Overview of Presentations
TheProteusConsortium.org

Introduction to PROs and PROTEUS

Introduction to the PROTEUS Tools

| Trial Protocol Development | Trial Accrual and Follow-up | Trial Analysis | Trial Reporting | Clinical Uptake of Trial Findings |

High-Quality PRO Evidence

SPIRIT PRO Protocol Guidance

ISOQOL PRO Measure Selection Standards

SISAQOL Analysis Guidance

CONSORT PRO Report Guidance

PRO Data Display Guidance

Clinician Users' Guide
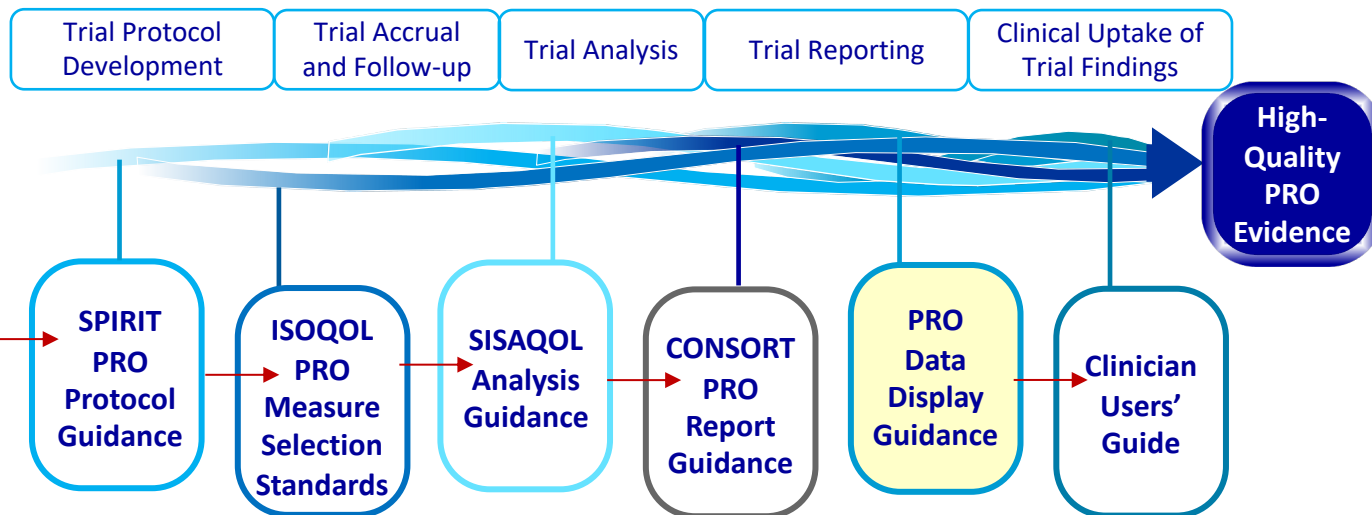
Overview of Tool Recommendations

How to Apply the Tools

Displaying PRO Results Graphically
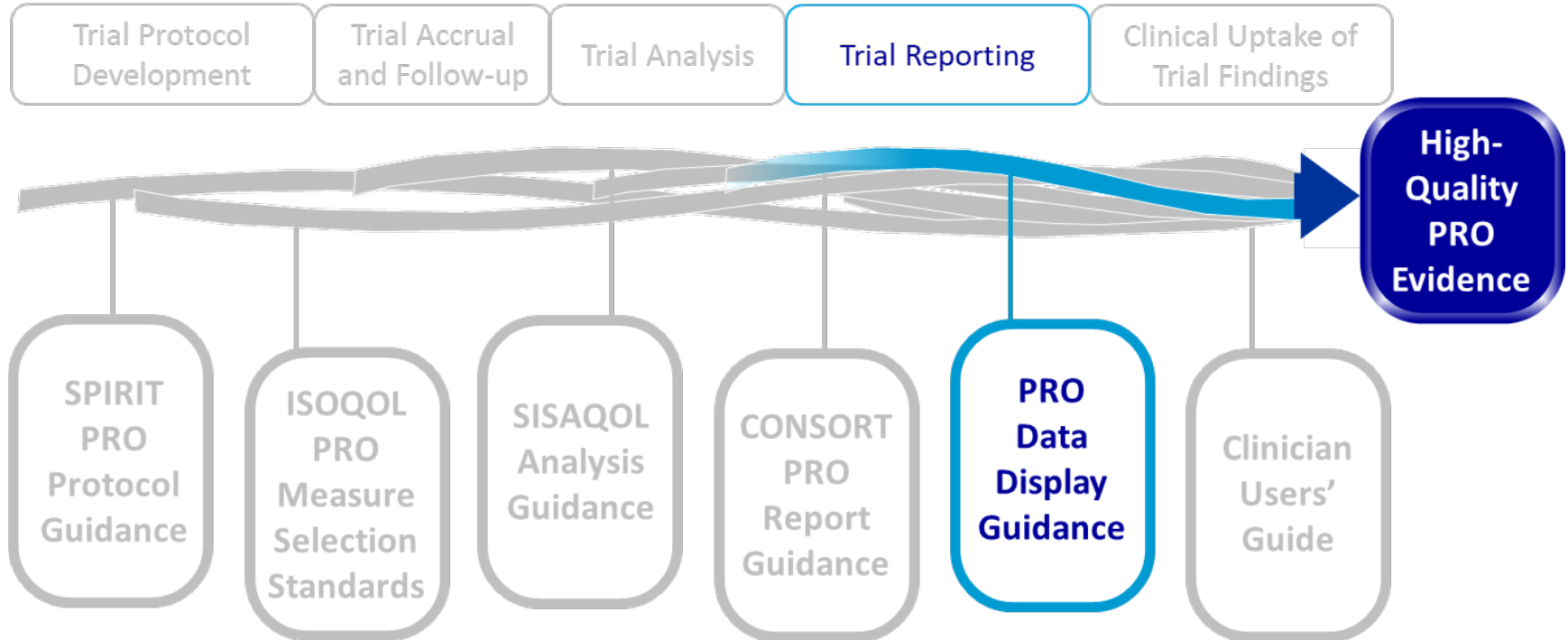
Displaying PRO Results Graphically

Why is it needed?

To promote consistent presentation of PRO data so that clinicians and patients can understand what PRO scores mean

What does it do?

Provides evidence-based recommendations for presenting PRO data clearly to patients and clinicians/researchers

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Displaying PRO Results Graphically

CrossMark

Making a picture worth a thousand numbers: recommendations for graphically displaying patient-reported outcomes data

Claire Snyder[1,2,3] · Katherine Smith[2,3] · Bernhard Holzner[4] · Yonaira M. Rivera[2] · Elissa Bantug[3] · Michael Brundage[5] ·
PRO Data Presentation Delphi Panel

Snyder et al, Qual Life Res 2019, 28(2), 345-356

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Acknowledgements

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Why Is This Resource Needed?

- Both patients and clinicians endorse the value of PROs, but also report challenges interpreting the meaning and implications of PRO data

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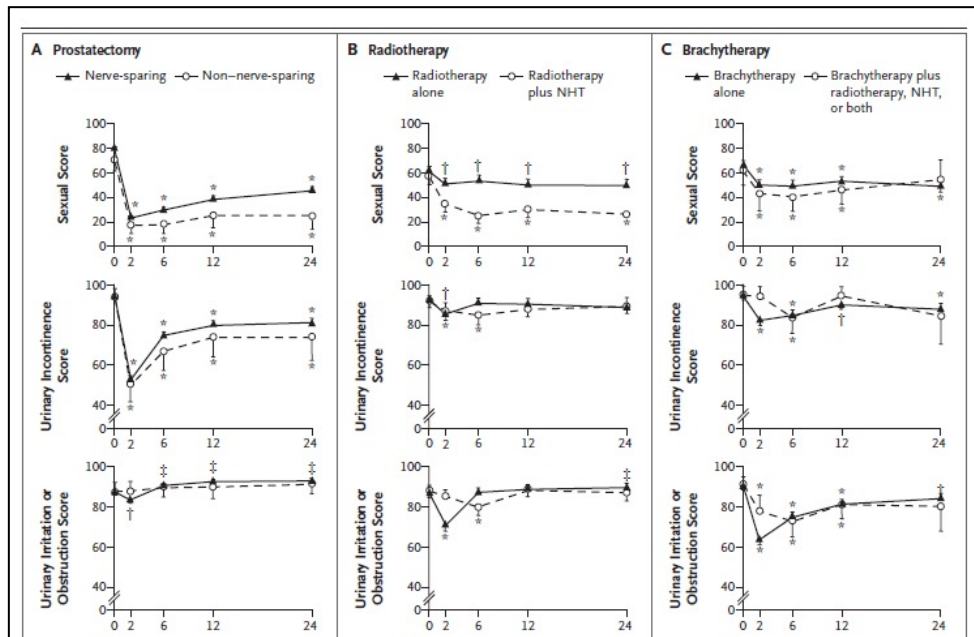
Why Is This Resource Needed?

Barriers to interpreting PRO data include **variation** in:

- PRO instruments
  - o Over 800 listed in PROOLID database (http://proqolid.org/)
- Scoring
  - o Higher scores may be better or worse
- Scaling
  - o E.g. 0-100 vs. normed to 50
- Presentation
  - o E.g. mean scores vs responders/ graphic vs. tabular

Why Is This Resource Needed?

- Variations in how PRO measures are scored and scaled, and in how the data are reported, make interpretation difficult and limit patients' and clinicians' use of the data in clinical practice

- Clear and standardized graphical presentation of PRO data has the potential to:
    - promote meaningful interpretation of PRO data
    - facilitate their use in practice
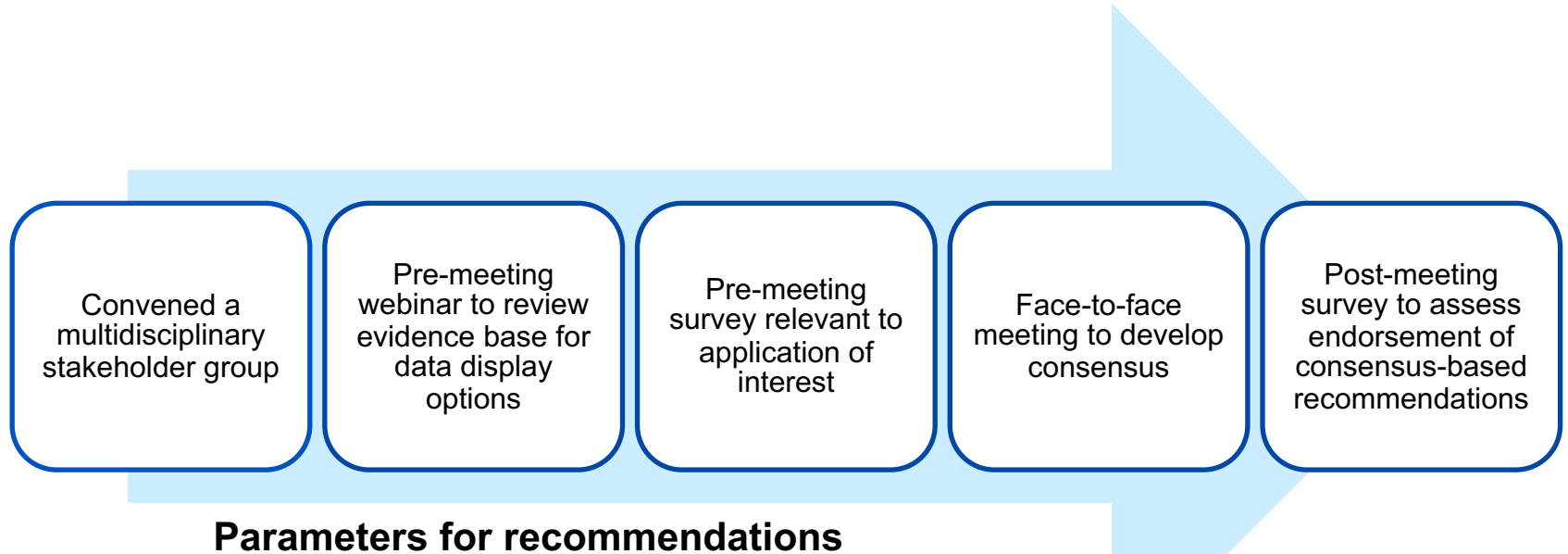
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Objective of Resource

To provide evidence-based recommendations for PRO data display to facilitate ease of interpretation for presenting results to:

- Patients (i.e. educational materials and decision aids)

- Clinicians/researchers (i.e. peer-reviewed publications)

[Also addresses display for individual patient data, though not covered here]

Methods: Modified-Delphi Process

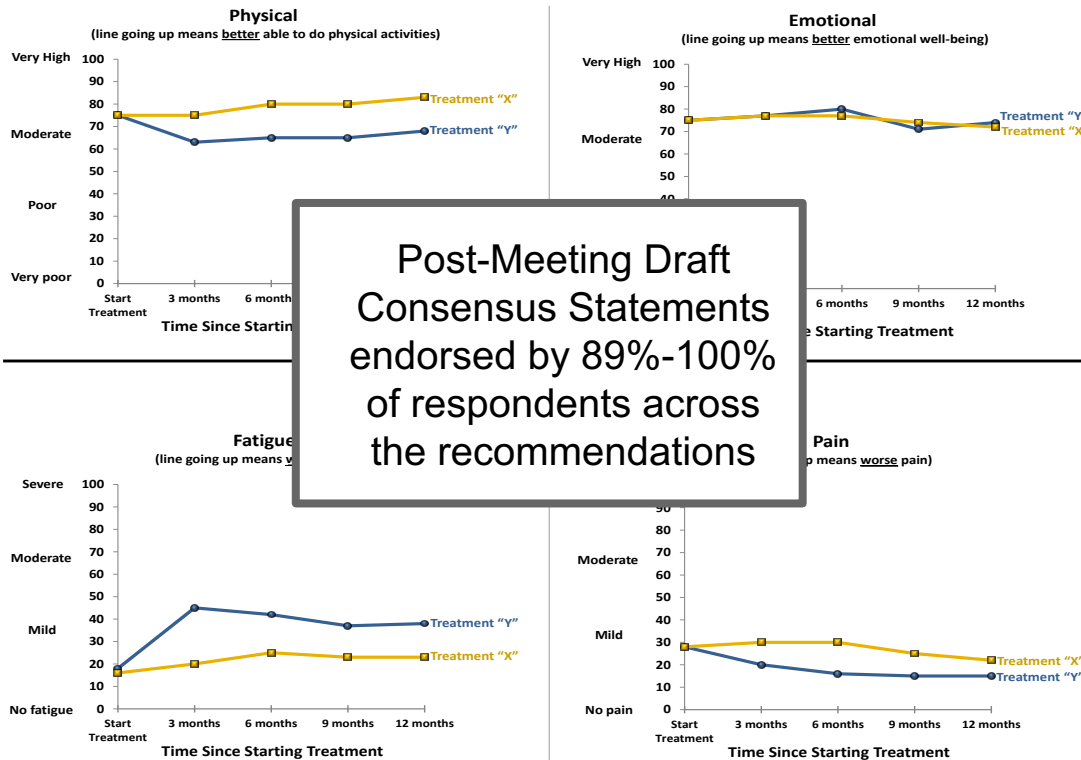| Convened a multidisciplinary stakeholder group | Pre-meeting webinar to review evidence base for data display options | Pre-meeting survey relevant to application of interest | Face-to-face meeting to develop consensus | Post-meeting survey to assess endorsement of consensus-based recommendations |

Parameters for recommendations

- Should work on paper (static presentation)
- Presentation in color is possible (but should be interpretable in grayscale)
- Additional functionality in electronic presentation is possible (but not part of standards)

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Recommendations:

**Research results presented to patients
(i.e. educational materials and decision aids)**

Research Results Presented to Patients

Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Emotional
(line going up means <u>better</u> emotional well-being)

Post-Meeting Draft Consensus Statements endorsed by 89%-100% of respondents across the recommendations

Fatigue
(line going up means ...)

Pain
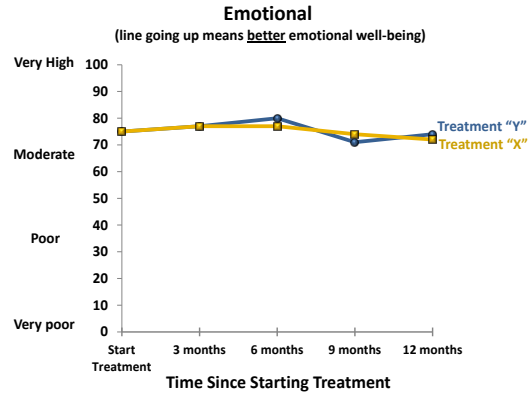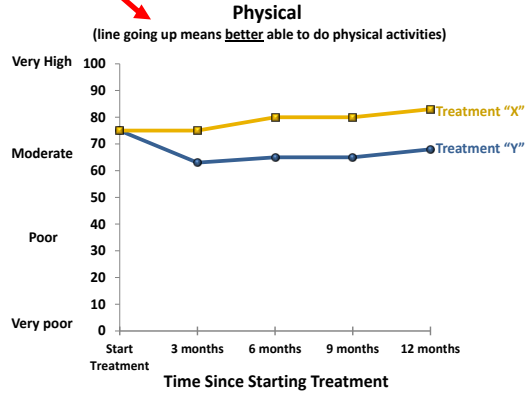(... up means <u>worse</u> pain)

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Directionality of PRO Scores

- There is no easy solution to the issue of directionality. There is a split in the "intuitive" interpretation of symptom scores, with some people expecting that higher scores would be "better" and others expecting that higher scores would be "more" of the symptom (and, therefore, worse)

- The Consensus Panel warned against trying to change current instruments – even if only how the data are displayed (e.g., "flipping the axes" where required for symptom scores so that lines going up are always better)

- PRO data presentation should avoid mixing score direction in a single display

- Mixed directionality between domains can cause confusion for both clinicians and patients. There is a need to address this potential confusion by using exceptionally clear labeling, titling, and other annotations
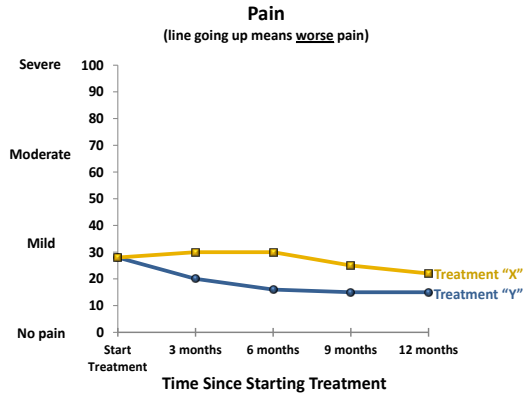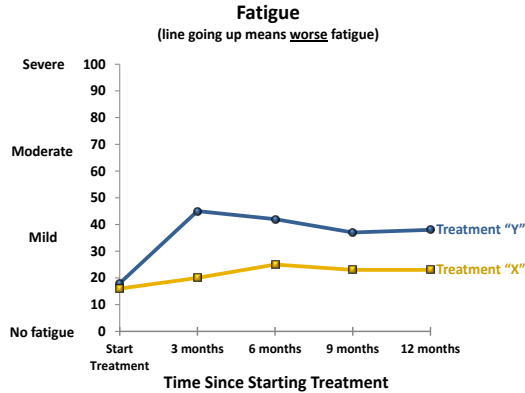
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Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Very High 100
90
80 — Treatment "X"
Moderate 70
60 — Treatment "Y"
50
Poor 40
30
20
10
Very poor 0

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Emotional
(line going up means <u>better</u> emotional well-being)

Very High 100
90
80
Moderate 70 — Treatment "Y" / Treatment "X"
60
50
Poor 40
30
20
10
Very poor 0

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Labels for directionality

Visually separate domains with different directionality

Patients' Symptoms

Fatigue
(line going up means <u>worse</u> fatigue)

Severe 100
90
80
Moderate 70
60
50
40 — Treatment "Y"
Mild 30
20 — Treatment "X"
10
No fatigue 0

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Pain
(line going up means <u>worse</u> pain)

Severe 100
90
80
Moderate 70
60
50
40
Mild 30 — Treatment "X"
20 — Treatment "Y"
10
No pain 0

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Y-axis labels reinforce directionality

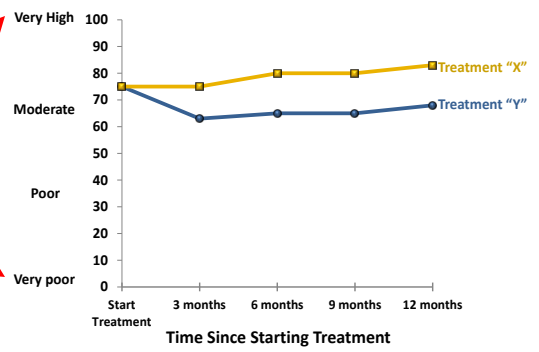**PROTEUS**

Conveying Score Meaning

- Descriptive labels (e.g., none/mild/moderate/severe) along the y-axis are helpful and should be used when data supporting their location on the scale are available

- At a minimum, anchors for the extremes should be included (e.g., none/severe), as these labels also help with the interpretation of directionality. Labels for the middle categories (e.g., mild/moderate) should be included if evidence is available to support the relevant score ranges for each label

- In addition to the descriptive y-axis labels, reference values for comparison populations should be included if they are available
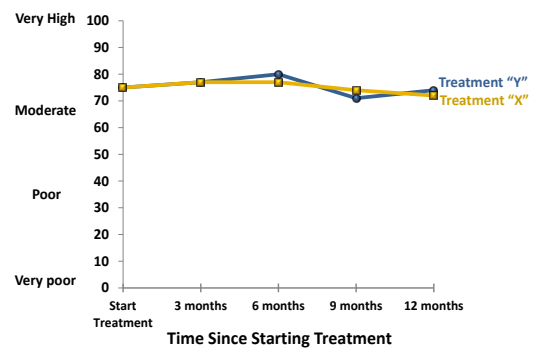
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Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Very High — 100
90
Moderate — 80, 70
60
50
Poor — 40, 30
20
10
Very poor — 0

Treatment "X"
Treatment "Y"

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Emotional
(line going up means <u>better</u> emotional well-being)

Very High — 100
90
80
Moderate — 70
60
50
Poor — 40, 30
20
10
Very poor — 0

Treatment "Y"
Treatment "X"

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Y-axis descriptive anchor labels

Patients' Symptoms

Fatigue
(line going up means <u>worse</u> fatigue)

Severe — 100
90
80
Moderate — 70, 60
50
40
Mild — 30
20
10
No fatigue — 0

Treatment "Y"
Treatment "X"

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Pain
(line going up means <u>worse</u> pain)

Severe — 100
90
80
Moderate — 70, 60
50
40
Mild — 30
20
10
No pain — 0

Treatment "X"
Treatment "Y"

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Additional Y-axis labels (when data support their location)

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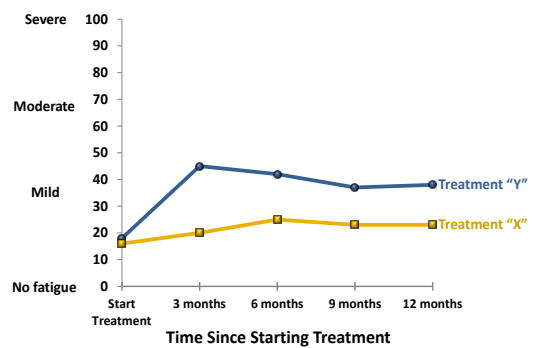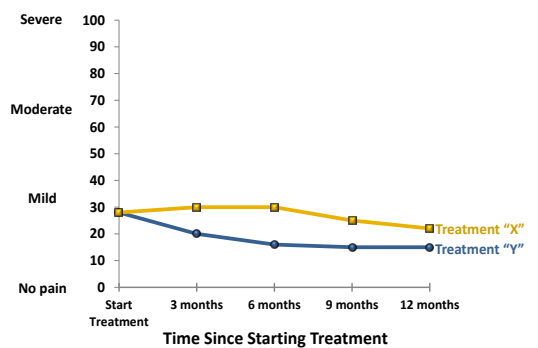
Normed Scoring

- PRO data presentation needs to accommodate instruments the way they were developed, with or without normed scoring

- One can decide if/when to show the reference population norm visually (with a line on the graph), understanding that displaying it might provide additional interpretive value, but potentially at the cost of greater complexity

- Comparison to the norm might be less relevant in the context where the primary focus is the choice between treatments
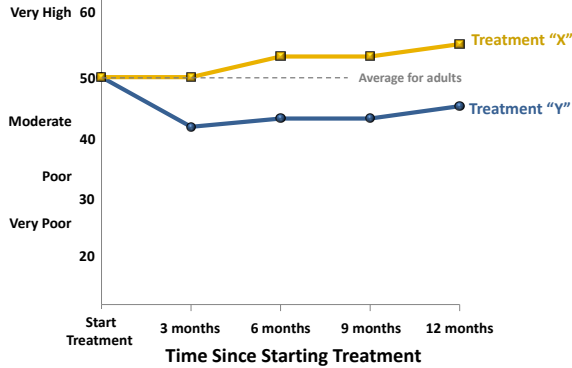
If a norm is displayed:

1. It is necessary to describe the reference population and label the norm as clearly as possible (recommend "average" rather than "norm")

2. It also requires deciding what reference population to show (to the extent that options are available)

3. It will need to be explained to patients that this normed population may not be applicable to a given patient
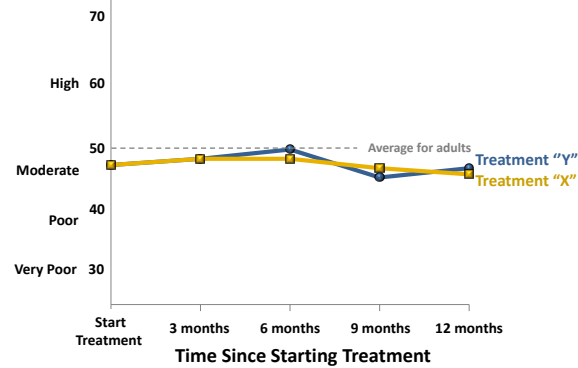
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Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Treatment "X"
Average for adults
Treatment "Y"

Very High 60
Moderate 50
Poor 40
Very Poor 30
20

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Emotional
(line going up means <u>better</u> emotional well-being)

70
High 60
Average for adults
Treatment "Y"
Moderate 50
Treatment "X"
Poor 40
Very Poor 30

Start Treatment | 3 months | 6 months | 9 months | 12 months
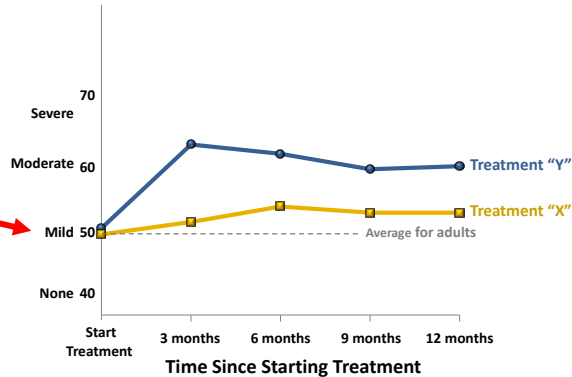**Time Since Starting Treatment**

Y-axis descriptive labels for normed scoring that also reinforce directionality

Patients' Symptoms

Fatigue
(line going up means <u>more</u> fatigue)

70
Severe
Moderate 60
Treatment "Y"
Mild 50
Treatment "X"
Average for adults
None 40

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Pain
(line going up means <u>more</u> pain)

70
Severe
Moderate 60
Mild 50
Treatment "X"
Average for adults
Treatment "Y"
None 40

Start Treatment | 3 months | 6 months | 9 months | 12 months
Time Since Starting Treatment

Display reference population norm visually
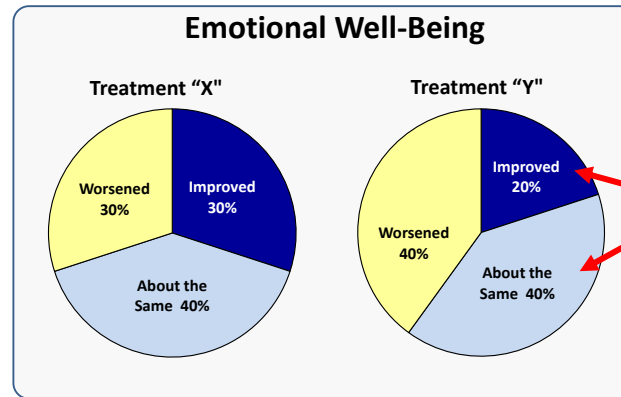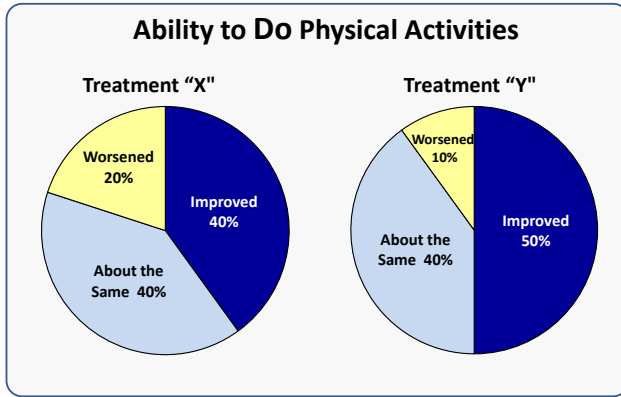
PROTEUS
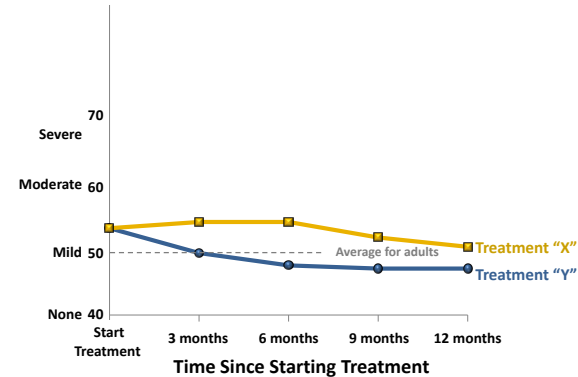
Clinically Important Differences

- Patients may find information regarding clinically important differences between treatments to be confusing, but it is important for them to know what differences "matter" if they are going to make an informed decision
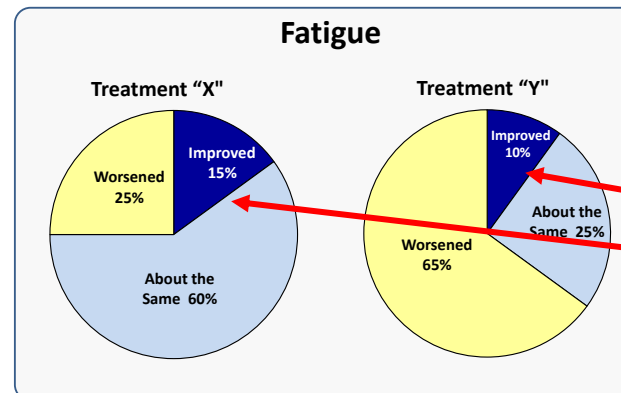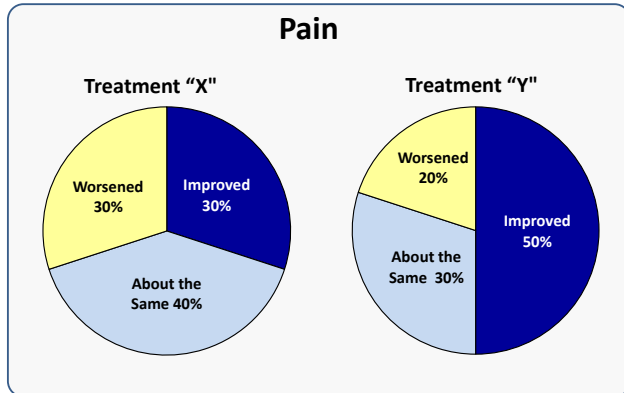
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Proportions changed

- Pie charts are the preferred format for displaying proportion meeting a responder definition (improved, stable, worsened), so long as the proportion is also indicated numerically

Status of 100 patients 9 months after starting treatment

Ability to Do Physical Activities

Treatment "X"
- Worsened 20%
- Improved 40%
- About the Same 40%

Treatment "Y"
- Worsened 10%
- Improved 50%
- About the Same 40%

Emotional Well-Being

Treatment "X"
- Worsened 30%
- Improved 30%
- About the Same 40%

Treatment "Y"
- Improved 20%
- Worsened 40%
- About the Same 40%

Data labels annotated on each slice

No horizontal line separating domains since directionality not relevant with proportions

Pain

Treatment "X"
- Worsened 30%
- Improved 30%
- About the Same 40%

Treatment "Y"
- Worsened 20%
- Improved 50%
- About the Same 30%

Fatigue

Treatment "X"
- Improved 15%
- Worsened 25%
- About the Same 60%

Treatment "Y"
- Improved 10%
- About the Same 25%
- Worsened 65%

Improved slice consistently starts at 12:00 position
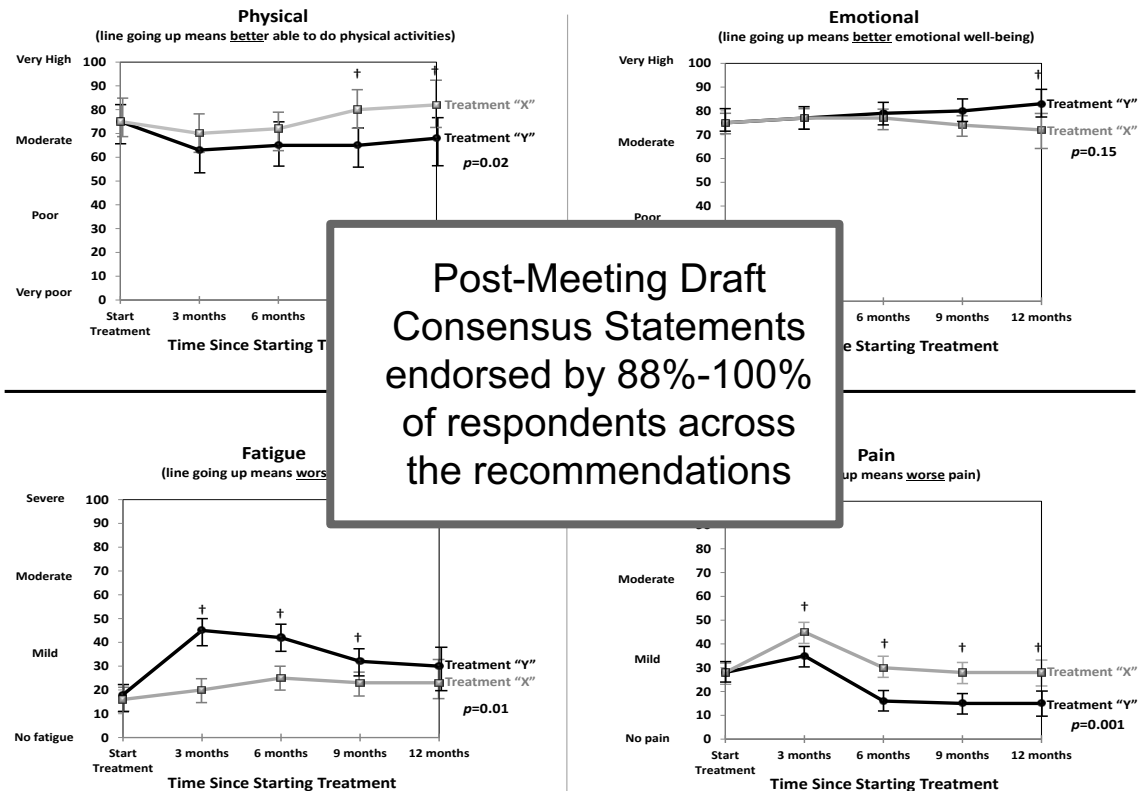
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Recommendations:

Research results presented to clinicians (i.e. peer-reviewed publications)

Research Results Presented to Clinicians
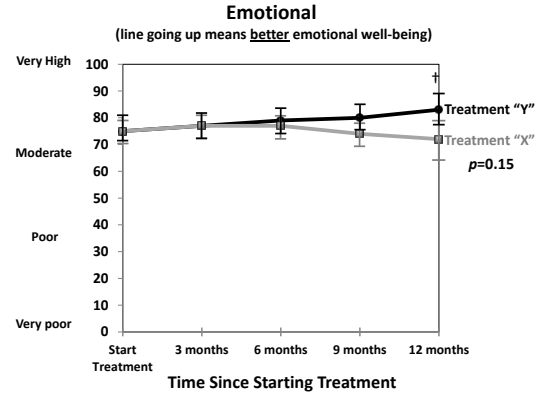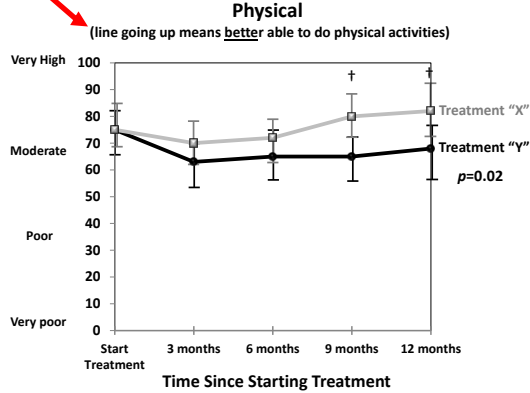

Patients' Functioning

Legend: For all graphs, *p*-values are for between-treatment differences over time, and vertical lines indicate 95% confidence limits at each time point.
† indicates differences between treatments that are clinically important.

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Directionality of PRO Scores

- The Consensus Panel acknowledges the challenges associated with directionality. There is a split in the "intuitive" interpretation of symptom scores, with some people expecting that higher scores would be "better" and others expecting that higher scores would be "more" of the symptom (and, therefore, worse)

- The Consensus Panel recommends against changing the scoring of current instruments

- PRO data presentation should avoid mixing score direction in a single display. In cases where this is not possible, authors should consider changing the directionality in the display to be consistent

- There is a need for exceptionally clear labeling, titling, and other annotations
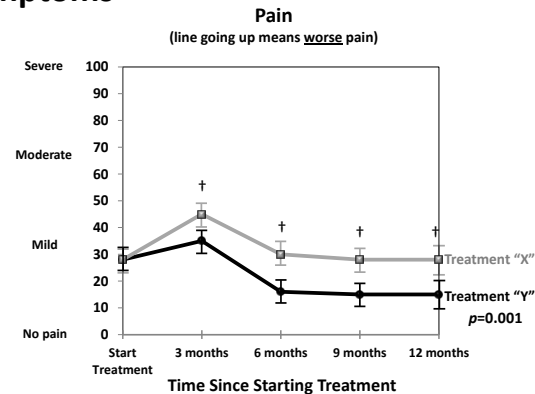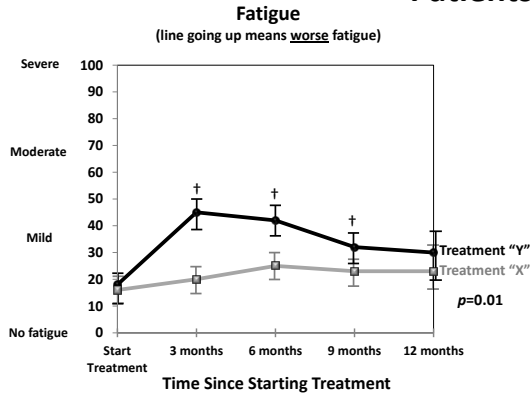
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Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Treatment "X"
Treatment "Y"
p=0.02

Y-axis labels: Very High 100, 90, 80, Moderate 70, 60, 50, Poor 40, 30, 20, Very poor 10, 0

X-axis: Start Treatment, 3 months, 6 months, 9 months, 12 months

Time Since Starting Treatment

Emotional
(line going up means <u>better</u> emotional well-being)

Treatment "Y"
Treatment "X"
p=0.15

Time Since Starting Treatment

Patients' Symptoms

Fatigue
(line going up means <u>worse</u> fatigue)

Severe 100, 90, 80, Moderate 70, 60, 50, Mild 40, 30, 20, No fatigue 10, 0

Treatment "Y"
Treatment "X"
p=0.01

Time Since Starting Treatment

Pain
(line going up means <u>worse</u> pain)

Severe 100, 90, 80, Moderate 70, 60, 50, Mild 40, 30, 20, No pain 10, 0

Treatment "X"
Treatment "Y"
p=0.001

Time Since Starting Treatment

Legend: For all graphs, *p*-values are for between-treatment differences over time, and vertical lines indicate 95% confidence limits at each time point.
† indicates differences between treatments that are clinically important.

Labels for directionality

Visually separate domains with different directionality

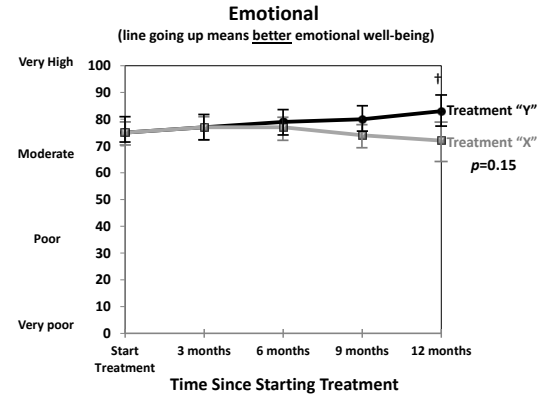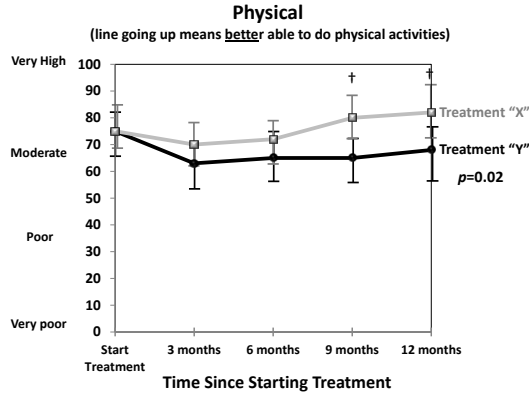Y-axis labels reinforce directionality

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Conveying Score Meaning

- Descriptive labels (e.g., none/mild/moderate/severe) along the y-axis are helpful and should be used when data supporting their location on the scale are available

- In addition to the descriptive y-axis labels, reference values for comparison populations should be considered for inclusion if they are available

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Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Very High — 100
90
80
Moderate — 70
60
50
40
Poor — 30
20
10
Very poor — 0

Treatment "X"
Treatment "Y"
p=0.02

†

Start Treatment, 3 months, 6 months, 9 months, 12 months

Time Since Starting Treatment

Emotional
(line going up means <u>better</u> emotional well-being)

Very High — 100
90
80
Moderate — 70
60
50
40
Poor — 30
20
10
Very poor — 0

Treatment "Y"
Treatment "X"
p=0.15

†

Start Treatment, 3 months, 6 months, 9 months, 12 months

Time Since Starting Treatment

Patients' Symptoms

Fatigue
(line going up means <u>worse</u> fatigue)

Severe — 100
90
80
Moderate — 70
60
Mild — 50
40
30
20
10
No fatigue — 0

Treatment "Y"
Treatment "X"
p=0.01

† † †

Start Treatment, 3 months, 6 months, 9 months, 12 months

Time Since Starting Treatment

Pain
(line going up means <u>worse</u> pain)

Severe — 100
90
80
Moderate — 70
60
Mild — 50
40
30
20
10
No pain — 0

Treatment "X"
Treatment "Y"
p=0.001

† † † †

Start Treatment, 3 months, 6 months, 9 months, 12 months

Time Since Starting Treatment

Legend: For all graphs, *p*-values are for between-treatment differences over time, and vertical lines indicate 95% confidence limits at each time point.
† indicates differences between treatments that are clinically important.

Y-axis descriptive anchor labels

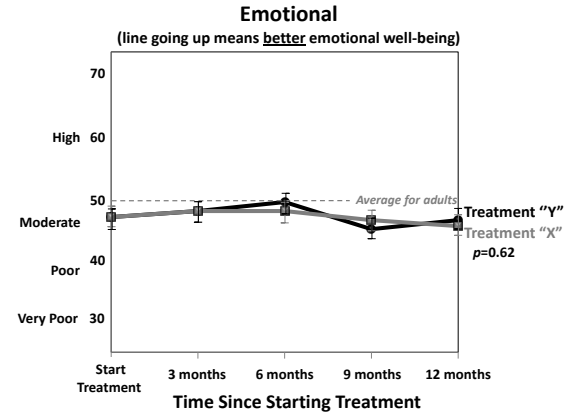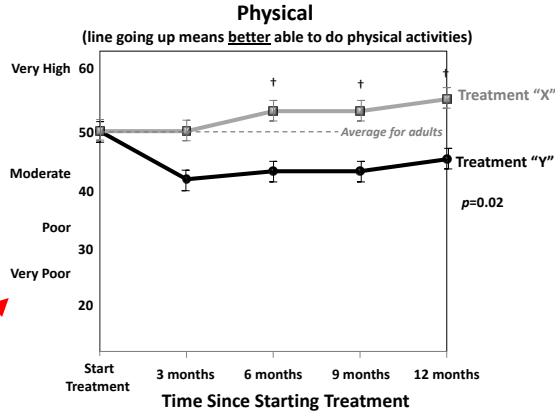Additional Y-axis labels (when data support their location)
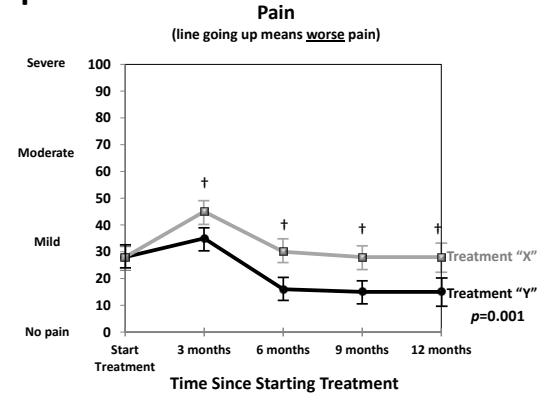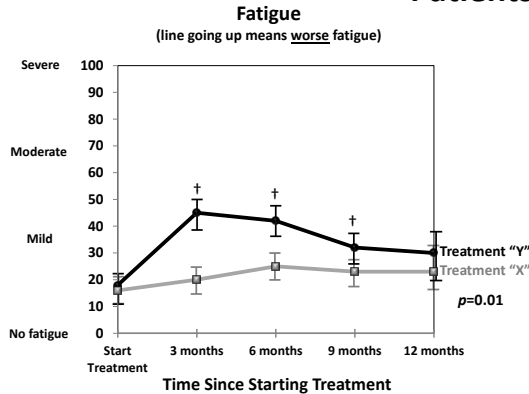
PROTEUS

Normed Scoring

- PRO data presentation needs to accommodate instruments the way they were developed, with or without normed scoring

- One can decide if/when to show the reference population norm visually (e.g., with a line on the graph), understanding that displaying it might provide additional interpretive value, but potentially at the cost of greater complexity

- Display of the norm might be less relevant in the context where the primary focus is the choice between treatments

If a norm is displayed:

1. It is necessary to describe the reference population and label the norm as clearly as possible (recommend "average" rather than "norm")

2. It also requires deciding what reference population to show (to the extent that options are available)
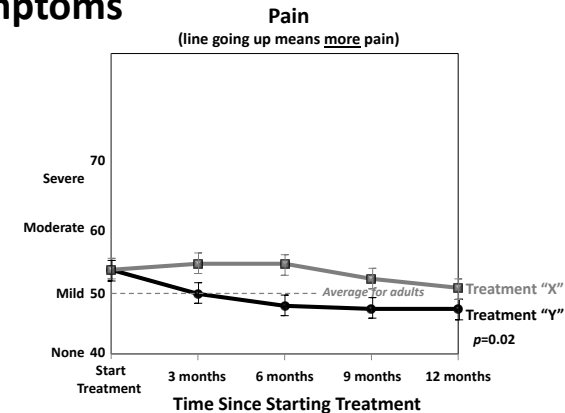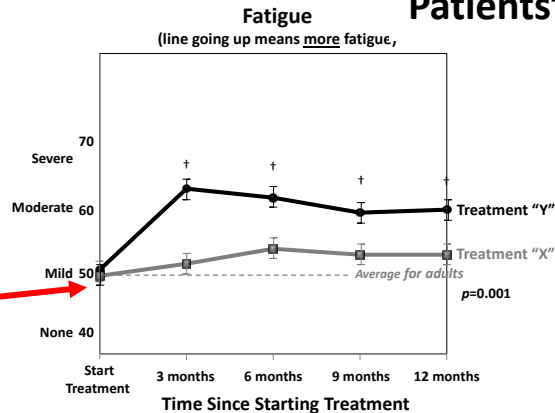
PROTEUS

Patients' Functioning

Physical
(line going up means **better** able to do physical activities)

Very High 60
50 — *Average for adults*
Moderate 40
Poor 30
Very Poor 20

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Treatment "X"
Treatment "Y"
p=0.02

Emotional
(line going up means **better** emotional well-being)

70
High 60
50 — *Average for adults*
Moderate
Poor 40
Very Poor 30

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Treatment "Y"
Treatment "X"
p=0.62

Y-axis descriptive labels for normed scoring that also reinforce directionality

Patients' Symptoms

Fatigue
(line going up means **more** fatigue)

70 Severe
Moderate 60
Mild 50 — *Average for adults*
None 40

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Treatment "Y"
Treatment "X"
p=0.001

Pain
(line going up means **more** pain)

70 Severe
Moderate 60
Mild 50 — *Average for adults*
None 40

Start Treatment — 3 months — 6 months — 9 months — 12 months

Time Since Starting Treatment

Treatment "X"
Treatment "Y"
p=0.02

Display reference population norm visually

Legend: For all graphs, p-values are for between-treatment differences over time.
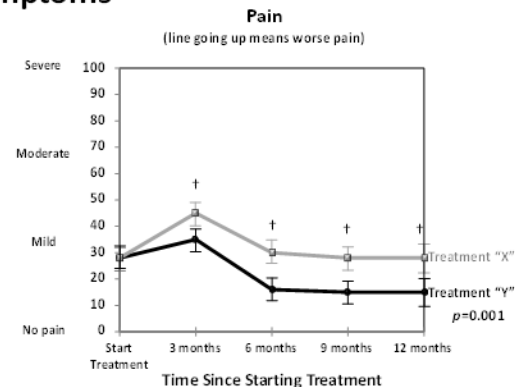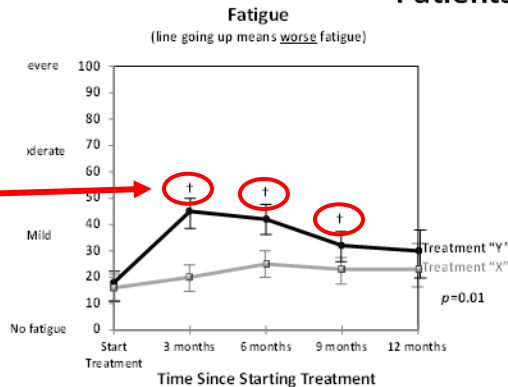† indicates differences between treatments that are clinically important.

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Clinical Importance

- Clinically important differences between treatments should be indicated with a symbol of some sort (described in a legend). The use of an asterisk is not recommended (as it is often used to indicate statistical significance)

- If there is no defined clinically important difference, that also needs to be in the legend and/or the text of the paper

Patients' Functioning

Physical
(line going up means _better_ able to do physical activities)

Treatment "X"
Treatment "Y"
p=0.02

Emotional
(line going up means _better_ emotional well-being)

Treatment "Y"
Treatment "X"
p=0.15

Patients' Symptoms

Fatigue
(line going up means _worse_ fatigue)
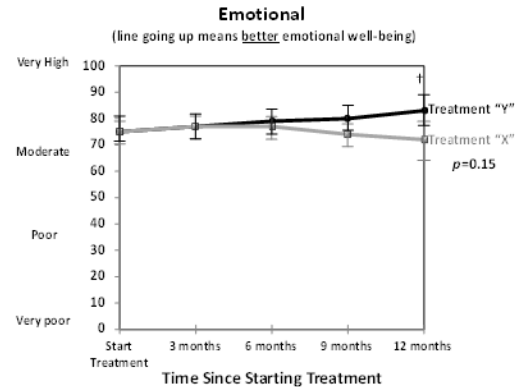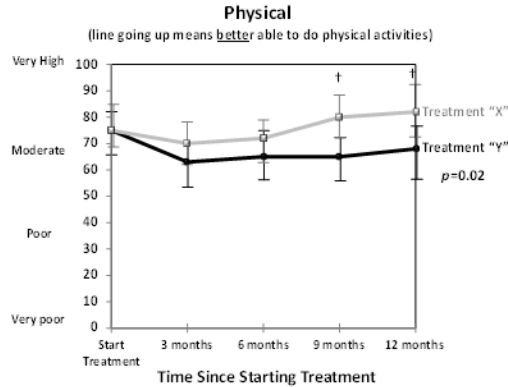
Symbols illustrating clinically important differences between group scores

Treatment "Y"
Treatment "X"
p=0.01

Pain
(line going up means _worse_ pain)

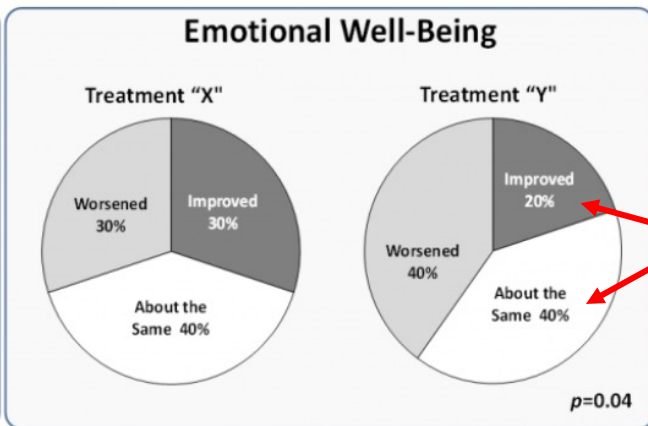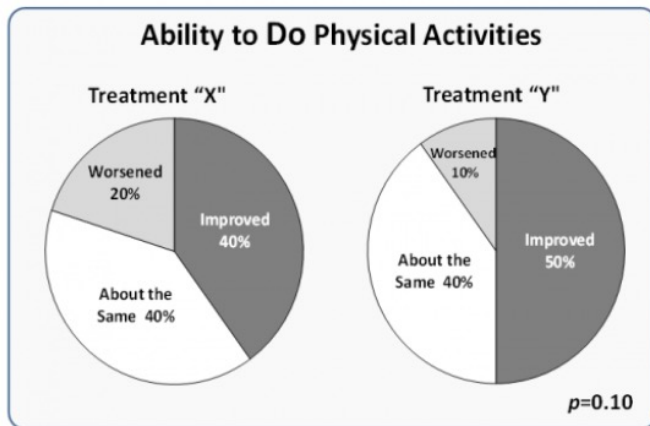Treatment "X"
Treatment "Y"
p=0.001

Legend explanation

Legend: For all graphs, p-values are for between-treatment differences over time, and vertical lines indicate 95% confidence limits at each time point.
† indicates differences between treatments that are clinically important.

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Statistical Significance

- The data suggest that clinicians and others appreciate p-values; however, the Consensus Panel recognizes a move away from reporting them (and toward the use of confidence limits to illustrate statistical significance)

- Regardless of whether p-values are reported, confidence intervals should always be displayed

Patients' Functioning

Physical
(line going up means <u>better</u> able to do physical activities)

Treatment "X"
Treatment "Y"
p=0.02

Emotional
(line going up means <u>better</u> emotional well-being)

Treatment "Y"
Treatment "X"
p=0.15

Patients' Symptoms

Fatigue
(line going up means <u>worse</u> fatigue)

Treatment "Y"
Treatment "X"
p=0.01

Pain
(line going up means worse pain)
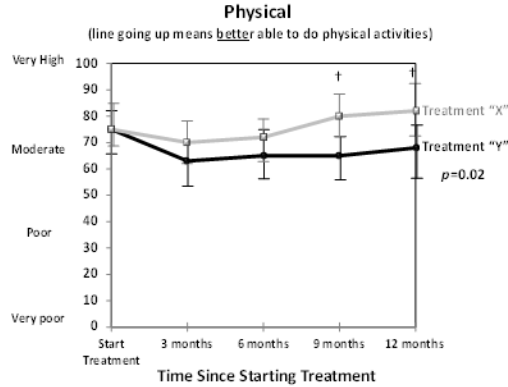
Treatment "X"
Treatment "Y"
p=0.001
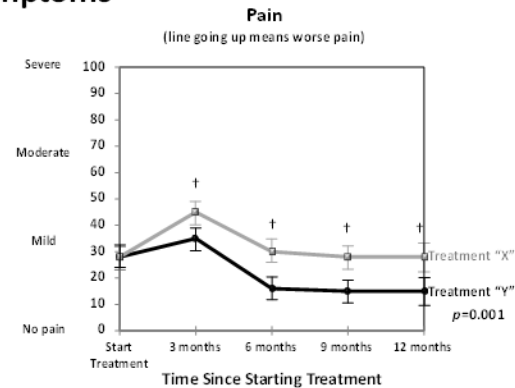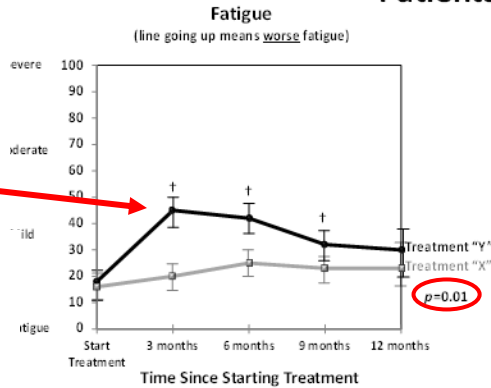
Confidence limits should always be shown

p-values often included but considered optional

Legend explanations

Legend: For all graphs, *p*-values are for between-treatment differences over time, and vertical lines indicate 95% confidence limits at each time point.
† indicates differences between treatments that are clinically important.

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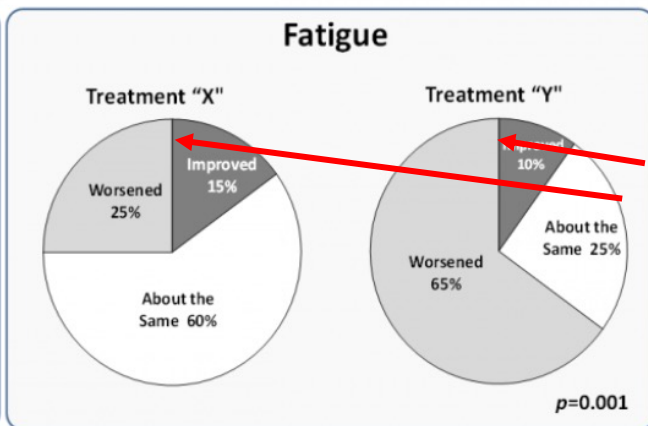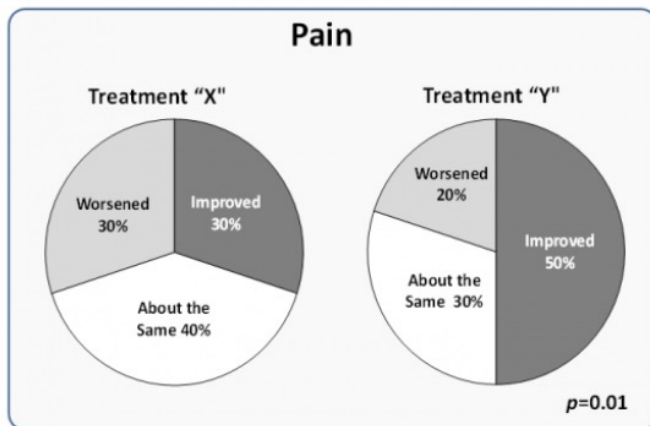
Proportions Changed

- Responder analysis results should be displayed visually

- Reasonable options include bar charts, pie charts, or stacked bar charts

Status of 100 patients 9 months after starting treatment

Ability to Do Physical Activities

Treatment "X"
- Worsened 20%
- Improved 40%
- About the Same 40%

Treatment "Y"
- Worsened 10%
- Improved 50%
- About the Same 40%

p=0.10

Emotional Well-Being

Treatment "X"
- Worsened 30%
- Improved 30%
- About the Same 40%

Treatment "Y"
- Improved 20%
- Worsened 40%
- About the Same 40%

p=0.04

Pain

Treatment "X"
- Worsened 30%
- Improved 30%
- About the Same 40%

Treatment "Y"
- Worsened 20%
- Improved 50%
- About the Same 30%

p=0.01

Fatigue

Treatment "X"
- Improved 15%
- Worsened 25%
- About the Same 60%

Treatment "Y"
- Improved 10%
- About the Same 25%
- Worsened 65%

p=0.001

Data labels annotated on each slice

No horizontal line separating domains since directionality not relevant with proportions

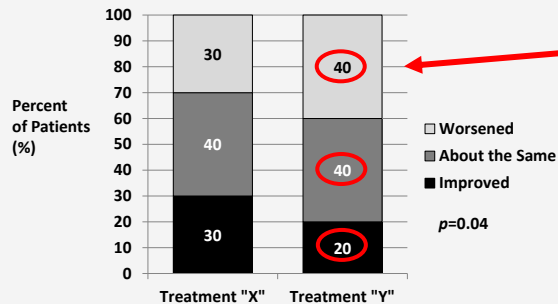Improved slice consistently starts at 12:00 position

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Status of 100 patients 9 months after starting treatment
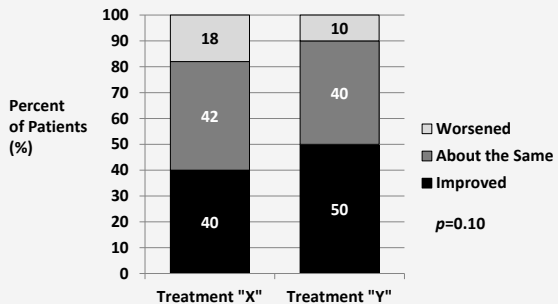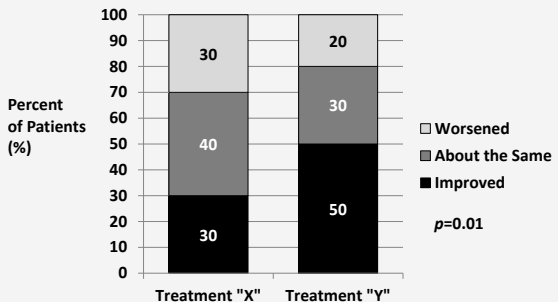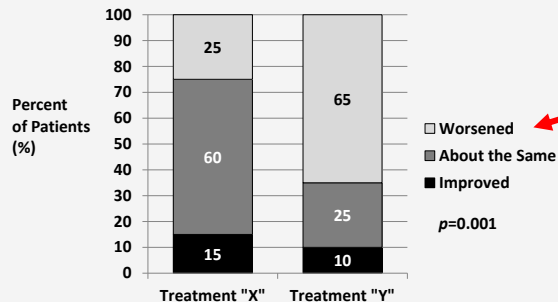
Key Differences Between Recommendations for Patients vs Clinicians/Researchers

Directionality (for clinicians and researchers only)

- If it is not possible to avoid mixing score direction in a single display, authors may consider changing the directionality in the PRO data display to be consistent in journal publications

Normed scoring (for patients only)

- If a norm is displayed it will need to be explained to patients that this normed population may not be applicable to a given patient

Conveying clinical and statistical significance (for clinicians and researchers only)

- A symbol should be used to indicate clinically important differences between treatments
- Confidence intervals should be displayed
- P-values may also be appreciated

Proportions changed

- Pie charts are preferred for patients
- Bar charts, pie charts, or stacked bar charts are reasonable options for clinicians and researchers

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Recap

- PRO data have enormous potential to promote patient-centered care, but for this potential to be realized, clinicians and patients need to be able to understand what PRO scores mean

- To address this, a modified Delphi consensus process was conducted with a broad range of key stakeholders to develop recommendations for PRO data display

- The consensus process produced clear guidance for PRO data display to promote patient-centered care by optimizing accurate and meaningful interpretation of PRO results

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Further Reading

Brundage M, Smith K, Little E et al. Communicating patient-reported outcome scores using graphic formats: Results from a mixed methods evaluation. *Quality of Life Research.*24;2457-2472; 2015.

Bantug E, Coles T, Smith K et al. Graphical displays of patient-reported outcomes (PRO) for use in clinical practice: What makes a PRO picture worth a thousand words? *Patient Education and Counselling.* 99;483-490; 2016.

Smith K, Brundage M, Tolbert E et al. Engaging stakeholders to improve presentation of patient-reported outcomes data in clinical practice. *Support Care Cancer*. 4149-4157; 2016.

Brundage M, Blackford A, Tolbert E et al. Presenting comparative study PRO results to clinicians and researchers: Beyond the eye of the beholder. *Quality of Life Research*. 27:75-90; 2018.

Tolbert E, Brundage M, Bantug E, Blackford AL, Smith K, Snyder C; PRO Data Presentation Stakeholder Advisory Board. Picture this: Presenting longitudinal patient-reported outcome research study results to patients. *Medical Decision Making.*38:994-1005;2018.

Tolbert E, Brundage M, Bantug E, Blackford AL, Smith K, Snyder C; PRO Data Presentation Stakeholder Advisory Board. In proportion: Approaches for displaying patient-reported outcome research study results as percentages responding to treatment. *Quality of Life Research.*28:609-20;2019.

Snyder C, Smith K, Holzner B et al. Making a picture worth a thousand numbers: Recommendations for graphically displaying patient-reported outcomes data. *Quality of Life Research.*28:345-35; 2019.