Title: Predictors of adverse outcomes and factors associated with the risk-stratification model through a community virtual ward for older persons with complex health and social care needs.

1Lewis, C., 2Patton, D., 3Moore, Z., 4O’Connor T., 5George S., 6Nugent, L.E.

1-6School of Nursing & Midwifery, Royal College of Surgeons Ireland
Contact Details, Clare Lewis, PhD student, School of Nursing and Midwifery, Royal College of Surgeons Ireland, clarelewis@rcsi.ie
Background

• Since 2011 there has been a 19.1% increase in the over 65s with a 17.2% increase in Centenarians (2016).

• Over half a million in this older population living in private households (Census 2016).

• Researchers report that the number of older people living with four or more chronic diseases including dementia will double by 2035 (Kingston et al 2018).

• Multi-borbidity aging population with hospitals already operating at 100% capacity and acute services overstretched.
A Community Virtual Ward

• In 2015 a Community Virtual Ward was introduced in North Dublin primary care to support older persons with complex healthcare needs.

• It was an exploratory pilot study to determine if this model could reduce unplanned hospital admissions and emergency department presentations.

• The model emulates aspects of hospital care in the home in terms of complex interventions and monitoring with access to specialist gerontology services.
Red Virtual Ward

**High Risk**, patients were an event has happened in the last 30 days or recently discharged from hospital in last 30 days

**Average number of HCPs**
6-10 (mean of 9.61 SD 3.583) with 88% input from a consultant geriatrician & 39% input from specialist in chronic disease cardiology, respiratory, diabetes.

Amber Virtual Ward

**Moderate Risk**, patients bypassed Red if the event was more than 30 days previous to presentation and it was more gradual decline. Others transferred from Red after a period of stability.

**Average number of HCPs**
6-10 (mean 5.02 SD 3.655) with 45% input from a consultant geriatrician & 18% input from chronic disease specialists.

Green Virtual Ward

**Low Risk**, all patients who had a period of stability were transferred to the green virtual ward for monitoring prior to discharge to usual care in primary care.

**Average Number of HCPs**
3-5 (mean 2.98 SD 2.373), 10% geriatrician input & < 5% chronic disease specialist input. GPs were primary contact as clinical lead.
Day Hospital Multi-Disciplinary Team Input During CVW Admission

Day hosp MDT 1= Y 2= N
Results 1\textsuperscript{st} phase of Study

• Reduction in ED presentations post CVW compared to pre ($p < 0.001$).

• Reduction in unscheduled hospital admission post CVW compared to pre ($p=0.001$).

• Conclusion CVW through an integrated approach to care could support older persons with complex healthcare needs at home avoiding unnecessary acute hospital care.
Unplanned Hospital Admissions 2016, 2017

- 2 or more hospital admissions
- 1 hospital admission

(post CVW) vs (pre CVW)
Expanding on these research findings

• Complex care in older persons and determining stability is difficult in this cohort, therefore is an overall risk score sufficient.

• If risk scores do not change what parameters determine stability through this model of care.

• Are there risk scores that are more specific to a frail older population in determining outcomes, type of events and interventions required.
Studies CVWs risk prediction

- UK Predictive risk tool (who was at risk of an unplanned admission combining hospital activity with GP data including chronic diseases and number of GP Visits). No significant reduction in ED presentations or admissions (Lewis et al 2013, 2014).

- Canada, The LACE tool, LOS, Acuity of event, Chronic Disease and ED admissions. No significant reductions in ED presentations and unplanned admissions (Dhalla et al 2015).

- Hong Kong, HARRPE tool examines risk over 14 areas including social care 28 days after an acute event to determine likelihood of re-admission, hospital focused risk prediction. There was a reduction in unplanned admissions with no significant affect on ED presentations (Lin et al 2015)
Research questions

Overall Aim
To determine risk stratification and associated risk factors that determine levels of risk of adverse healthcare outcomes (e.g. institutionalisation, hospitalisation and death) through a CVW model of care for older persons living within the community.

Research Questions

Primary Questions
1. What is the relationship between risk scores, events and associated interventions in predicting and mitigating risk of adverse outcomes?
2. What is the relationship between risk scores and frequency of events and health status in determining when a patient can move to a lower level of risk?
3. Does the level of frailty determine level of risk adverse outcomes over time?
4. What key factors determine transfer to lower levels of risk?

Secondary Questions
1. Do risk scores predict events?
2. Is there a relationship between risk scores and types of events experienced?
Study Design

• Non-experimental observational study of a consecutive sample of 88 older persons living in the community and not in long term care.
• Quantitative methodology using numerical data and validated risk tools to examine risk prediction, risk factors and adverse outcomes.
• A Markov model informed study design for risk prediction through:
  ▪ Transient states of health e.g unstable, deteriorated, improved, stable
  ▪ Absorbing states e.g outcome at end of study, home, hospitalisation, death, institutionalisation.
Risk Scores results measured at 3 time points
- On admission
- ½ way time-point Stage 2 of admission
- On discharge

Risk Scores MMSE, MUST, BARTHEL, MOBILITY, WALSALL, ISAR (Identification of seniors at risk), Rockwood Clinical Frailty Index, Geriatric Depression Scale.

Stability 3 time points
- On admission
- Stage 2 of admission
- On discharge

Transient States of Stability
- Unstable
- Deteriorated
- Improved
- Stable

Virtual Ward Days
Stage 2 VW days were measured & VW admission at that time point
Stage 3 VW days were measured & VW admission at that time point

Days Stability VW
Average time to determine stability within each ward as an overall mean.

Stability
- Red
- Amber
- Green

Initial Event/Subsequent Events
These were grouped as categorical data based on frequency of occurrence.

Interventions
These were grouped as categorical data based on frequency of occurrence.

Number of Health Care Professionals Core Group

Absorbing State
This was the outcome at the end of admission to the CVW
- Home
- Hospitalisation
- Institutionalisation
- Death
Data Analysis

- Descriptive Statistics
- Frequency Distributions
- Created a coding log
- Non-parametric testing using chi-square & Spearman’s rho
- Univariate regression analysis following onto hierarchical multivariate regression analysis
- Kaplan Meier Survival Analysis
<table>
<thead>
<tr>
<th>Demographics</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>82.68 SD 6.406</td>
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<tr>
<td>Gender</td>
<td>66% female 34% male</td>
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<tr>
<td>Living alone</td>
<td>38% lived alone 62 % living with a caregiver 37% of caregivers had signs of frailty</td>
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<tr>
<td></td>
<td>Average number of HC hours hours 10.9</td>
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<tr>
<td>Self neglect</td>
<td>51% had evidence of self neglect</td>
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<tr>
<td></td>
<td>• Neglect to personal hygiene</td>
</tr>
<tr>
<td></td>
<td>• Repeated refusal to services reasonable to improve QOL</td>
</tr>
<tr>
<td></td>
<td>• Self endangerment</td>
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<tr>
<td></td>
<td>• Inadequate food provisions</td>
</tr>
<tr>
<td>Acute hospital presentations</td>
<td>40% had 1 ED presentation</td>
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<tr>
<td>previous 6 months</td>
<td>35% had 2 or more</td>
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<tr>
<td></td>
<td>40% had 1 hosp admission</td>
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<tr>
<td></td>
<td>23% had 2 or more</td>
</tr>
<tr>
<td>Co-morbidity index</td>
<td>Average score 6-7 with a 20% chance of survival over next 10 years</td>
</tr>
<tr>
<td>No. co-morbidities</td>
<td>Average number 3 with most common:</td>
</tr>
<tr>
<td></td>
<td>• Dementia</td>
</tr>
<tr>
<td></td>
<td>• Hypertension</td>
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<td></td>
<td>• COPD</td>
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<td></td>
<td>• IHD</td>
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<td></td>
<td>• HF</td>
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<td>• Diabetes</td>
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Risk scores over 3 transient states during admission
<table>
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<tr>
<th>Variable</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlson Co-Morbidity Index</td>
<td>Strong association &amp; Correlation score 6-7 and remaining at home &amp; number of VW days (chi-square sig 0.000, Spearman’s rho sig 0.002) This included being at home at 30-60 days at stage 2 and ≥90 days at stage 3.</td>
</tr>
<tr>
<td>Rockwood Frailty Index</td>
<td>Strong association and correlation with outcome but no relationship to events or interventions (Chi-square sig 0.000, Spearman’s rho .654, sig 0.000)</td>
</tr>
<tr>
<td>Falls</td>
<td>Falls in first 30 days was significantly associated (chi-square sig 0.000) and correlated (Spearmans rho .966 sig 0.000) to an increase in further falls. Likewise nearer a fall prior to admission associated with further fall in proceeding 30 days.</td>
</tr>
<tr>
<td>MUST</td>
<td>Sig association (chi-square sig 0.000) Must and remaining at home and the number of events (low risk 1-2 events, moderate/high risk 5-6 events (p=0.011) and interventions (mod-high risk behavioral component to interventions) (p=0.017)</td>
</tr>
<tr>
<td>Mobility</td>
<td>Mobility at stage 2 statistically improved and related to outcome at end of admission (sig 0.006) and significantly related to interventions</td>
</tr>
<tr>
<td>Barthel</td>
<td>Barthel scores of maximum dependency were significantly associated and correlated to death, LTC, hospitalisation at stage 2 and 3 (chi square 0.000,, Spearman’s rho .365 sig 0.000)</td>
</tr>
<tr>
<td>Risk scores and relationship to</td>
<td>MUST score showed a significant relationship to initial event e.g functional decline (p= 0.011) no other scores were related.</td>
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<tr>
<td>initial event</td>
<td></td>
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## Results to date

<table>
<thead>
<tr>
<th>Variable</th>
<th>Results</th>
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<tbody>
<tr>
<td>Stability</td>
<td>Stability at transient stage 2 of admission significant associations and correlations with outcome at end e.g remaining at home (Chi-square sig 0.000, Spearman’s rho sig 0.002).</td>
</tr>
<tr>
<td>Total No. of episodes &amp; outcome</td>
<td>Greater than 2 episodes of care significant association with poorer outcomes hospitalisation, institutionalisation, death (Chi square sig 0.000, Spearman’s rho sig 0.004).</td>
</tr>
<tr>
<td>Number of events and transient stages</td>
<td>&gt; 6 events association with instability at stage 2 (chi-square sig 0.000)</td>
</tr>
<tr>
<td>Stability</td>
<td>If stable at stage 2 significant association (Chi-square sig 0.001) and correlation (Spearmans rho -.481 sig 0.000) with being stable at home at stage 3.</td>
</tr>
<tr>
<td>In a Red VW at stage 2 &amp; type of events</td>
<td>If experiencing events grouped as • social care &amp; functional decline. • Falls, functional decline, clinical deterioration, increase in social care needs and behavioral. -Association with instability at stage 2 (Chi square sig 0.000)</td>
</tr>
<tr>
<td>Initial event post admission</td>
<td>Mostly occurred after the first 30 days with greatest at 14 days post admission (chi-square 0.000, correlation co-efficient .227 sig 0.034)</td>
</tr>
<tr>
<td>Number of health care professionals involved &amp; outcome</td>
<td>In red number &amp; green No. of HCP involved was significantly associated to outcome at end (Red p=0.009) (green p= 0.004)</td>
</tr>
</tbody>
</table>
Stability over time

Transient states of health

On admission

On discharge

Transient state 1

Transient state 2

Transient state 3

unstable

deteriorated

stable
Survival rates & determining stability

**Survival Functions**

- **CumSurvival**
  - 1.0
  - 0.8
  - 0.6
  - 0.4
  - 0.2
  - 0.0

- **Stage 3 VW**
  - 0
  - 200
  - 400
  - 600

- **average time determining stability**
  - no time
  - less or equal to 30 days
  - 60 days
  - 90 days
  - Interpolation Line
**Survival Functions**

Overall Comparisons
Chi-Square df Sig.
Log Rank (Mantel-Cox) 12.967 4 .011
Test of equality of survival distributions for the different levels of BMI stage 3.
Conclusion

- Rockwood, MUST, Barthel risk scores & level of Mobility assisted in determining outcome over the 3 stages of the CVW.
- Those with improved MUST scores & Mobility level at stage 2 at a 30-60 day time point had a better outcome.
- The MUST was the only score linked to initial events.
- Achieving stability at stage 2 was an important indicator for outcome at end.
- Instability at stage 2 and >2 episodes of care indicated worse outcomes e.g hospitalisation, death, institutionalisation.
- Events post admission there was a higher risk of occurring in the first 30 days with risk of falls increasing if a fall was experienced 30 days previously.
- The number of health care professionals involved was an indicator of outcome at end of the CVW.
- Survival rates were better if stability overall was determined over 90 day period from admission & and this also included high normal or above normal BMI rates.
- A deeper analysis of results will be available later in the year.
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