Predictors of Improvement in Mobility for Home Healthcare Patients Using Electronic Health Record Data

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ACKNOWLEDGMENTS

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PROBLEM

• In United States, 2010:
  – 4.9 million people required help to complete ADLs
  – 9.1 million people unable to complete IADLs

• Home Healthcare (HHC)
  – Spending in 1980 increased from $2.4 billion to $17.7 billion today
  – Report improved mobility in 46.9% adults before discharge from HHC

• Mobility is one component of functional status
  – Mobility affects functional status and functional disability
  – Less than one-third of older adults recover pre-hospital function

SIGNIFICANCE OF PROBLEMS

• Amenable to nursing interventions

• Compliance with quality indicators

• Impact on patient:
  – Increased risk of falls in home
    • Risk of rehospitalization, cycle of reduced activity, disability, fear of falling, social isolation, loss of independence 3-8, 10
  – Morbidity and mortality
    • Besides physical, also psychosocial comorbidity and death 9-11

PURPOSE OF STUDY

• To determine the prevalence of impaired mobility in adults receiving home healthcare

• To identify predictors of mobility outcomes (improvement vs no improvement) for adult home healthcare
VARIABLES

• Outcome ASsessment Information Set (OASIS-B1)
  – Clinical record items
  – Demographic and patient history
  – Living arrangements and supportive assistance
  – Health status
  – Functional status
  – Service utilization (high therapy needs)
  – NO INTERVENTION DATA

• Mobility (M0700 - Ambulation/ locomotion)
  – Improvement - change from admission to discharge (Y/N)
• Inclusion Criteria
  – Medicare certified agency – OASIS documentation
  – Minimum of two OASIS records representing an episode
  – Adult, non-maternity clients receiving skilled homecare services
  – No missing data to calculate a change from start to end of an episode for the outcome variables

• Exclusion Criteria
  – Patients with no mobility problem on admission for outcome variables
DATA PREPARATION/ TRANSFORMATION

• Data preparation mostly done in original study

• Analyzed / cleaned up data

• Created binary variables
  – i.e. No or minimal bowel continence vs moderate to severe
• Several data mining techniques examined
• Discriminative pattern analysis - rule mining
  – A set of rules that predict the occurrence of an outcome based on likelihood of a factor occurring relative to other factors
  – An implication expression of the form: \( X \rightarrow Y \), where \( X \) and \( Y \) are factors

<table>
<thead>
<tr>
<th>TID</th>
<th>ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bread, Milk</td>
</tr>
<tr>
<td>2</td>
<td>Bread, Diapers, Beer, Eggs</td>
</tr>
<tr>
<td>3</td>
<td>Milk, Diapers, Beer, Coke</td>
</tr>
<tr>
<td>4</td>
<td>Bread, Milk, Diapers, Beer</td>
</tr>
<tr>
<td>5</td>
<td>Bread, Milk, Diapers, Coke</td>
</tr>
</tbody>
</table>

  – Example of association rules:
    • \( \{\text{Diapers}\} \rightarrow \{\text{Beer}\} \)
    • \( \{\text{Milk, Bread}\} \rightarrow \{\text{Eggs, Coke}\} \)
    • \( \{\text{Beer, Bread}\} \rightarrow \{\text{Milk}\} \)
  – Implication is \textit{CO-OCCURRENCE}, not causality

• In this study:
  – \( X \) can be predictors
  – \( Y \) is class label (outcome), i.e. mobility improvement/no improvement, and
• EXAMPLE:
  – If patient requires assistance or device for mobility at all times and if little or no cognitive impairment, the Improvement in mobility likely
DEMOGRAPHICS

• 270,634 patients receiving care from 581 agencies
  – Range from 1 to 4,792 patients/agency, Med = 306 patients/agency

• Patient ambulation ≠ 0 at admission (no impairment)
  – 261,035 patients (96.5% of original)

• Analyzed patient data: 261,035 patients
  – U.S. Region: 70.2% South; 14.8% Midwest; 7.6% West; 7.4% Northeast
  – 83.2% white, 64.5% female, 81.3% >65 years old
  – 95% Medicare/Medicaid as payer
  – 67.4% Discharged from in-patient facility
  – 72.3% Length of stay <60 days
Metrics for Keeping Patterns

- **Support difference**
  - the difference in number of patients with a pattern associated with improvement vs no improve improvement (> .2)

- **Confidence**
  - the discriminative power of a pattern to differentiate between improvement and no improvement (> .75)

- **IS measure**
  - the association strength between the variables in a pattern (pairs > .5, triplets > .7)

- **Odds ratio**
  - the likelihood a pattern is predictive of improvement vs no improvement

- **P value**
  - all patterns retained were significant at p < .0001

- **Clinically meaningful patterns**
Tentative Results

- Single variable pattern (n = 1)
  - Patients who required assistance or supervision to walk at all times (M0700 = 2), 7.26 times more likely to improve no improved

- Paired variable pattern (n = 28)
  - Every pair includes patients who required assistance or supervision to walk at all times (M0700 = 2)

- Triplet variable patterns (n=31)
  - Every triplet [except 1] includes patients who required assistance or supervision to walk at all times (M0700 = 2)
### Demographics +

<table>
<thead>
<tr>
<th>Demographics +</th>
<th>Odds-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>6.34</td>
</tr>
<tr>
<td>Medicaid</td>
<td>6.58</td>
</tr>
<tr>
<td>Treatment change in past 14 days</td>
<td>6.71</td>
</tr>
<tr>
<td>Good prognosis</td>
<td>7.80</td>
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</tbody>
</table>

All variables are paired with Mobility problems ad admission (M0700 = 2)

### ADLs/ IADLs

<table>
<thead>
<tr>
<th>ADLs/ IADLs</th>
<th>Odds-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty dressing lower body</td>
<td>5.35</td>
</tr>
<tr>
<td>Difficulty bathing</td>
<td>7.10</td>
</tr>
<tr>
<td>No problem with feeding</td>
<td>7.84</td>
</tr>
<tr>
<td>Difficulty doing laundry</td>
<td>5.78</td>
</tr>
<tr>
<td>Difficulty with housekeeping</td>
<td>5.46</td>
</tr>
<tr>
<td>Difficulty with shopping</td>
<td>6.27</td>
</tr>
<tr>
<td>No problem using a phone</td>
<td>9.32</td>
</tr>
</tbody>
</table>
## Additional paired patterns

All variables are paired with Mobility problems at admission (M0700 = 2)

<table>
<thead>
<tr>
<th>Additional Variables</th>
<th>Odds-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little or no urinary incontinence</td>
<td>8.10</td>
</tr>
<tr>
<td>Little or no bowel incontinence</td>
<td>8.06</td>
</tr>
<tr>
<td>Little or no pain</td>
<td>5.99</td>
</tr>
<tr>
<td>No surgical wound or it is healing</td>
<td>6.86</td>
</tr>
<tr>
<td>Little or no hearing problems</td>
<td>7.39</td>
</tr>
</tbody>
</table>

**Odd Stuff**  
Any issues with speech  
Any frequency of assistance from a primary caregiver
Triplets – Examples

- Feeding, 0-1
- Laundry, 2
- Limited Therapy
- Mobility = 2
- Bathing
- Dressing Lower Body
- Laundry
- Medicaid
- Surgical wound, 0-2
- Cognition, 0-2
- Housekeeping, 3-4
- Shopping, 2-3
- Medicaid
- Shopping, 2-3
- Limited Therapy

(OR range 4.6 – 8.10)
DISCUSSION: CLINICAL IMPLICATIONS & LIMITATIONS

• Data mining is an iterative process

• Every pattern except one, included mobility = 2 for improvement
  – Exception, Mobility = 1, problems with medication management, and pressure ulcer present

• From inter-domain expertise, comes discovery
  – Symbiotic collaboration
  – Quantitative results – look at meaning

• Power of rules
  – Format of rules: absence v. presence of variable
  – Rules describe associations, not causation

• Data set lacks nursing intervention data – important for evidence-based practice – this study only points to patient risk based on assessment
Thank you, for further information:

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