An analysis of the spatial distribution of older adults’ falls in long-term care

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Aim
To determine the spatial distribution of falls and its association with resident density (residents/m²).

Background
- 50% of long-term care (LTC) residents fall at least once per year.¹
- Falls are the leading cause of unintentional injuries in older adults, accounting for 90% hip and wrist fractures and 60% head injuries.²
- The spatial distribution of falls is non-uniform.³ Improved understanding of the spatial distribution of falls and factors separating high-risk and low-risk locations may guide improved interventions.

Methods
- 232 falls were captured from 46 individuals (mean age 78, SD 8) captured with 29 cameras in common areas of a single LTC unit.
- Each camera was calibrated to map the locations of falls at the onset of imbalance.

Figures
- Figure 1a. Mapping of fall locations (falls/m²).
- Figure 1b. Mapping of resident locations in the same videos.

- Interpolated fall density using a Gaussian kernel function and identified hot spots using nearest-neighbor hierarchical clustering.
- Interpolated intensity of spatial use (resident density) and tested (using log-log regression) whether this associated with the spatial distribution of falls.

- Figure 2. Kernel density functions interpolate data to provide a continuous statistical surface⁴ (left). The nearest neighbor hierarchical clustering⁵ (right) clusters data.

Results
- Figure 3a. Fall density.
- Fall and resident density were highest in the dining room (0.05 falls/m², 0.44 residents/m²), followed by the lounges (0.04 falls/m², 0.22 residents/m²), and hallways (0.01 falls/m², 0.02 residents/m²).
- We identified 9 fall hot spots (cluster size 3) and 17 resident hot spots (cluster size 5) in the dining and lounge areas (p = 0.05, adaptive bandwidth).
- Intensity use (resident density) was highly correlated with the spatial distribution of falls, and explained 86% of the distribution (log-log regression, r = 0.93, r² = 0.86).

- Figure 3b. Resident density.

- Figure 4. Relative Fall Risk. Dual kernel function of the spatial distribution of falls/intensity use.
- We identified 4 high fall risk clusters in the hallways, and 15 low fall risk clusters are in the dining and lounge areas (p = 0.05, adaptable bandwidth, natural log risk ratio).

Discussion
- Intensity use explained 86% of the spatial distribution of falls by older adults in long-term care.
- Limitation: High fall risk in low resident count areas (ex. hallways) are more affected by random fall incidence variations⁶.
- This may cause fall risk overestimation in hallways.
- We are collecting a month of hourly snapshots to achieve a uniform depiction of the spatiotemporal distribution of intensity use.
- Future research will investigate contributions to the 4 high fall risk clusters, to effectively target fall prevention in long-term care.
- We now focus on a single LTC unit which has similar internal architecture as 7 other LTC units.
- Further research will compare the single LTC unit’s spatial distribution of falls, intensity use, and fall risk with the other 7 LTC units.

References

Conclusion
- Fall and resident density were highest in the dining and lounge areas.
- The spatial distribution of falls is 86% explained by intensity use.

Acknowledgements/QR Code