#### **Psychometric Evaluation of Items**

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Patient-Reported Outcomes Measurement Information System (PROMIS®)

 A nine-year \$70 million commitment of NIH to improve and standardize measurement of patient-reported outcomes (PROs)

 Self-reported health

An answer to the PRO "Tower of Babel"



# PROMIS-1 Network: 2004-2009





#### **PROMIS II Network Diagram**









Are you able to get in and out of bed?
Are you able to stand without losing your balance for 1 minute?
Are you able to walk from one room to another?
Are you able to walk a block on flat ground?
Are you able to run or jog for two miles?
Are you able to run five miles?

### Normal Curve

Bell-shaped "normal" curve (68.2%, 95.4%, and 99.6% within 1, 2 and 3 SDs, respectively)





#### Computerized Adaptive Testing (CAT)

- Select questions based on a person's response to previously administered questions.
- Iteratively estimate a person's standing on a domain (e.g., fatigue, depressive symptoms)
- Administer most informative items
- Desired level of precision can be obtained using the minimal possible number of questions.



#### Reliability Target for Use of Measures with Individuals

- z-score (mean = 0, SD = 1)
- Reliability ranges from 0-1
  - 0.90 or above is goal
  - SE = SD (1- reliability)<sup>1/2</sup>
  - Reliability = 1 SE<sup>2</sup>
  - Reliability = 0.90 when <u>SE = 0.32</u>
- 95% CI = true score +/- 1.96 x SE

(CI =  $-0.63 \rightarrow 0.63$  z-score when reliability = 0.90)













Patient-Reported Outcomes Measurement Information System PROMIS Dynamic Tools to Measure Health Outcomes From the Patient Perspective



#### **PROMIS Adult Self-Reported Health-**

**Global Health** 

PROMIS Profile Domains

PROMIS Additional Domains

Physical Health Physical Function

Pain Intensity Pain Interference Fatigue Sleep Disturbance

Pain Behavior Pain Quality Sleep-related Impairment Sexual Function Gastro-Intestinal Symptoms Dyspnea

#### <u>Mental Health</u>

Depression

Anxiety

Anger Cognitive Function Alcohol Use, Consequences, & Expectancies Smoking Substance Use Psychosocial Illness Impact Self-efficacy

#### Social Health

Ability to Participate in Social Roles & Activities

Satisfaction with Social Roles & Activities

Social Isolation Companionship

#### PROMIS v.1.0/1.1 - Global

#### **Global Health Scale**

#### Please respond to each item by marking one box per row.

		Excellent	Very good	Good	Fair	Poor
Global01	In general, would you say your health is:	5		□ 3	2	
Global02	In general, would you say your quality of life is:	5	4		2	
Global03	In general, how would you rate your physical health?	5			2	
Global04	In general, how would you rate your mental health, including your mood and your ability to think?	5	4	3	2	
Giobal05	In general, how would you rate your satisfaction with your social activities and relationships?	5	<b>—</b> 4		□ 2	р. Т
Global09	In general, please rate how well you carry out your usual social activities and roles. (This includes activities at home, at work and in your community, and responsibilities as a parent, child, spouse, employee, friend, etc.)	<b>—</b> 5	□4		2	
		Completely	Mostly	Moderately	A little	Not at all
Global06	To what extent are you able to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries, or moving a chair?	5		□	2	

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### 10 Global Health Items

Items	
Global01. Rate general health Global02. Rate quality of life	
Global03. Rate physical health	
Global04. Rate mental health	
Global05. Rate satisfaction with social activities	
Global09. Rate carry out social activities and roles	
Global08. Carry out physical activities	
Global10. Bothered by emotional problems	
Global08. Rate fatigue	
Global07. Rate pain	

# Sample (n = 21,133)

- Age: 18-100 (mean = 53)
- 52% Female
- 9% Latino/Hispanic, 9% black, 2% other
- 3% < high school, 16% high school only
- 59% Married
- 39% Working full-time

#### Fit Indices

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2  $\frac{\chi_{null} - \chi_{model}}{\chi_{null}^2}$ • Normed fit index:  $\chi_{null}$  $df_{null}$  Non-normed fit index:  $\frac{\chi_{null}}{df} - 1$  $1 - \left( \frac{\chi_{model}^2 - df_{model}}{\chi_{null}^2 - df_{null}} \right)$ • Comparative fit index: RMSEA = SQRT ( $\lambda^2 - df$ )/SQRT (df (N – 1))

### Are the 10 items unidimensional?

- Item-scale correlations
   Ranged from 0.53 to 0.80
- Internal consistency reliability = 0.92
- Confirmatory factor analysis (categorical) for one-factor model
  - -CFI = 0.927
  - RMSEA = 0.249 (*note:* < .06 desirable)
    - SQRT ( $\lambda^2 df$ )/SQRT (df (N 1))
    - 0.01 (excellent), 0.05 (good), 0.08 (mediocre) MacCallum et al. (1996)
- PCA eigenvalues: 6.25, 1.20, 0.75, ...

#### Item-scale correlation matrix ("Multi-trait Scaling")

	<u>Physical</u>	<u>Mental</u>	
ltem #1	0.80*	0.20	
ltem #2	0.80*	0.20	
Item #3	0.80*	0.20	
Item #4	0.80*	0.20	
ltem #5	0.80*	0.20	
ltem #6	0.80*	0.20	
ltem #7	0.20	0.80*	
ltem #8	0.20	0.80*	
ltem #9	0.20	0.80*	
Item #10	0.20	0.80*	



\*Item-scale correlation, corrected for overlap.

#### **Two-Factor CFA Loadings**

ltem	Physical	Mental
1. Rate general health	0.88	
3. Rate physical health	0.89+	
6. Carry out phys. activ.	0.81+	
7. Rate pain	0.64+	
8. Rate fatigue	0.58+	0.18
2. Rate quality of life	0.50	0.46+
4. Rate mental health		0.87+
5. Rate sat with social		0.88+
10. Bothered emot. Prob.		0.66+
9. Usual social act	0.50	0.44

# Physical Health 1-factor CFA

Five items

- RMSEA = 0.220

- r = 0.29 between two items:
  - In general, how would you rate your health (1)
  - In general, how would you rate your physical health? (3)
  - RMSEA = 0.081

# 4-Item Global Physical Health Scale

- In general, how would you rate your physical health? (3)
- To what extent are you able to carry out your everyday physical activities ...? (6)
- How would you rate your pain on average? (7)
- How would you rate your fatigue on average? (8)

# Mental Health 1-factor CFA

• Four items

- RMSEA = 0.196

- r = 0.16 between two items:
  - In general, how would you rate your mental health? (4)
  - How often have you been bothered by emotional problems? (10)
  - RMSEA = 0.084

### 4-item Global Mental Health Scale

- In general, would you say your quality of life is ...? (2)
- In general, how would you rate your mental health ...? (4)
- In general, how would you rate your satisfaction with social activities and relationships? (5)
- How often have you been bothered by emotional problems ...? (10)

# Physical Health Item Parameters

ltem	Α	B1	<b>B2</b>	<b>B</b> 3	b4
Global03	2.31	-2.11	-0.89	0.29	1.54
Global06	2.99	-2.80	-1.78	-1.04	-0.40
Global07	1.74	-3.87	-1.81	-0.67	1.00
Global08	1.90	-3.24	-1.88	-0.36	1.17

- 3. In general, how would you rate your physical health?
- 6. To what extent are you able to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries or moving a chair?
- 7. How would you rate your pain on average?
- 8. How would you rate your fatigue on average?
- 3: Poor; Fair: Good; Very Good: Excellent
- 6: Not at all,; A Little; Moderately; Mostly; Completely
- 7: Worst pain imaginable (10) -- No pain (0)
- 8: Very Severe; Severe; Moderate: Mild; None

# Mental Health Item Parameters

ltem	Α	B1	B2	<b>B</b> 3	b4
Global02	2.41	-2.45	-1.32	-0.19	1.07
Global04	3.67	-2.31	-1.26	-0.33	0.67
Global05	2.98	-1.78	-0.90	-0.01	1.07
Global10	1.89	-2.82	-1.51	-0.25	0.99

- 2. In general, would you say your quality of life is ...?
- 4. In general, how would you rate your mental health, including your mood and your ability to think?
- 5. In general, how would you rate your satisfaction with social activities and relationships?
- 10. How often have you been bothered by emotional problems such as feeling anxious, depressed or irritable?
- 2, 4, 5: Poor; Fair: Good; Very Good: **Excellent** 10: Always; Often; Sometimes; Rarely; **Never**

# SF-36/12 Summary Scores

Physical and Mental health Composite Summary Scores (PCS & MCS)

- Reliability estimates: 0.88-0.93
- Completion time
  - -7-10 minutes
  - 3 minutes for SF-12

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VR-12 MCS Score	PROMIS GMH T-score	VR-12 MCS Score	PROMIS GMH T-score	VR-12 PCS Score	PROMIS GPH T-score	VR-12 PCS Score	PROM T-score
9	20.5	43	45.1	10	16.6	41	43.1
10	21.3	44	45.8	11	17.4	42	43.9
11	22.1	45	46.5	12	18.4	43	44.7
12	22.9	46	47.3	13	19.6	44	45.5
13	23.6	47	48.0	14	20.9	45	46.3
14	24.3	48	48.8	$15^{*}$	21.6	46	47.2
15	25.1	49	49.5	16	22.2	47	48.0
16	25.8	50	50.3	17	23.6	48	48.8
17	26.6	51	51.0	18	24.6	49	49.7
18	27.4	52	51.8	19	25.5	50	50.6
19	28.2	53	52.6	20	26.4	51	51.5
20	28.9	54	53.5	21	27.3	52	52.5
21	29.7	55	54.4	22	28.1	53	53.5
22	30.4	56	55.4	23	28.9	54	54.7
23	31.1	57	56.5	24	29.8	55	56.0
24	31.8	58	57.7	25	30.6	56	57.5
25	32.5	59	59.0	26	31.5	57	59.1
26	33.1	60	60.3	27	32.3	58	60.8
27	33.8	61	61.9	28	33.1	59	62.7
28	34.5	62	63.7	29	33.9	60	64.8
29	35.2	63	65.9	30	34.6	61	67.2
30	35.9	64	68.4	31	35.4	62	69.8
31	36.6	65	70.6	32	36.1	63	71.2
32	37.4	66	71.0	33	36.9	64	71.4
33	38.1	67	71.0	34	37.7	65	71.5
34	38.8	68	71.1	35	38.4	66	71.7
35	39.5			36	39.2		
36	40.2			37	40.0		
37	40.9			38	40.7		
38	41.6			39	41.5		
39	42.3			40	42.3		
40	43.1			*No participant	and 15, we linearly inter	notated the DDOME	Гассио
41	43.8			"No paracipant se	corea 15; we linearly inter	potatea the PROMIS .	-score
42	44.4			PCS physical Veterans RAN	component score, ( D 12-Item Health Si	GPH global phy uvev	sical he

Table 4 Algorithm-Based VR-1	12 Mental Health Component Scores
Associated with PROMIS	<b>Global Mental Health T-Scores</b>

 Table 6 Algorithm-Based VR-12 Physical Health Component Scores

 Associated with PROMIS Global Physical Health T-Scores

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#### Table 1. Means, Standard Deviations, and Reliability Estimates for PROMIS Global

#### **Health Scales**

	Mean	SD	Lower	Upper	Quartile	Alpha	Marginal
			Quartile	Quartile	Range		Reliability
GPH-4	48.99	10.35	41.95	55.10	13.15	0.81	0.76
GPH-2	48.93	10.35	43.11	57.03	13.92	0.73	0.60
Global01	49.06	10.19	45.02	54.89	9.88	NA	0.64
GMH-4	49.84	10.28	42.82	57.19	14.37	0.86	0.85
GMH-2	49.86	10.24	43.40	57.11	13.71	0.81	0.77

GPH-4 = 4-item global physical health scale; GPH-2 = 2-item global physical health scale; *Global01* = Single general health rating item; GMH-4 = 4-item global mental health scale; GMH-2 = 2-item global mental health scale;

SD = standard deviation; Alpha = Coefficient alpha; NA = not applicable; Marginal reliability is one minus the ratio of the average of the squared standard errors of observed expected a-posteriori (EAP) scores over the observed EAP score variance.

#### Table 2. Product-moment correlations of PROMIS Global Health Scales with Domain

#### Scores

	GPH-4	GPH-2	Global01	GMH-4	GMH-2
Physical functioning	0.78	0.76	0.61	0.43	0.38
Pain behavior	64	53	47	41	37
Pain interference	73	64	54	50	45
Fatigue	72	60	55	66	60
Anxiety	46	38	36	64	60
Anger	32	26	26	49	46
Depressive symptoms	46	39	38	69	65
Social discretionary	0.52	0.47	0.41	0.60	0.57
Social roles	0.62	0.57	0.49	0.60	0.56
EQ-5D-3L	0.74	0.66	0.55	0.56	0.51
Chronic conditions*	53	51	47	34	31
Condition limitations**	56	53	45	43	39

GPH-4 = 4-item global physical health scale; GPH-2 = 2-item global physical health scale; Global01 = Single general health rating item; GMH-4 = 4-item global mental health scale; GMH-2 = 2 item slobal mental health scale;

GMH-2 = 2-item global mental health scale \* Possible range = 0-25 and observed range = 0-25

\*\* Possible range = 0-25 and observed range = 0-25

# Item Characteristic Curve for Polytomous Response Scale



### Questions?

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