- For patients with LOS 7-21, we compared the Proportion of LOS spent in continuous days between the risk groups low, medium and high (numbered 1, 2, 3, respectively).

• Observations





- **Conclusion**

- The high fall-risk group spent the longest continuous proportion of time in the middle DZ (12-16), followed by the medium fall-risk group and the low fall-risk group, respectively.
- In the lower DZ (8-12), the medium fall-risk group spent the longest continuous proportion of time, followed by high fall-risk then low fall-risk.
- In the higher DZ (16-20), the medium fall-risk group spent the longest continuous proportion of time, followed by low fall-risk then high fall-risk.

ii) Comparison of continuous time spent inside the danger zone between fallers and non-fallers.

- **Methods**

- Conducted T-test and KS-test on proportion of continuous days over LOS spent in DZ to determine the significance of difference in mean between the fallers and the non-fallers.
- Defining continuous days:

- Raw continuous days (ie. 0-1-1-0-1 would be 2 continuous days; and 0-1-1-1-0-1-1 would be 5 continuous days)
 - Proportion of continuous days over LOS (ie. raw continuous days / LOS of specific patient)
- Observations

Welch Two Sample t-test

```
data: tot_c by FallInjuryYN
t = -1.9197, df = 98.05, p-value = 0.0578
alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
95 percent confidence interval:
 -2.44268154  0.04052565
sample estimates:
mean in group 0 mean in group 1
    1.694444      2.895522
```

Exact two-sample Kolmogorov-Smirnov test

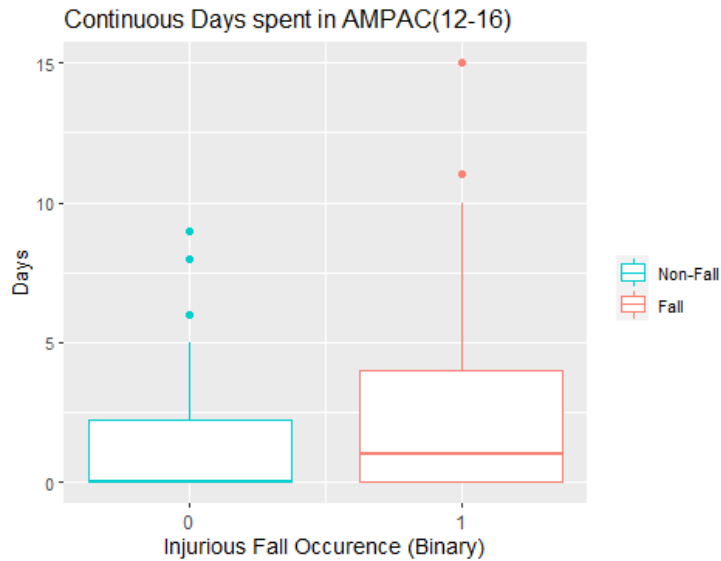
```
data: Matches_fallers$tot_c and Matches_nonfallers$tot_c
D = 0.16791, p-value = 0.2578
alternative hypothesis: two-sided
```

```
summary(Matches_fallers$tot_c)
```

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|-------|---------|--------|-------|---------|--------|
| 0.000 | 0.000 | 1.000 | 2.896 | 4.000 | 15.000 |

```
summary(Matches_nonfallers$tot_c)
```

| Min. | 1st Qu. | Median | Mean | 3rd Qu. | Max. |
|-------|---------|--------|-------|---------|-------|
| 0.000 | 0.000 | 0.000 | 1.694 | 2.250 | 9.000 |



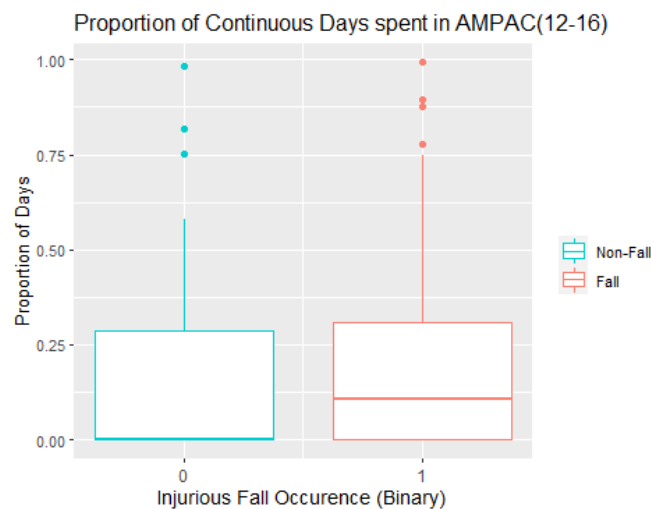
Welch Two Sample t-test

```
data: c_rat by FallInjuryYN
t = -0.70358, df = 72.307, p-value = 0.484
alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
95 percent confidence interval:
 -0.14571915  0.06968753
sample estimates:
mean in group 0 mean in group 1
 0.1737320      0.2117478
```

Exact two-sample Kolmogorov-Smirnov test

```
data: Matches_fallers$c_rat and Matches_nonfallers$c_rat
D = 0.13143, p-value = 0.6165
alternative hypothesis: two-sided
```

```
summary(Matches_fallers$c_rat)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.0000 0.0000  0.1079  0.2117  0.3069  0.9932
summary(Matches_nonfallers$c_rat)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.0000 0.0000  0.0000  0.1737  0.2860  0.9839
```



- Conclusion
 - Fallers spent a higher number and proportion of time in DZ 12-16.

- The trend is similar in the other danger zones, though insignificant.
- On average, fallers spent approximately one more continuous day in the danger zone compared to non-fallers.
- KS tests are insignificant which suggests fallers and non-fallers' time (continuous days) inside DZ are drawn from the same underlying distribution. The same thing can be said about fallers and non-fallers' proportions of time inside DZ.

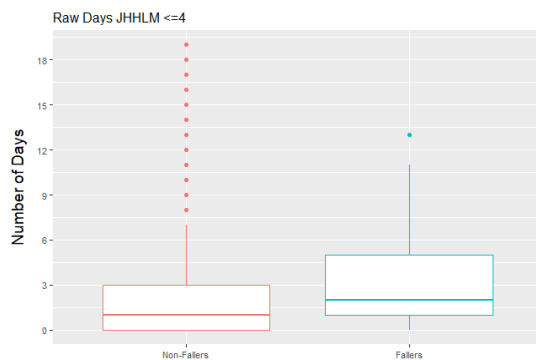
4. Comparing Fallers and Non-Fallers' Time Spent in JH-HLM Zones

- Methods

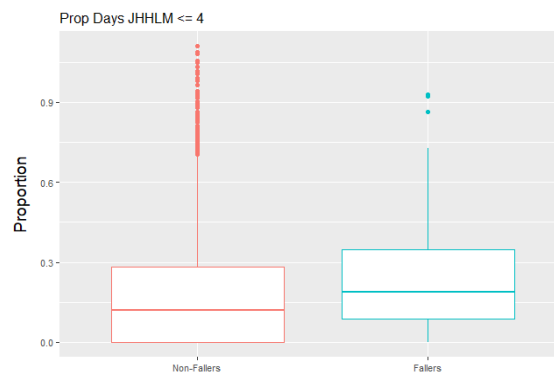
- Matched Population [7,21]
 - 63 Fallers, 1923 Non-Fallers
- Using t-tests and K-S test to compare distributions
- Analyzing the days spent in various JH-HLM zones
 - JH-HLM zones: 1-4, 5-6, 7-8
 - Number of non-continuous days, proportion of non-continuous days ($\frac{\text{Days Spent in Range}}{\text{Length of Stay}}$), continuous days, proportion of continuous days ($\frac{\text{Continuous Days Spent in Range}}{\text{Length of Stay}}$)

- Observations & Conclusion

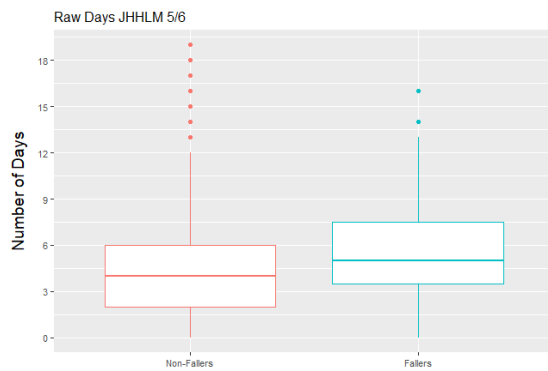
- Non-continuous days
 - Fallers and Non-Fallers appear to spend a similar number of total days (non-continuous) in high mobility (JH-HLM 7-8) as well as similar amounts of time relative to their length of stay
 - Fallers spend more total non-continuous days in mid (JH-HLM 5-6) and low (JH-HLM 1-4) than non-fallers
 - Difference becomes more muted when comparing days relative to length of stay, but fallers still spend a greater proportion of time in the mid and lower zones



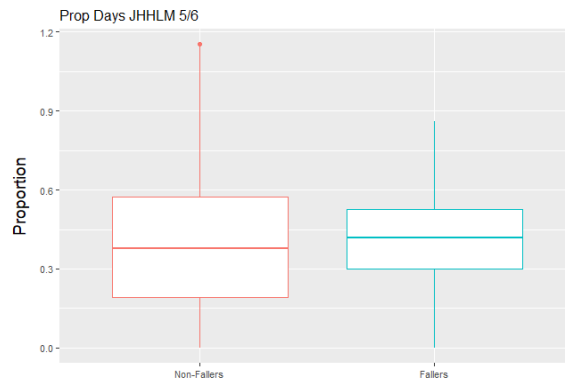
(t-test p-val: 0.008, K-S: 0.013)



(t-test p-val: 0.063, K-S: 0.037)



(t-test p-val: 0.019, K-S: 0.035)



(t-test p-val: 0.69, K-S: 0.057)

5. Comparing Fallers and Non-Fallers' Continuous Days in JHHLM (7-8)

• Methods

- Matched Population [7,21]
 - 63 Fallers, 1923 Non-Fallers
- Conducted T-test and KS-test on proportion of continuous days over LOS spent in JHHLM 7-8 to determine the significance of difference in mean between the fallers and the non-fallers.

• Observations

Welch Two Sample t-test

```
data: tot_c by FallInjuryYN
t = 0.98517, df = 47.049, p-value = 0.3296
alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
95 percent confidence interval:
-0.4909626 1.4333369
sample estimates:
mean in group 0 mean in group 1
4.804520      4.333333
```

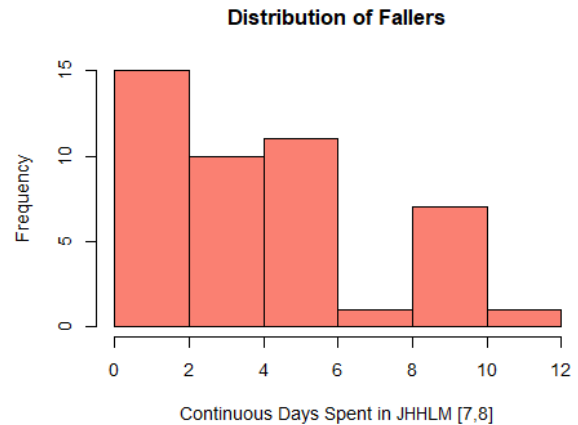
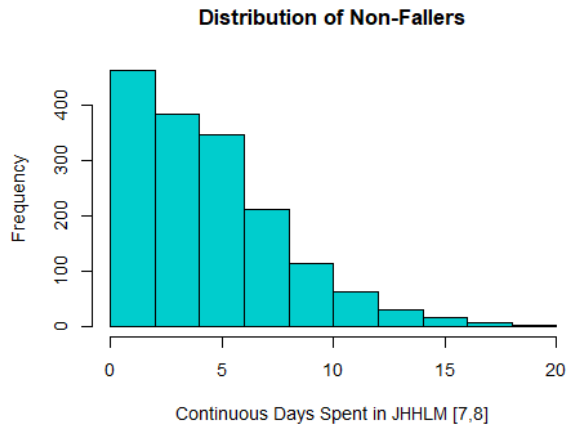
```
> ks.test(Matches_fallers$tot_c, Matches_nonfallers$tot_c, alternative = "two.sided")
```

Two-sample Kolmogorov-Smirnov test

```
data: Matches_fallers$tot_c and Matches_nonfallers$tot_c
D = 0.092432, p-value = 0.8484
alternative hypothesis: two-sided
```

```
summary(Matches_fallers$tot_c)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
0.000  2.000   4.000   4.333  6.000  11.000    18

summary(Matches_nonfallers$tot_c)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
0.000  2.000   4.000   4.804  7.000  20.000   557
```



Welch Two Sample t-test

```
data: c_rat by FallInjuryYN
t = 2.5947, df = 47.374, p-value = 0.01256
alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0
95 percent confidence interval:
 0.02108026 0.16643005
sample estimates:
mean in group 0 mean in group 1
 0.4368405      0.3430853
```

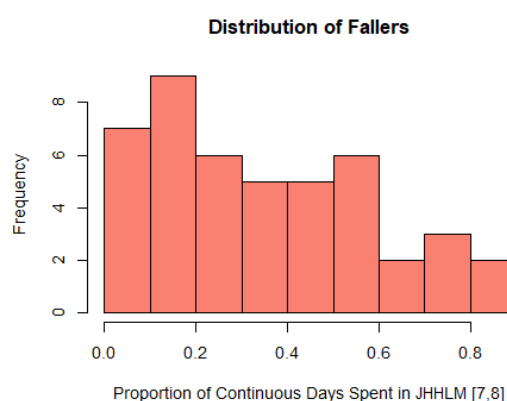
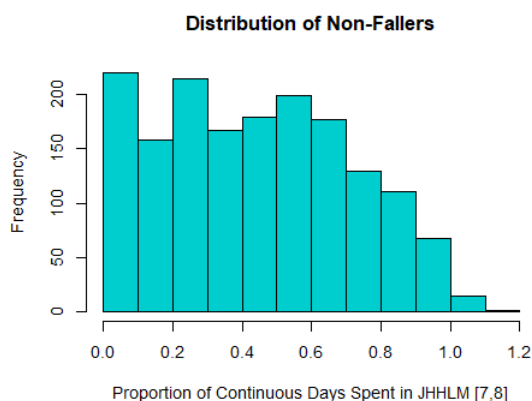
```
> ks.test(Matches_fallers$c_rat, Matches_nonfallers$c_rat, alternative = "two.sided")
```

Two-sample Kolmogorov-Smirnov test

```
data: Matches_fallers$c_rat and Matches_nonfallers$c_rat
D = 0.19486, p-value = 0.07189
alternative hypothesis: two-sided
```

```
summary(Matches_fallers$c_rat)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
0.0000 0.1566  0.3370  0.3431 0.5105  0.8244    18

summary(Matches_nonfallers$c_rat)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
0.0000 0.2173  0.4238  0.4368 0.6682  1.1107   557
```



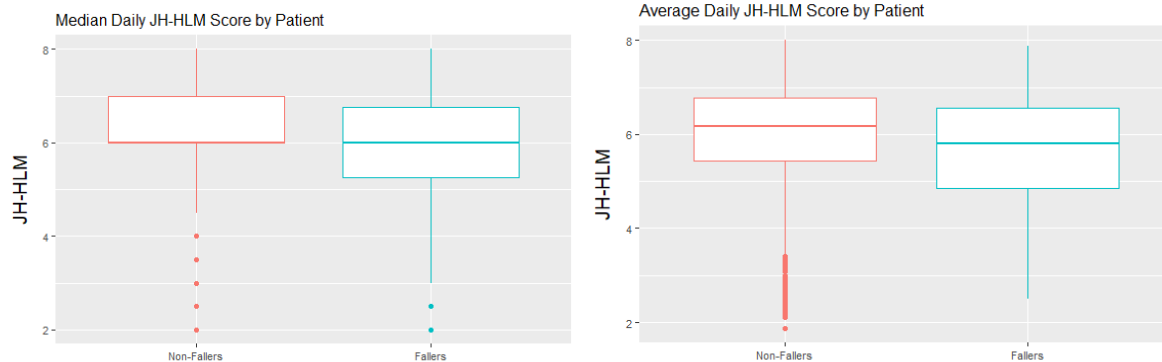
- **Conclusion**

- Raw days of continuous days in 7-8 is not significant, though fallers spent less time in units of days in this high mobility region. Distributions of raw continuous days between fallers and non-fallers are not significantly different.

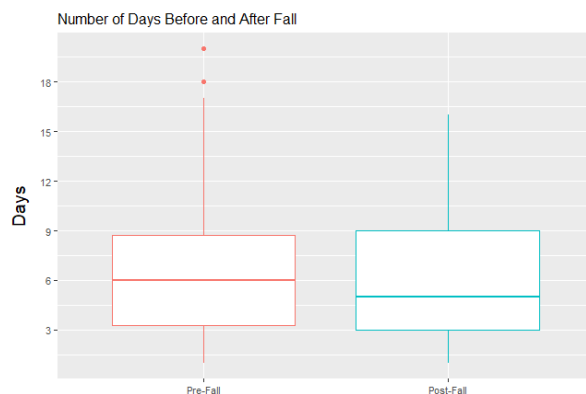
- On average, non-fallers spent approximately 0.5 more continuous days compared to the fallers.
- Proportion ($\frac{\text{Time spent in Range}}{\text{Length of Stay}}$) of continuous days in 7-8 is significantly lower for fallers and non-fallers, yet the distributions are not significantly different.
- On average, non-fallers spent approximately 0.1 (10%) more time out of their LOS in continuous days within JHHLM 7-8 compared to fallers.

6. Fallers vs. Non-Fallers Daily JH-HLM Scores

- non-Fallers have a higher median and average score across their length of stay than fallers



● Pre-Fall vs. Post-Fall: Raw/Prop Days in JH-HLM (ranges)



- Number of days pre-fall and post-fall allow analysis to be comparable
 - Median 6 days pre-fall, 5 days post
 - Does not appear to be a large difference in JH-HLM pre-fall vs post-fall