The Role of Patient-Centered Outcomes in Predictive Analytics

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TOTAL JOINT ARTHROPLASTY

LEARNING HEALTH UNIT

DATA. DECISIONS. OUTCOMES.

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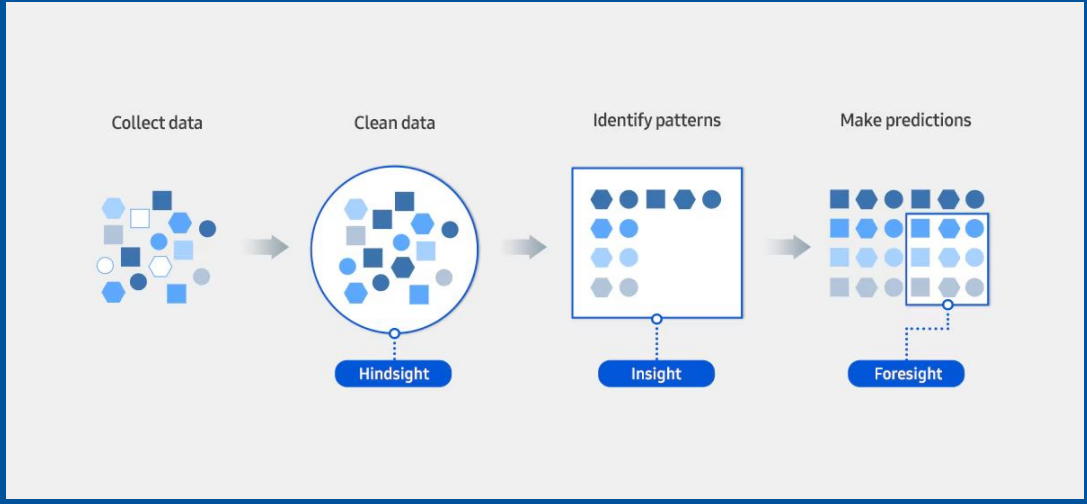
Development of the TJA LHU

- Health system driven initiative
- Outcomes after TJA
  - Patient-centered outcomes
  - Utilization
  - Costs
- Focus on building data infrastructure
- End goals:
  - Dissemination
  - Implementation
  - Improve care

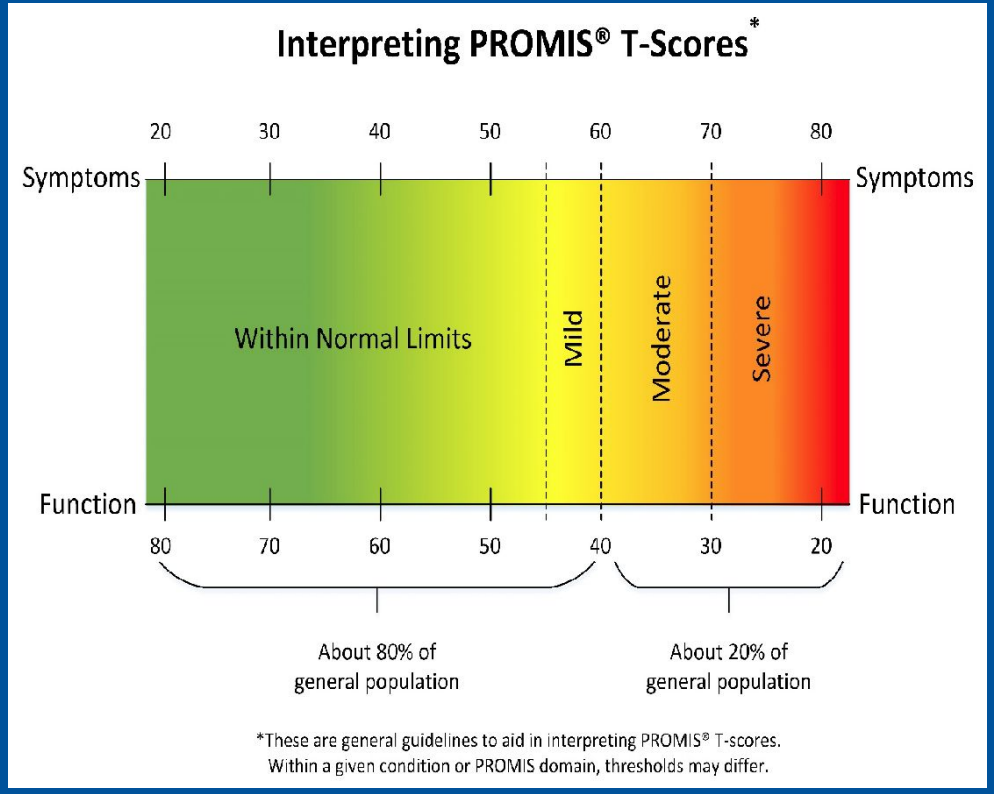
Predictive Analytics with Patient-Centered Outcomes

- Analytic approaches
- Data Sources
- PROMIS Measures



Interpretation of PROMIS Measures

- T-Scores
- Crosswalk with legacy measures
- Categorical presentation
- MCID



Creating Patient Phenotypes Using PROMIS

Cluster Analysis

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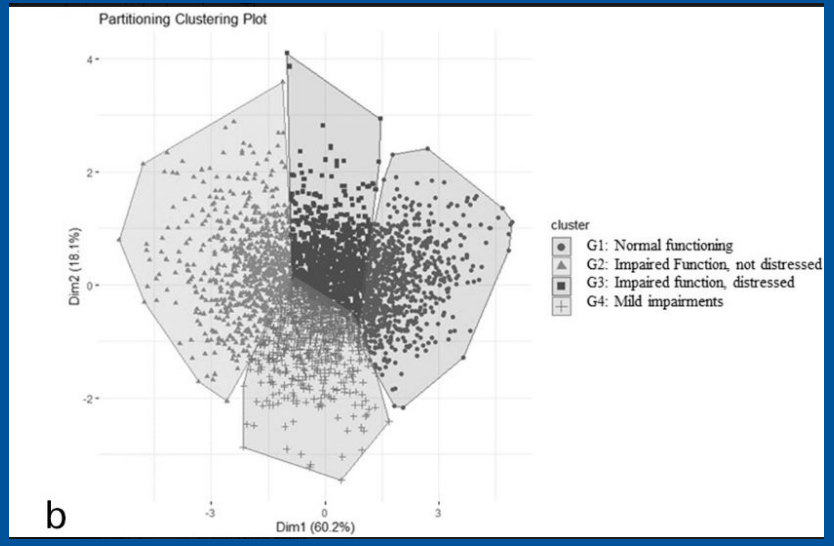
Analytic Approach

Clinical Question: Can PROMIS Measure Be Used to Create Subgroups of Patients Seeking Orthopedic Care?

- Two retrospective cohorts
  - 1: n=12,141
  - 2: n = 4,638
- Development and validation cohorts
- Cluster Analysis



Patient Phenotypes from PROMIS Clusters

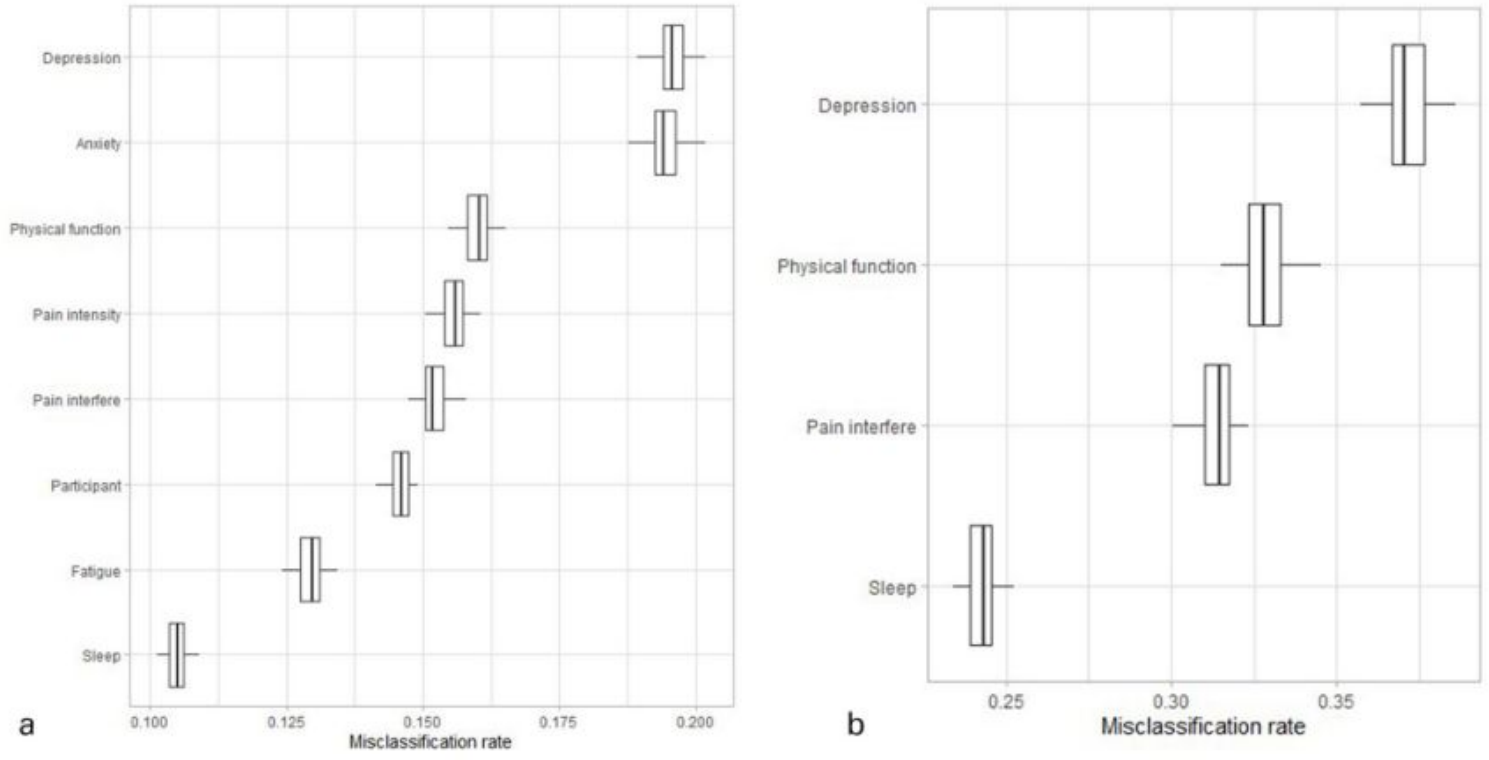
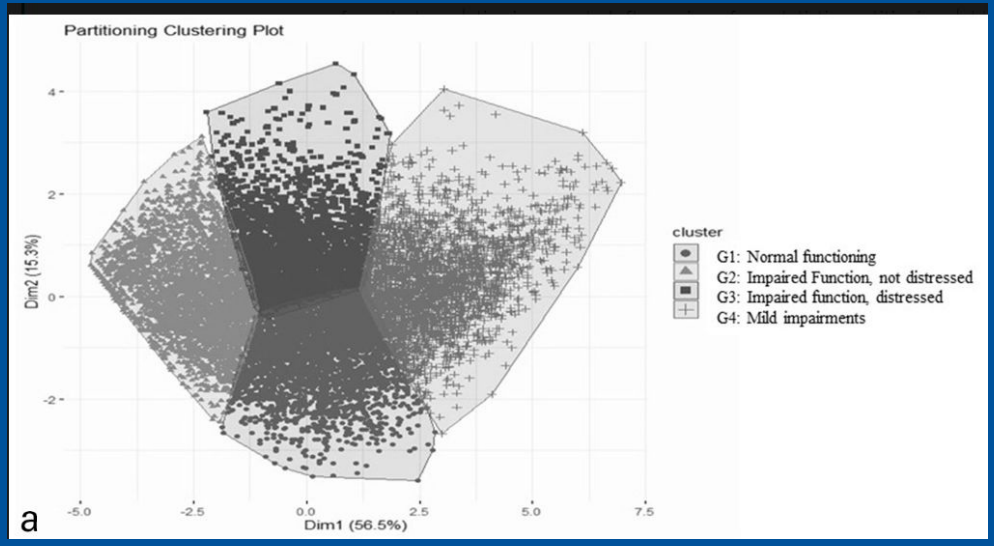
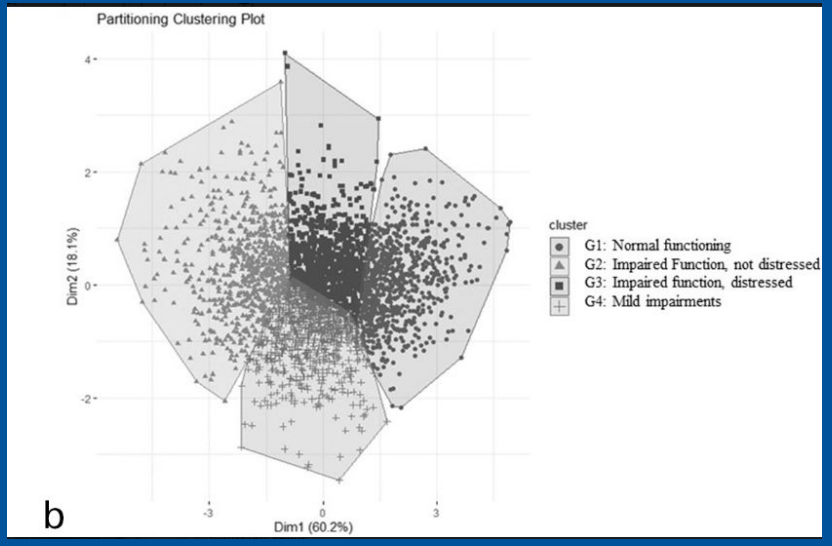


Fig. 2

Analytic Approach

Clinical Question: Can PROMIS Measure Be Used to Create Subgroups of Patients Seeking Orthopedic Care?





Patient Phenotypes from PROMIS Clusters

Table II. Clinical characteristics of empirically derived Patient-Reported Outcomes Measurement Information System (PROMIS) subgroups. Data are presented as mean (SD).

Cohort #1

PROMIS domain	Normal Function (n = 3,331)	Mild Impairments (n = 2,736)	Impaired Function, Not Distressed (n = 3,259)	Impaired Function, Distressed (n = 2,815)
Physical Function	44.77 (6.07)	40.54 (6.38)	32.05 (6.45)	28.39 (6.11)
Pain Interference	49.79 (6.61)	55.39 (5.82)	62.52 (4.38)	66.09 (3.52)
Pain Intensity	2.44 (1.84)	3.37 (1.75)	5.97 (1.82)	6.79 (1.76)
Depression	40.57 (4.08)	50.67 (5.93)	42.81 (5.33)	57.83 (7.15)
Anxiety	42.3 (6.09)	54.38 (5.52)	45.61 (7.0)	60.61 (6.82)
Sleep Quality	42.65 (7.76)	51.1 (7.37)	49.77 (8.47)	59.32 (8.29)
Participation in Social Roles	59.88 (6.28)	50.76 (6.16)	45.77 (6.99)	37.62 (6.45)
Fatigue	40.7 (6.71)	51.83 (6.29)	50.29 (7.89)	62.44 (7.24)

Cohort #2

PROMIS domain	Normal Function (n = 1,078)	Mild Impairments (n = 1,212)	Impaired Function, Not Distressed (n = 1,143)	Impaired Function, Distressed (n = 1,205)
Physical Function	51.19 (6.68)	44.44 (5.09)	37.65 (4.87)	33.19 (5.27)
Pain Interference	51.53 (5.62)	57.74 (4.45)	63.07 (4.46)	68.68 (4.46)
Depression	42.42 (6.74)	53.16 (5.35)	44.22 (6.33)	58.88 (6.74)
Sleep Quality	44.94 (7.53)	54.65 (6.01)	52.12 (7.28)	62.06 (7.26)

Colour coding corresponds to PROMIS score interpretation based on population comparisons (Green = Within Normal Limits, Yellow = Mild Deficit, Orange = Moderate Deficit, Red = Severe Deficit).

All p-values < 0.001, calculated using analysis of variance for any between-group difference.

SD, standard deviation.

Estimating High Impact Chronic Pain Using PROMIS Measures

Classification Analysis

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Analytic Approach

Clinical Question: Can PROMIS Measure Be Used to Estimate HICP After Arthroplasty?

- Secondary analysis of TJA cohort from observational, survey study
- n= 2,400
- 47.5% hip (n = 1,142) and 52.5% TKA (n = 1,258)
- Discriminant Function Analysis (DFA)
- ROC Curves with AUC values
- Cut-off scores

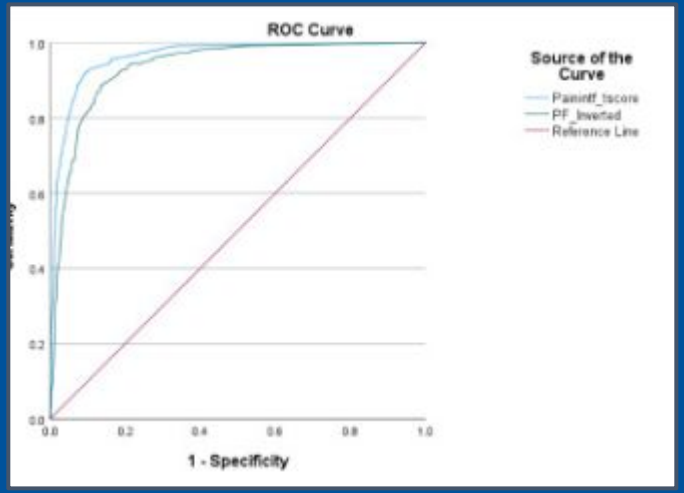
AUC by PROMIS Domain

Table 2. Area Under the Curve for High Impact Chronic Pain Status With PROMIS Measures.

PROMIS Measures	Area Under Curve	95% Lower Bound	95% Upper Bound
Physical function (score inverted for AUC)	0.935	0.921	0.949
Pain interference	0.963	0.951	0.973
Sleep disturbance	0.809	0.780	0.838
Anxiety	0.722	0.687	0.757
Dyspnea	0.704	0.668	0.740

Difference in PROMIS Measure Scores by HICP Status

High Impact Chronic Pain Status			
	Yes	No	Score Difference
Physical Function	35	49.5	14.5
Pain Interference	64.6	45.5	19.1



Domain	AUC (95% CI)
Physical Function	0.94 (0.92-.095)
Pain Interference	0.96 (0.95-0.97)

Cutoff Scores to Estimate HICP Status

Table 3. Cutoff Scores for Estimating High Impact Chronic Pain Status With PROMIS Measures.

PROMIS Measure	+LR	Probability of HICP Status[a]
Pain Interference		
Cutoff Score		
50	2.9	60%
55	5.9	75%
60	16.4	89%
65	46.0	96%
Physical Function		
Cutoff Score		
50	1.8	47%
45	3.5	64%
40	7.1	78%
35	17.4	90%

Take Home Message

- Predictive analytics methods are varied and should be selected based on the clinical question and outcomes of interest
- Finding ways to implement these findings into practice can improve the clinicians ability to diagnose, treat and give accurate prognosis based not only on the patients objective findings, but subjective reports of their health status