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

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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 ¹

• 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 ²

• 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 ³

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 (4–6, 9–11)
  -- 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

METHOD – DATA MINING

VARIABLES
• Outcome ASessment 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)

SAMPLE
• 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
**DATA ANALYSIS**

- 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
  
  - Example of association rules:
    - \{Diapers\} \( \rightarrow \) \{Beer\}
    - \{Bread\} \( \rightarrow \) \{Eggs, Coke\}
  
  - 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 all times and if little or no cognitive impairment, the improvement in mobility likely

<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>

**DEMGRAPHICS**

- 270,634 patients receiving care from 581 agencies
  - Range from 1 to 4,792 patients/agency, Med = 306 patients/agency
- Patient ambulation \( \neq 0 \) at admission (no impairment)
  - 361,035 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% \( \geq 65 \) 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 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 \((M0700 = 2)\)

Paired Variable Patterns – Summary

<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>
</tr>
</tbody>
</table>

### ADLs / IADLs

<table>
<thead>
<tr>
<th>Odds-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty dressing lower body</td>
</tr>
<tr>
<td>Difficulty bathing</td>
</tr>
<tr>
<td>No problem with feeding</td>
</tr>
<tr>
<td>Difficulty doing laundry</td>
</tr>
<tr>
<td>Difficulty with housekeeping</td>
</tr>
<tr>
<td>Difficulty with shopping</td>
</tr>
<tr>
<td>No problem using a phone</td>
</tr>
</tbody>
</table>

Additional paired patterns

<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>5.06</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>6.88</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
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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