

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 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 ^{3-8, 10}
 - Morbidity and mortality
 - Besides physical, also psychosocial comorbidity and death ⁹⁻¹¹

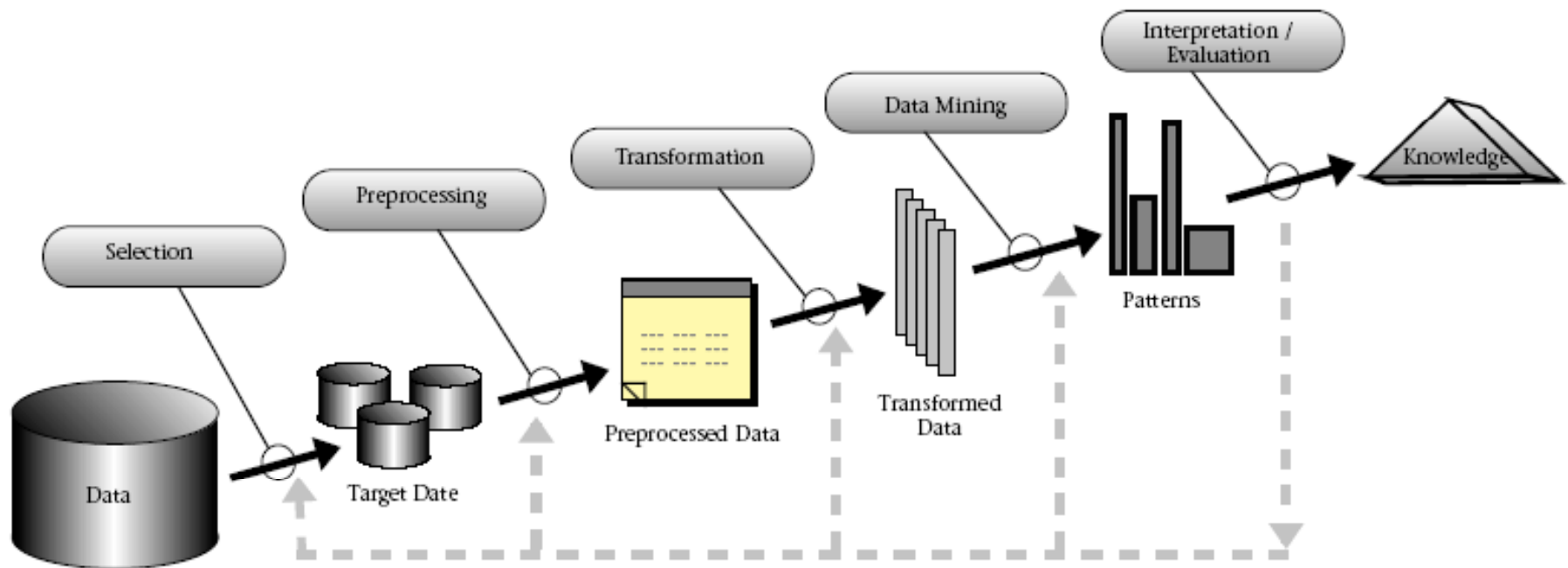
3. Chen, Wang, and Huang, 2008; 4. Meijers, et al., 2012; 5. Clemson, Mackenzie, Ballinger, and Close, 2008; 6. Gill, Allore, Gahbauer, and Murphy, 2008; 7. Rubenstein and Josephson, 2006; 8. Paulozzi, Ballesteros, and Stevens, 2006; 9. Overcash and Beckstead, 2008; 10. Iezzoni, McCarthy, Davis, and Seibens, 2001; 11. Fallah et al., 2011



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



12. Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). From data mining to knowledge discovery in databases. *AI Magazine*, pp. 37 – 54. <http://www.kdnuggets.com/gspubs/aimag-kdd-overview-1996-Fayyad.pdf>. P. 41



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)



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

TID	ITEMS
1	Bread, Milk
2	Bread, Diapers, Beer, Eggs
3	Milk, Diapers, Beer, Coke
4	Bread, Milk, Diapers, Beer
5	Bread, Milk, Diapers, Coke

- Example of association rules:
 - {Diapers} \rightarrow {Beer}
 - {Milk, Bread} \rightarrow {Eggs, Coke}
 - {Beer, Bread} \rightarrow {Milk}
- Implication is **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 \neq 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 ($\geq .75$)
- **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 $p \leq .0001$
- **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

Demographics +	Odds-ratio
White	6.34
Medicaid	6.58
Treatment change in past 14 days	6.71
Good prognosis	7.80

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

ADLs/ IADLs	Odds-ratio
Difficulty dressing lower body	5.35
Difficulty bathing	7.10
No problem with feeding	7.84
Difficulty doing laundry	5.78
Difficulty with housekeeping	5.46
Difficulty with shopping	6.27
No problem using a phone	9.32



Additional paired patterns

Additional Variables	Odds-ratio
Little or no urinary incontinence	8.10
Little or no bowel incontinence	8.06
Little or no pain	5.99
No surgical wound or it is healing	6.86
Little or no hearing problems	7.39

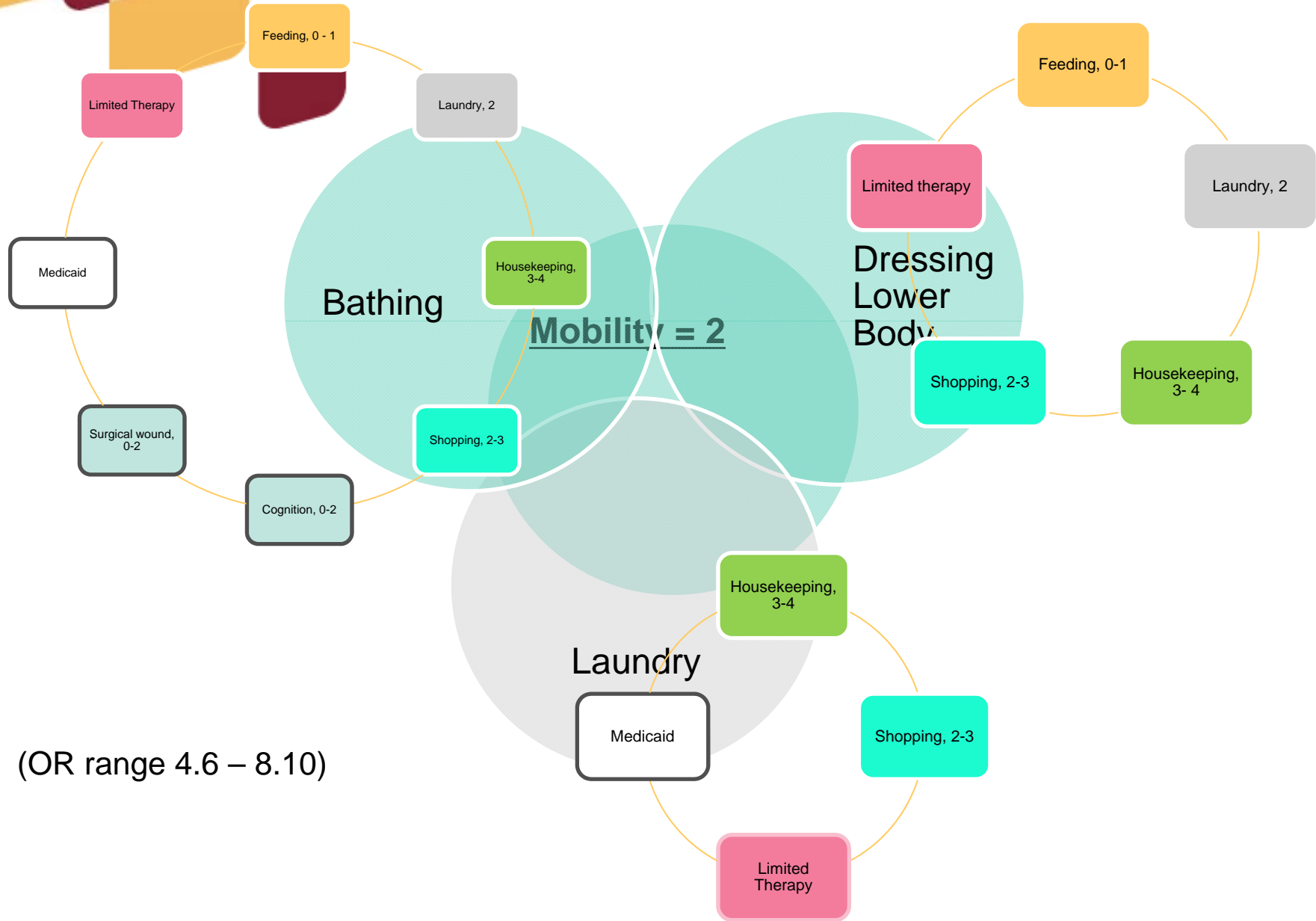
All variables are paired with Mobility problems at admission (M0700 = 2)

Odd Stuff

Any issues with speech

Any frequency of assistance from a primary caregiver

Triplets – Examples





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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