Patient-Centered Outcomes of Health Care

Ron D. Hays

CTSI Training Model 2
Comparative Effectiveness Research

December 4, 2012 (9:00-11:50 am)
UCLA MRL 1-441
Introduction to Patient-Reported Outcomes

9:00-9:50am
Health-Related Quality of Life is:

How the person FEELs (well-being)
- Emotional well-being
- Pain
- Energy

What the person can DO (functioning)
- Self-care
- Role
- Social
HRQOL is Multi-Dimensional

HRQOL

Physical

Mental

Social
HRQOL is Not

- Quality of environment
- Type of housing
- Level of income
- Social Support
In general, how would you rate your health?

Excellent
Very Good
Good
Fair
Poor
Does your health now limit you in walking more than a mile?

(If so, how much?)

Yes, limited a lot
Yes, limited a little
No, not limited at all
How much of the time during the past 4 weeks have you been happy?

None of the time
A little of the time
Some of the time
Most of the time
All of the time
Types of HRQOL Measures

- Profile: Generic vs. Targeted
- Preference
SF-36 Generic Profile Measure

- Physical functioning (10 items)
- Role limitations/physical (4 items)
- Role limitations/emotional (3 items)
- Social functioning (2 items)
- Emotional well-being (5 items)
- Energy/fatigue (4 items)
- Pain (2 items)
- General health perceptions (5 items)
Scoring HRQOL Profile Scales

- Average or sum all items in the same scale.

- Transform average or sum to
  - 0 (worse) to 100 (best) possible range
  - z-score (mean = 0, SD = 1)
  - T-score (mean = 50, SD = 10)
Linear Transformations

\[ X = \frac{(\text{original score} - \text{minimum}) \times 100}{(\text{maximum} - \text{minimum})} \]

\[ Y = \text{target mean} + (\text{target SD} \times Z_x) \]

\[ Z_x = \frac{(X - \bar{X})}{SD_x} \]
HRQOL in HIV Compared to other Chronic Illnesses and General Population

Hays et al. (2000), American Journal of Medicine
Targeted HRQOL Measures

• Designed to be relevant to particular group.
• Sensitive to small, but clinically-important changes.
• More familiar and actionable for clinicians.
• Enhance respondent cooperation.
During the last 4 weeks, how often were you angry about your irritable bowel syndrome?

None of the time
A little of the time
Some of the time
Most of the time
All of the time
Burden of Kidney Disease

- My kidney disease interferes too much with my life.
- Too much of my time is spent dealing with my kidney disease.
- I feel frustrated with my kidney disease.
- I feel like a burden on my family.
Ultimate Use of HRQOL Measures--Helping to Ensure Access to Cost-Effective Care

Cost ↓

Effectiveness ↑

© Original Artist

"NOW THERE'S A PERFECT EXAMPLE OF SOMETHING THAT'S NOT COST EFFECTIVE. FIRE HIM!"
Physical Health

Physical function
Role function physical
Pain
General Health
Mental Health

Emotional Well-Being  Role function-emotional  Energy  Social function
SF-36 PCS and MCS

PCS\_z = (PF\_Z * 0.42) + (RP\_Z * 0.35) +
(BP\_Z * 0.32) + (GH\_Z * 0.25) +
(EF\_Z * 0.03) + (SF\_Z * -0.01) +
(RE\_Z * -0.19) + (EW\_Z * -0.22)

MCS\_z = (PF\_Z * -0.23) + (RP\_Z * -0.12) +
(BP\_Z * -0.10) + (GH\_Z * -0.02) +
(EF\_Z * 0.24) + (SF\_Z * 0.27) +
(RE\_Z * 0.43) + (EW\_Z * 0.49)

PCS = (PCS\_z*10) + 50
MCS = (MCS\_z*10) + 50
536 Primary Care Patients Initiating Antidepressant Tx

- 3-month improvements in physical functioning, role—physical, pain, and general health perceptions ranging from 0.28 to 0.49 SDs.
  - Trivial < 0.20 SD
  - Small = 0.20 SD
  - Medium = 0.50 SD
  - Large = 0.80 SD
- Yet SF-36 PCS did not improve.

Simon et al. (Med Care, 1998)
n = 194 with Multiple Sclerosis

Lower scores than general population on
- Emotional well-being (↓ 0.3 SD)
- Role—emotional (↓ 0.7 SD)
- Energy (↓ 1.0 SD)
- Social functioning (↓ 1.0 SD)

Yet SF-36 MCS was only 0.2 SD lower.

Nortvedt et al. (Med Care, 2000)
Farivar et al. alternative weights

\[ \text{PCS}_z = (\text{PF}_z \times 0.20) + (\text{RP}_z \times 0.31) + (\text{BP}_z \times 0.23) + (\text{GH}_z \times 0.20) + (\text{EF}_z \times 0.13) + (\text{SF}_z \times 0.11) + (\text{RE}_z \times 0.03) + (\text{EW}_z \times -0.03) \]

\[ \text{MCS}_z = (\text{PF}_z \times -0.02) + (\text{RP}_z \times 0.03) + (\text{BP}_z \times 0.04) + (\text{GH}_z \times 0.10) + (\text{EF}_z \times 0.29) + (\text{SF}_z \times 0.14) + (\text{RE}_z \times 0.20) + (\text{EW}_z \times 0.35) \]

Is New Treatment (X) Better Than Standard Care (O)?

- Physical Health: $X > 0$
- Mental Health: $0 > X$
Is Medicine Related to Worse HRQOL?

<table>
<thead>
<tr>
<th>Person</th>
<th>Medication Use</th>
<th>HRQOL (0-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td>dead</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>dead</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>50</td>
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<tr>
<td>9</td>
<td>Yes</td>
<td>75</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>HRQOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Medicine</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Yes Medicine</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>
Quality of Life for Individual Over Time

quality of life (HRQL)
Direct Preference Measures

Underlying attributes unknown

- Rating Scale
- Standard gamble
- Time tradeoff
Overall Health Rating Item

Overall, how would you rate your **current** health?
(Circle One Number)

0 1 2 3 4 5 6 7 8 9 10

- Worst possible health (as bad or worse than being dead)
- Half-way between worst and best
- Best possible health
Indirect Preference Measures

Attributes know and used to estimate “societal” preferences

- SF-6D
- EQ-5D
- HUI2/HUI3
- Quality of Well-Being (QWB) Scale
SF-6D

Brazier et al. (1998, 2002)

— 6-dimensional classification  
(collapsed role scales, dropped general health)

— Uses 11 SF-36 items (8 SF-12 and 3 additional physical functioning items)

--- 18,000 possible states

— 249 states rated by sample of 836 from UK general population

http://www.shef.ac.uk/scharr/sections/heds/mvh/sf-6d
Health state 424421 (0.59)

- Your health limits you a lot in moderate activities (such as moving a table, pushing a vacuum cleaner, bowling or playing golf)
- You are limited in the kind of work or other activities as a result of your physical health
- Your health limits your social activities (like visiting friends, relatives etc.) most of the time.
- You have pain that interferes with your normal work (both outside the home and housework) moderately
- You feel tense or downhearted and low a little of the time.
- You have a lot of energy all of the time
EQ-5D (243 states, 3 levels each)

- Mobility
- Self-care
- Usual activities
- Pain/discomfort
- Anxiety/depression

http://www.euroqol.org/
## Change in Indirect Preference Measures Over Time

<table>
<thead>
<tr>
<th></th>
<th>Cataract (1 mon. – B)</th>
<th>Heart F (6 mons. – B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUI3</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>HUI2</td>
<td>0.03</td>
<td>0.00</td>
</tr>
<tr>
<td>QWB-SA</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>EQ-5D</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>SF-6D</td>
<td>0.00</td>
<td>0.01</td>
</tr>
</tbody>
</table>

- Kaplan, R. M. et al. (2011). Five preference-based indexes in cataract and heart failure patients were not equally responsive to change. *J Clinical Epidemiology, 64*, 497-506.
Development and Evaluation of Patient-reported Outcomes

10:00-10:50am

Measurement and Modeling of Health-Related Quality of Life

R D Hays, University of California at Los Angeles, Los Angeles, CA, USA
B B Reeve, National Cancer Institute, Bethesda, MD, USA

Introduction

Health-related quality of life (HRQOL) refers to how well a person functions in their life and his or her perceived well-being in physical, mental, and social domains of health. HRQOL includes whether the person can carry out a range of activities of daily living such as bathing or dressing himself- or herself (physical functioning). It also includes whether the person can climb stairs, walk, or run. Other relevant aspects of functioning include the extent to which one is able to interact with family, friends, and others (social functioning). The functional part of HRQOL consists of behaviors that can be observed by other people.

The well-being part of HRQOL refers to internal, subjective perceptions such as vitality, pain, anxiety, depressive symptoms, and general health perceptions. These perceptions are not directly observable by others. A person who is anxious might look nervous to an external observer or someone in pain might grimace, but these external signs can be hidden, difficult to detect, and provide at best an indirect indicator of the way the person feels.

Methods of Assessing Health-Related Quality of Life

The target person is considered the best source of information about his or her functioning and well-being. Hence, the usual mode of assessing HRQOL is through self-reports. HRQOL data are typically gathered using
End goal is measure that is “Psychometrically Sound”

• Same people get same scores

• Different people get different scores and differ in the way you expect

• Measure works the same way for different groups (age, gender, race/ethnicity)

• Measure is practical
Measurement Steps

• Review literature
• Focus groups
  – Define constructs and draft items
• Pretest (cognitive interviews)
  – Revise items
• Field test
  – Analyze and finalize items
Focus Groups

- Discuss feelings, attitudes, perceptions
- Learn
  - Vocabulary and thinking patterns
- Conversational meeting
  - Moderator and 6-12 people
  - Questions posed
  - Group synergy
  - Economical
Pretesting

“Cut and try, see how it looks and sounds, see how people react to it, and then cut again, and try again”  
*Converse & Presser (1986, p. 78)*

Identify problems with

- Comprehension of items (stem/response options)
- Retrieval of information
- Skip patterns
- Response burden
Cognitive Interviews

• “Think aloud”
• Intermittent probes
• Retrospective recall
Flesch-Kincaid Grade Level

FK GL = 0.39 * (n of words/n of sentences) + 11.8 * (n of syllables/n of words) – 15.59

• Driven by sentence length and syllables per word

• U.S. school grade level (e.g., 8.0 implies that 8th grader can understand the document).

• Possible minimum = -3.4
  – Green eggs and ham averages 5.7 words per sentence and 1 syllable per word
  – (FK GL = -1.3)
# Intraclass Correlation and Reliability

<table>
<thead>
<tr>
<th>Model</th>
<th>Reliability</th>
<th>Intraclass Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way</td>
<td>$\frac{MS_{BMS} - MS_{WMS}}{MS_{BMS}}$</td>
<td>$\frac{MS_{BMS} - MS_{WMS}}{MS_{BMS} + (k - 1)MS_{WMS}}$</td>
</tr>
<tr>
<td>Two-way fixed</td>
<td>$\frac{MS_{BMS} - MS_{EMS}}{MS_{BMS}}$</td>
<td>$\frac{MS_{BMS} - MS_{EMS}}{MS_{BMS} + (k - 1)MS_{EMS}}$</td>
</tr>
<tr>
<td>Two-way random</td>
<td>$\frac{N(MS_{BMS} - MS_{EMS})}{NMS_{BMS} + MS_{JMS} - MS_{EMS}}$</td>
<td>$\frac{MS_{BMS} - MS_{EMS}}{MS_{BMS} + (k - 1)MS_{EMS} + k(MS_{JMS} - MS_{EMS}) / N}$</td>
</tr>
</tbody>
</table>

- **BMS** = Between Ratee Mean Square
- **WMS** = Within Mean Square
- **JMS** = Item or Rater Mean Square
- **EMS** = Ratee x Item (Rater) Mean Square
- **N** = n of ratees
- **k** = n of items or raters

45
Reliability Minimum Standards

- 0.70 or above (for group comparisons)
- 0.90 or higher (for individual assessment)

- \( \text{SEM} = \text{SD} \times (1 - \text{reliability})^{1/2} \)
- 95\% CI = true score +/- 1.96 x SEM
  - if true z-score = 0, then CI: -.62 to +.62
  - Width of CI is 1.24 z-score units
Range of reliability estimates

0.80-0.90 for blood pressure
0.70-0.90 for multi-item self-report scales

Category Response Curves

Appreciating each day.

Probability of Response

Posttraumatic Growth

- No change
- Very small change
- Small change
- Moderate change
- Great change
- Very great change

No Change

Great Change
Differential Item Functioning (2-Parameter Model)

Location DIF

Slope DIF

Location = uniform; Slope = non-uniform
## Item-scale correlation matrix

<table>
<thead>
<tr>
<th>Item #</th>
<th>Depress</th>
<th>Anxiety</th>
<th>Anger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item #1</td>
<td>0.80*</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #2</td>
<td>0.80*</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #3</td>
<td>0.80*</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #4</td>
<td>0.20</td>
<td>0.80*</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #5</td>
<td>0.20</td>
<td>0.80*</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #6</td>
<td>0.20</td>
<td>0.80*</td>
<td>0.20</td>
</tr>
<tr>
<td>Item #7</td>
<td>0.20</td>
<td>0.20</td>
<td>0.80*</td>
</tr>
<tr>
<td>Item #8</td>
<td>0.20</td>
<td>0.20</td>
<td>0.80*</td>
</tr>
<tr>
<td>Item #9</td>
<td>0.20</td>
<td>0.20</td>
<td>0.80*</td>
</tr>
</tbody>
</table>

*Item-scale correlation, corrected for overlap.*
# Item-scale correlation matrix

<table>
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<tr>
<th></th>
<th>Depress</th>
<th>Anxiety</th>
<th>Anger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item #1</td>
<td>0.50*</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Item #2</td>
<td>0.50*</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Item #3</td>
<td>0.50*</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Item #4</td>
<td>0.50</td>
<td>0.50*</td>
<td>0.50</td>
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<tr>
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<td>0.50</td>
<td>0.50*</td>
<td>0.50</td>
</tr>
<tr>
<td>Item #6</td>
<td>0.50</td>
<td>0.50*</td>
<td>0.50</td>
</tr>
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<td>Item #7</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50*</td>
</tr>
<tr>
<td>Item #8</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50*</td>
</tr>
<tr>
<td>Item #9</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50*</td>
</tr>
</tbody>
</table>

*Item-scale correlation, corrected for overlap.
Validity

• Content validity
  – Patients and/or experts judge the items to be representing the intended concept adequately

• Construct validity
  – Extent to which associations with other variables are consistent with prior hypotheses
Self-Reports of Physical Health Predict Five-Year Mortality

SF-36 Physical Health Component Score (PCS)—T score

Dead

<table>
<thead>
<tr>
<th>Age Group</th>
<th>% Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;35</td>
<td>17</td>
</tr>
<tr>
<td>35-44</td>
<td>6</td>
</tr>
<tr>
<td>45-54</td>
<td>5</td>
</tr>
<tr>
<td>&gt;55</td>
<td>2</td>
</tr>
</tbody>
</table>

Listed below are a few statements about your relationships with others. How much is each statement TRUE or FALSE for you?

- I am always courteous even to people who are disagreeable.
- There have been occasions when I took advantage of someone.
- I sometimes try to get even rather than forgive and forget.
- I sometimes feel resentful when I don’t get my way.
- No matter who I’m talking to, I’m always a good listener.

Definitely True/Mostly True/Don’t Know/Mostly False/Definitely False
Group Comparisons and Evaluating Individual Change in PROs

11:00-11:50am
SEER-MHOS Dataset (1)

- Surveillance, Epidemiology and End Results (SEER) program of cancer registries that collect standardized clinical and demographic information for persons with newly diagnosed (incident) cancer in specific geographical areas
- Began in 1973 and covers ~ 26% of U.S. pop.
  - [http://seer.cancer.gov/registries/list.html](http://seer.cancer.gov/registries/list.html)
  - California, Connecticut, Hawaii, Iowa, Kentucky, Louisiana, New Mexico, New Jersey, Utah
  - Atlanta, Detroit, rural Georgia, Seattle-Puget Sound metropolitan areas
SEER-MHOS Dataset (2)

- **Medicare Health Outcomes Survey (MHOS)**
  - 95-item survey administered to 1,000 randomly selected beneficiaries (including institutionalized and disabled) in Medicare managed care plans
  - Baseline and follow-up survey (2 years later).
  - 63-72% response rates for baseline surveys

Sample (n = 126,366)

- 55% female
- 79% non-Hispanic white, 7% Hispanic, 5% Black, 5% Asian
- 60% married
- 58% high school graduate or less
- 51% < $30,000 income
Dependent Variable = SF-6D

- SF-36 health survey, version 1

- 11 of 36 questions representing 6 of 8 domains
  - Physical functioning
  - Role limitations
  - Social function
  - Pain
  - Emotional well-being
  - Energy/fatigue

- Standard gamble elicitation of preferences from a population sample in the UK.

- Scores for alive range from 0.30 to 1.00 (dead = 0.00).
10 Cancer Conditions (n = 22,740; 18%)

- Prostate cancer (n = 5,593; 4%)
- Female breast Cancer (n = 4,311; 3%)
- Colorectal cancer (n = 3,012; 2%)
- Non-small cell lung cancer (n = 1,792; 1%)
- Bladder cancer (n = 1,299; 1%)
- Melanoma (n = 1,135; 1%)
- Endometrial cancer (n = 902; 1%)
- Non-Hodgkin's lymphoma (n = 668; 1%)
- Kidney cancer (n = 488; 0.4%)
- Other cancer (n = 3,540; 3%)

Note: Those with more than one cancer diagnosis are excluded.
Historic Stage of Disease (time of diagnosis)

- Localized
  - 2045 breast, 2652 prostate, 1481 colorectal, 466 lung

- Distant (metastatic)
  - 26 breast, 61 prostate, 48 colorectal, 47 lung

- Unstaged
  - 347 breast, 633 prostate, 203 colorectal, 65 lung
13 Non-cancer Conditions
(mean number = 2.44)

Hypertension n = 66,968 (53%)
Arthritis of the hip n = 44,524 (35%)
Arthritis of the hand n = 40,402 (32%)
Sciatica n = 26,878 (21%)
Other heart disease n = 25,455 (20%)
Diabetes n = 20,089 (16%)
Angina/coronary artery disease n = 18,017 (14%)
Chronic obstructive pulmonary disease n = 15,445 (12%)
Depressed in the last year n = 14,815 (12%)
Myocardial infarction/heart attack n = 11,982 (9%)
Stroke n = 9,479 (8%)
Congestive heart failure n = 7,893 (6%)
Inflammatory bowel disease n = 5,882 (5%)

Has a doctor ever told you that you had: ...
In the past year, have you felt depressed or sad much of the time?
Demographic & Administration Variables

✓ Age (continuous)
✓ Education (8th grade or less; some high school; high school graduate; some college; 4 year college grad; > 4 year college)
✓ Gender (male; female)
✓ Income (<10k, 10-19999, 20-29999, 30-39999, 40-49999, 50-79999, 80k and above, don’t know or missing)
✓ Race/ethnicity (Hispanic, non-Hispanic white, black, Asian, American Indian, other race, missing)
✓ Marital status (married, widowed, divorced/separated/never married)
✓ Proxy completed survey (11%)
✓ Mode of administration (88% mail vs. 12% phone)
Results (1)

• Adjusted R-squared of 39% for 43 dfs
• Intercept = 0.80
  – No chronic condition, average education and age, divorced/separated/never married, white, don’t know/missing income, phone mode)
  – SD = 0.14
• Only 2 of 23 conditions had non-significant associations (melanoma, endometrial cancer)
Results (2)

• Adjusted means
  – 0.80 (colorectal cancer, melanoma, endometrial cancer, female breast cancer, bladder cancer, prostate cancer, myocardial infarction)
  – 0.79 (kidney cancer, non-Hodgkin’s lymphoma, other cancer, angina/CAD, other heart disease, hypertension)
  – 0.78 (non-small cell lung cancer, diabetes, arthritis of the hand, CHF, inflammatory bowel disease)
  – 0.77 (stroke, COPD/asthma, sciatica)
  – 0.76 (arthritis of the hip)
  – 0.68 (depressive symptoms)
Results (3)

- 52 possible two-way interactions between four most prevalent cancers (female breast, prostate, colorectal, lung) and the 13 non-cancer conditions
  - Only 6 were statistically significant.
  - Two negative interaction coefficients (-0.01)
    - Colorectal cancer and diabetes
    - Lung cancer and COPD/asthma
Distant stage of cancer associated with 0.05-0.10 lower SF-6D Score

Figure 1. Distant Stage of Disease Associated with Worse SF-6D Scores (Sample sizes for local/regional, distant, and unstaged: Breast (2045, 26, 347); Prostate (2652, 61 and 633), Colorectal (1481, 48 and 203), and Lung (466, 47 and 65).
Summary

• Unique associations of multiple chronic conditions on health-related quality of life are generally similar and additive, not interactive.

• The largest unique associations of chronic conditions with health-related quality of life among Medicare managed care beneficiaries was observed for four conditions:
  – Stroke, COPD/asthma, sciatica, arthritis of the hip.

• Advanced stage of cancer is associated with noteworthy decrement in health-related quality of life for four “big” cancers (breast, prostate, colorectal, lung).
Physical Functioning and Emotional Well-Being at Baseline for 54 Patients at UCLA-Center for East West Medicine

MS = multiple sclerosis; ESRD = end-stage renal disease; GERD = gastroesophageal reflux disease.
Effect Sizes for Changes in SF-36 Scores

Energy = Energy/Fatigue; EWB = Emotional Well-being; Gen H = General Health; MCS = Mental Component Summary; Pain = Bodily Pain; PCS = Physical Component Summary; PFI = Physical Functioning; Role-E = Role-Emotional; Role-P = Role-Physical; Social = Social Functioning
Significant Improvement in all but 1 of SF-36 Scales (Change is in T-score metric)

<table>
<thead>
<tr>
<th></th>
<th>Change</th>
<th>t-test</th>
<th>prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF-10</td>
<td>1.7</td>
<td>2.38</td>
<td>.0208</td>
</tr>
<tr>
<td>RP-4</td>
<td>4.1</td>
<td>3.81</td>
<td>.0004</td>
</tr>
<tr>
<td>BP-2</td>
<td>3.6</td>
<td>2.59</td>
<td>.0125</td>
</tr>
<tr>
<td>GH-5</td>
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<td>2.86</td>
<td>.0061</td>
</tr>
<tr>
<td>EN-4</td>
<td>5.1</td>
<td>4.33</td>
<td>.0001</td>
</tr>
<tr>
<td>SF-2</td>
<td>4.7</td>
<td>3.51</td>
<td>.0009</td>
</tr>
<tr>
<td>RE-3</td>
<td>1.5</td>
<td>0.96</td>
<td>.3400</td>
</tr>
<tr>
<td>EWB-5</td>
<td>4.3</td>
<td>3.20</td>
<td>.0023</td>
</tr>
<tr>
<td>PCS</td>
<td>2.8</td>
<td>3.23</td>
<td>.0021</td>
</tr>
<tr>
<td>MCS</td>
<td>3.9</td>
<td>2.82</td>
<td>.0067</td>
</tr>
</tbody>
</table>
Defining a Responder: Reliable Change Index (RCI)

\[
\frac{X_2 - X_1}{(\sqrt{2}) \times (SEM)}
\]

\[
SEM = SD_{bl} \times \sqrt{1 - r_{xx}}
\]

Note: \(SD_{bl}\) = standard deviation at baseline  
\(r_{xx}\) = reliability
## Amount of Change in Observed Score Needed for Significant Individual Change

<table>
<thead>
<tr>
<th>Scale</th>
<th>RCI</th>
<th>Effect size</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF-10</td>
<td>8.4</td>
<td>0.67</td>
<td>0.94</td>
</tr>
<tr>
<td>RP-4</td>
<td>8.4</td>
<td>0.72</td>
<td>0.93</td>
</tr>
<tr>
<td>BP-2</td>
<td>10.4</td>
<td>1.01</td>
<td>0.87</td>
</tr>
<tr>
<td>GH-5</td>
<td>13.0</td>
<td>1.13</td>
<td>0.83</td>
</tr>
<tr>
<td>EN-4</td>
<td>12.8</td>
<td>1.33</td>
<td>0.77</td>
</tr>
<tr>
<td>SF-2</td>
<td>13.8</td>
<td>1.07</td>
<td>0.85</td>
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<tr>
<td>RE-3</td>
<td>9.7</td>
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<td>0.94</td>
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<td>EWB-5</td>
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<td>1.26</td>
<td>0.79</td>
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<td>PCS</td>
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<td>0.94</td>
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<tr>
<td>MCS</td>
<td>9.7</td>
<td>0.73</td>
<td>0.93</td>
</tr>
</tbody>
</table>
7-31% of People in Sample Improve Significantly

<table>
<thead>
<tr>
<th></th>
<th>% Improving</th>
<th>% Declining</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF-10</td>
<td>13%</td>
<td>2%</td>
<td>+11%</td>
</tr>
<tr>
<td>RP-4</td>
<td>31%</td>
<td>2%</td>
<td>+29%</td>
</tr>
<tr>
<td>BP-2</td>
<td>22%</td>
<td>7%</td>
<td>+15%</td>
</tr>
<tr>
<td>GH-5</td>
<td>7%</td>
<td>0%</td>
<td>+7%</td>
</tr>
<tr>
<td>EN-4</td>
<td>9%</td>
<td>2%</td>
<td>+7%</td>
</tr>
<tr>
<td>SF-2</td>
<td>17%</td>
<td>4%</td>
<td>+13%</td>
</tr>
<tr>
<td>RE-3</td>
<td>15%</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>EWB-5</td>
<td>19%</td>
<td>4%</td>
<td>+15%</td>
</tr>
<tr>
<td>PCS</td>
<td>24%</td>
<td>7%</td>
<td>+17%</td>
</tr>
<tr>
<td>MCS</td>
<td>22%</td>
<td>11%</td>
<td>+11%</td>
</tr>
</tbody>
</table>
Reliability and SEM

• For z-scores (mean = 0 and SD = 1):
  - Reliability = 1 - SE^2
  - So reliability = 0.90 when SE = 0.32

• For T-scores (mean = 50 and SD = 10):
  - Reliability = 1 - (SE/10)^2
  - So reliability = 0.90 when SE = 3.2
In the past 7 days

I was grouchy [1st question]

- Never
- Rarely
- Sometimes
- Often
- Always

• θ = 56.1  SE = 5.7 (rel. = 0.68)
In the past 7 days ...

I felt like I was read to explode [2nd question]

- Never
- Rarely
- Sometimes
- Often
- Always

• Theta = 51.9  SE = 4.8 (rel. = 0.77)
In the past 7 days ...

I felt angry [3rd question]

- Never
- Rarely
- Sometimes
- Often
- Always

• Theta = 50.5  SE = 3.9 (rel. = 0.85)
In the past 7 days ...

I felt angrier than I thought I should

[4th question]

- Never
- Rarely
- Sometimes
- Often
- Always

• θ = 48.8  SE = 3.6 (rel. = 0.87)
In the past 7 days ...

I felt annoyed [5th question]
- Never
- Rarely
- Sometimes
- Often
- Always

• Theta = 50.1  SE = 3.2 (rel. = 0.90)
In the past 7 days ...

I made myself angry about something just by thinking about it. [6th question]
- Never
- Rarely
- Sometimes
- Often
- Always

• $\Theta = 50.2 \ SE = 2.8 \ (rel = 0.92)$
Theta and SEM estimates

- 56 and 6 (reliability = .68)
- 52 and 5 (reliability = .77)
- 50 and 4 (reliability = .85)
- 49 and 4 (reliability = .87)
- 50 and 3 (reliability = .90)
- 50 and <3 (reliability = .92)
Questions?

Contact Information:

drhays@ucla.edu  (310-794-2294)
Powerpoint file available for downloading at:
http://gim.med.ucla.edu/FacultyPages/Hays/