# From Safety Alerts to Actionable Evidence: Evaluating AI-Enabled Fall Prevention in Virtual Nursing

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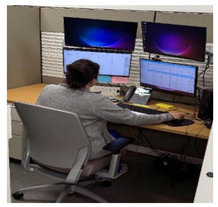
## BACKGROUND

- Inpatient falls increase harm, length of stay, and mortality risk
- Injurious falls create significant costs and unreimbursed expenses
- Falls increase staff workload, diagnostics, and extended care needs
- Traditional prevention methods are labor-intensive and difficult to scale
- AI-enhanced Virtual Nursing (VRN) combines remote nurses with camera-based AI monitoring that detects unsafe movement (e.g., bed exits, fall-risk behaviors) and alerts staff in real time

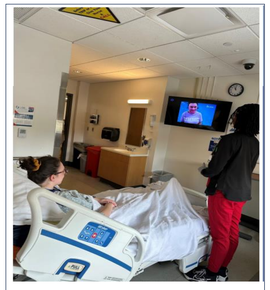
### Figure 1: AI-Enhanced Virtual Nursing + Virtual Observation

**AI-enhanced Virtual Nursing was piloted on 2 UMMC units (46 beds), using tele-sitters 24/7 and VRN coverage 9am–9pm with an initial focus on fall prevention.**



**Virtual RNs**
- Admissions
- Discharge education, care co-ordination
- Pain reassessment, safety checks

**Tele-sitters**
- Monitor ~20 high-risk patients via camera
- Redirect patients; preventing fall
- Alert Bedside RN if needed



**Bedside RN**
- In-Person Intervention
- Assists the patient; preventing fall

**AI- Assisted Monitoring**


## GOAL + METHODS

- **Goal: Estimate the impact of AI-enabled Virtual Nursing and tele-sitting on fall rates**.
- **Design**: Quasi-experimental difference-in-differences (DiD) approach comparing pre- and post-intervention trends.
- **Setting**: Pilot units (4N, 6W) compared with similar UMMC inpatient units.
- **VRN Implementation:** Feb 2025
- **Data**: Monthly unit-level data (Feb 2024–Nov 2025; pre: Feb 2024–Jan 2025, post: Feb 2025–Nov 2025; n = 2 intervention units and 7 control units, 198 unit-month observations).
- **Outcome**: Falls per 1,000 patient-days.
- **Approach**: Compared changes over time in pilot units versus matched controls.

## RESULTS

### Figure 2: Cluster Analysis

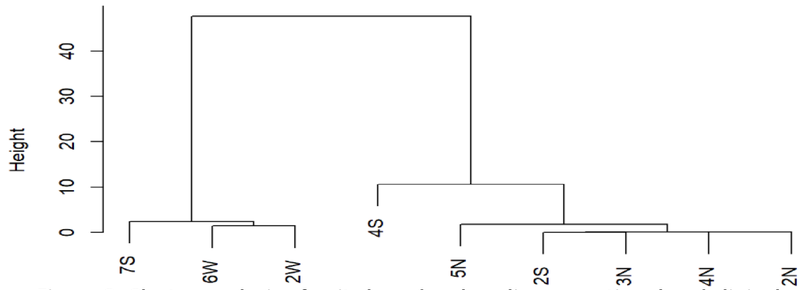
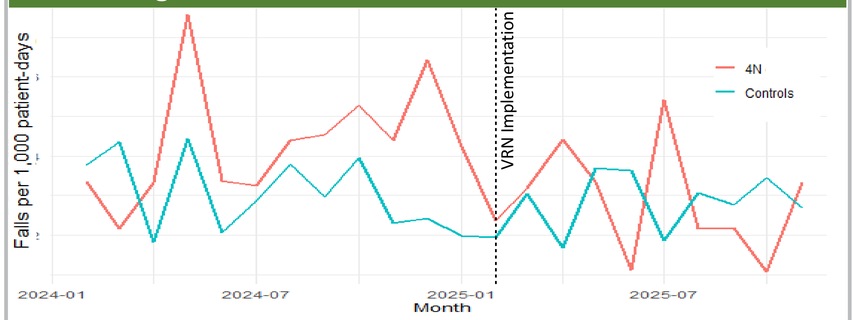



***Figure 2: Cluster analysis of units based on baseline operational and clinical characteristics. Height reflects dissimilarity between units; lower height indicates greater similarity for control selection.***

## 4N

### Figure 3: 4N vs Control Units Parallel Trends




***Stable pre-intervention fall trends between intervention and control groups support the parallel trends assumption underlying the difference-in-differences (DiD) analysis***

## REGRESSION MODEL

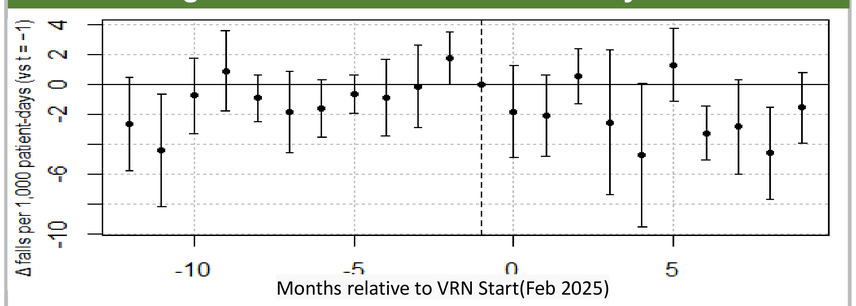
$$\text{Fall Rate}_{it} = \alpha + \beta_1(\text{Treated}_i) + \beta_2(\text{Post}_t) + \beta_3(\text{Treated}_i * \text{Post}_t) + \gamma_i + \delta_t + \epsilon_{it}$$

↓ **Total falls**: −1.23 per 1,000 pt-days (p = 0.02)
↓ **Harmful falls**: −0.44 per 1,000 pt-days (p = 0.01)

*Statistically Significant*

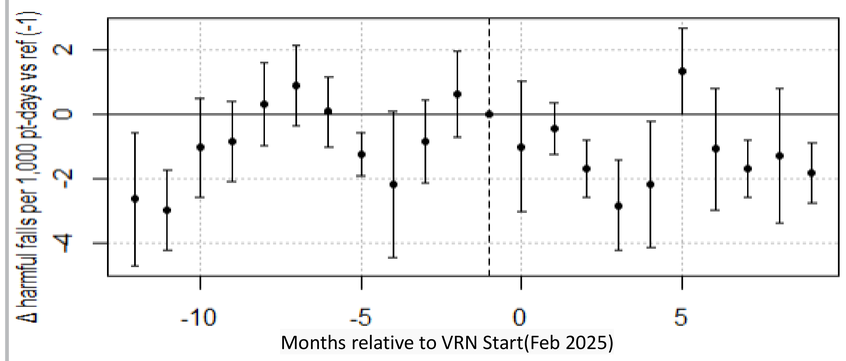
***Indicates a reduction in clinically meaningful (harmful) falls***

### Figure 4: 4N Total Falls Event-Study Plot




***Plot shows monthly VRN effect on total falls relative to matched controls, indicating a decline after implementation beyond normal trend changes.***

### Figure 5: 4N Harmful Falls Event-Study Plot

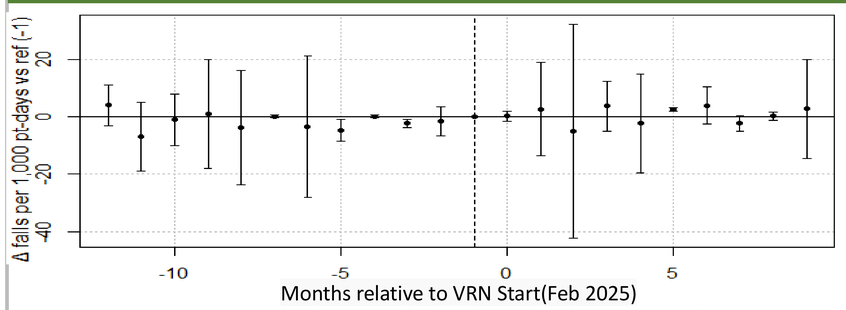



***Plot isolates the intervention's effect on harmful falls over time, showing a clearer sustained reduction compared with control units after implementation.***

## 6W

- No significant change due to low baseline fall rates
- Small 6W sample made results sensitive to minor fall changes

### Figure 6: 6W Total Falls Event-Study Plot




***Plot shows no clear sustained change in 6W falls after implementation vs controls***

## IMPACT

- 4N: Meaningful reductions in overall and harmful falls
- Approx. 4 harmful falls avoided, suggesting cost savings
- 6W:No clear effect due to low baseline falls and small sample size
- Results highlight the importance of unit context and baseline risk
- Greatest value may be in higher-risk units with reduced need for labor-intensive monitoring

## LIMITATIONS & FUTURE WORK

- Limited post-implementation duration
- Small sample size
- Unit-level aggregation; no patient-level adjustment
- Extend follow-up period
- Stratify by patient risk
- Incorporate additional safety outcomes

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