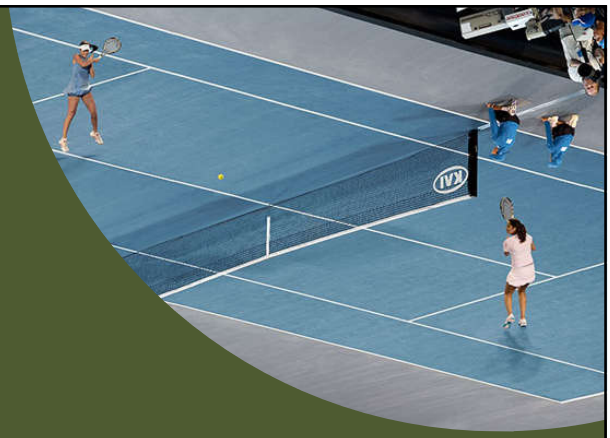
DEPARTMENT OF SPORTS SCIENCE AND CLINICAL BIOMECHANICS



Interpretation

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SDU

1

Interpretation

Definition

"The degree to which one can assign qualitative meaning - that is, clinical or commonly understood connotations – to an instrument's quantitative scores or change in scores"

Cosmin 2011

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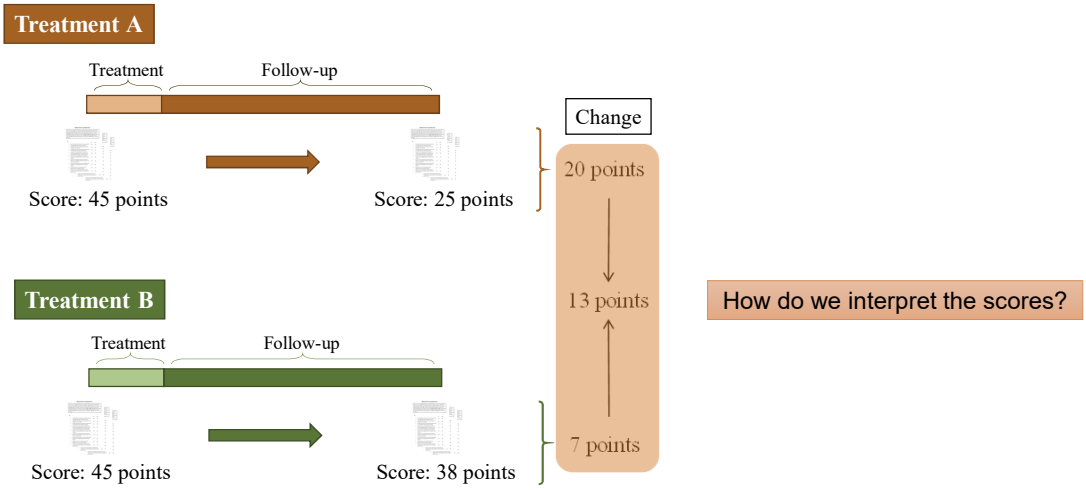
2

Interpretation



3

Minimal Important Change (MIC)

Definition

"The smallest change in score in the construct to be measured which patients perceive as important"

MIC is the smallest change in score that you **WANT** to detect with the instrument

Mokkink et al, 2010

4

A 'pet' has many names

MID/**MIC**/MCID/MCIC

MI = Minimal important
MCI = Minimal clinically important
D = difference
C = change

Change: within persons/groups
Difference: between persons/groups

van der Roer et al. , Spine (2006), De Vet et al., Health Qual Life Out (2006)

5

Calculation of MIC

MIC can determined by either

1) Distribution-based methods → NOT recommended
2) Anchor-based methods
3) Predictive modelling

E.g. $MIC = 1 \times SEM$ or $MIC = \frac{1}{2} \times SD$

If MIC is defined as $1 \times SEM$ the SDC will always (by definition) be larger than the MIC, because:

$$SDC = 1.96 \times \sqrt{2} \times SEM$$

This would mean that one can never distinguish important change from measurement error in individual patients (the same is true for 0.5 x SD).

Terluin et al. J Clin Epidemiol. 2017

6

Anchor-based MIC distribution method

Graphical method to determine the best MIC interval

- Uses a globalt anchor:
  - Must substantially correlate with the health status instrument (> 0.5)
    - Transition question method – retrospective
    - Punum Ladder method - prospective

Can be made for an ‘important improvement’ and ‘important deterioration’

5-step process

de Vet et al., Quality of Life Research (2007)

7

Step 1-2

1. Choose a global anchor (transition question)
2. Define an ‘important change’

Transition question method

”How are you now compared to when you started?”

- ❑ Much better
- ❑ Better

Important improvement

- ❑ A little better
- ❑ No change
- ❑ A little worse

Unchanged

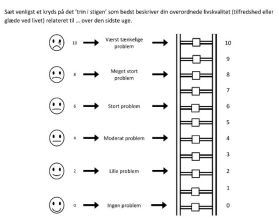
- ❑ Worse
- ❑ Much worse

Important deterioration

Hebrew: face

Punum Ladder method

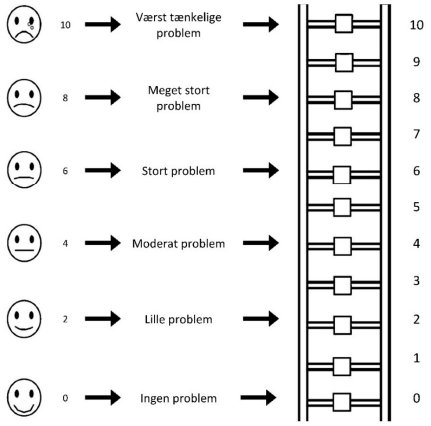
”Change in QoL in the measured domain”



8

The Punum Ladder

Sæt venligst et kryds på det 'trin i stigen' som bedst beskriver din overordnede livskvalitet (tilfredshed eller glæde ved livet) relateret til ... over den sidste uge.



Used longitudinally

Difference between t_1 and t_2 (i.e. t_2-t_1):

-4, -3 = Important improvement

+3, +4 = Important deterioration

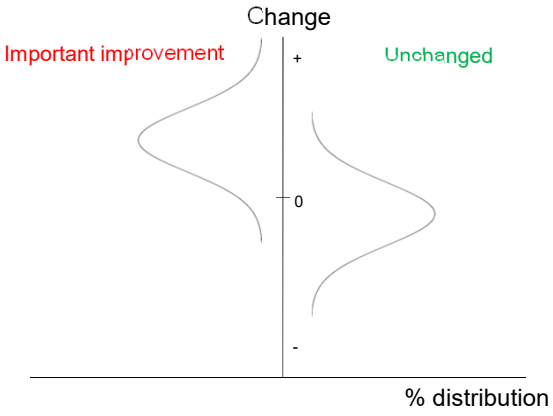
-2, -1, 0, +1, +2 = Unchanged

Fletcher et al. A prospective global measure, the Punum Ladder, provides more valid assessments of quality of life than a retrospective transition measure. J Clin Epidemiol. 2010;63(10):1123-31.

9

Step 3

3. Draw the curves



10

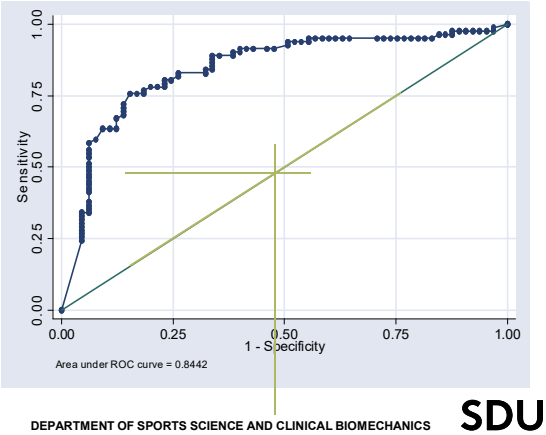
Step 4

4. Calc. MIC from ROC analysis

Point in the top left corner:

- Highest true positive rate
- Lowest false positive rate

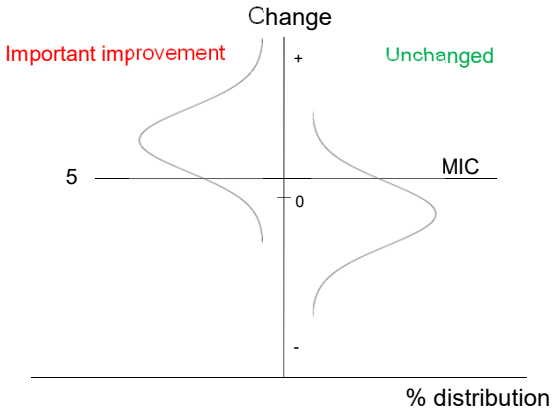
Minimal Important Change



11

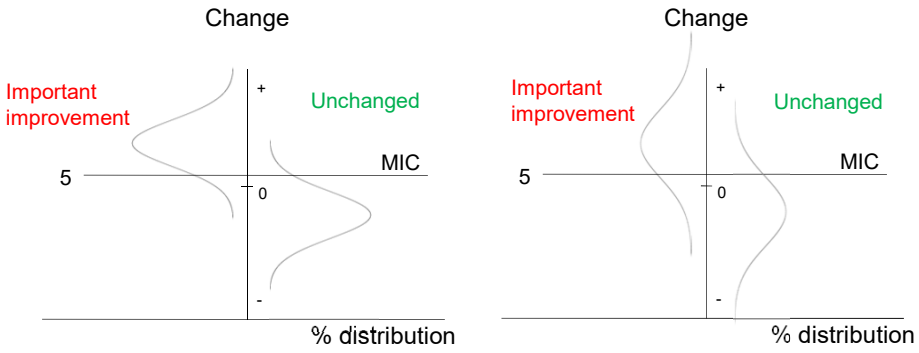
Step 5

5. Insert MIC in the graph



12

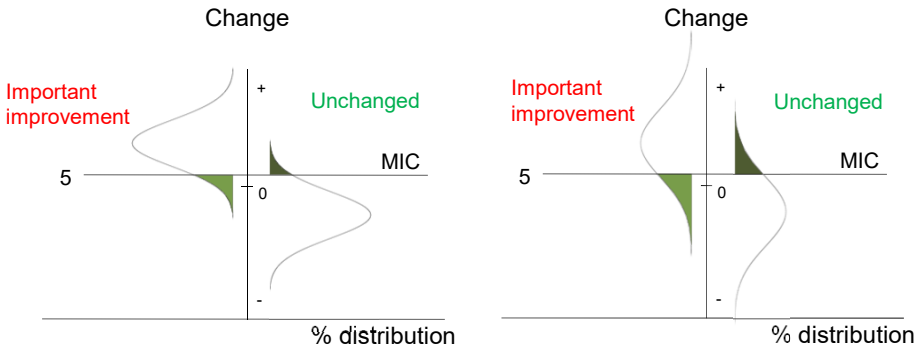
Interpretation of the graphs



Assess the hight of the curves:
Peaked curves → high correlation between anchor and score → High discrimination of the anchor

13

Interpretation of the graphs



- Assess misclassification of the curves
  - = false positive (1 – specificity) according to cut-point
  - = false negative (1 – sensitivity) according to cut-point

14

Limitation of MIC determined using ROC

1. Very sensitive to random sample variations (esp. small samples)
2. Difficult to obtain CI – requires non-parametric bootstrapping
3. Does not allow for accomodation of external factors (effect modifiers)
    - E.g. baseline score (except for % change when proportionate to baseline severity)

MIC based on a predictive modeling approach

A model which 'predicts' if a patient belongs to the 'improved' or 'not improved' group

Makes use of:

- A logistic regression model with an anchor as the dependent variable and instrument change score as independent variable
- The likelihood ratio

Accommodates the limitations of the ROC method

Terluin et al. J Clin Epidemiol. 2017; Terluin et al. J Clin Epidemiol. 2015

Regression model

Odds of belonging to the improved group given a certain change score X

Odds = $\frac{Probability_{improved}}{Probability_{not\ improved}} = \frac{Probability_{improved}}{1-Probability_{improved}}$

Intercept

Regression coefficient B of the change score X

$$\ln(odds_{post}) = C + B_x * X$$

Applying the likelihood ratio: $LR = \frac{\text{odds}_{post}}{\text{odds}_{pre}}$

LR = 1 gives a change score that separates patients with a relatively large probability of belonging to the improved group from patients with a relatively small probability of belonging to the improved group (relative to the pretest probability)

= MIC based on predictive modeling ($MIC_{predictive}$)

$$MIC_{pred} = X = (\ln(\text{odds}_{pre}) - C)/B_x$$

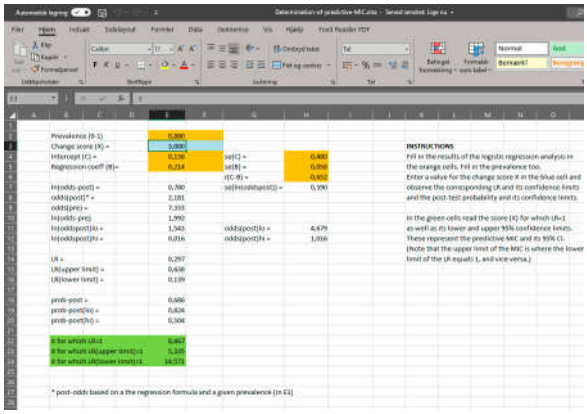
For a full explanation please see below articles

Terluin et al. J Clin Epidemiol. 2017; Terluin et al. J Clin Epidemiol. 2015

17

How to calculate MIC_{pred}

1. **Determine logistic regression model**
2. **Extract the following parameters from the model:**
   - C (intercept)
   - se_c (standard error of the intercept)
   - B_x (regression coefficient of change score)
   - se_{bx} (standard error of regression coefficient)
   - $r_{c\text{-}bx}$ (correlation between C and B_x)
3. **Use the provided Excel spreadsheet and determine MIC_{pred}**
4. **Apply correction formula if proportion of improved is ≠ 0.5**



18

Correction formula

MIC_{pred} is a biased estimate of gMIC if proportion of improved is > or < 0.5

$$\mathrm{MIC}_{Adjusted} = \mathrm{MIC}_{Pred} - (0.09 + 0.103 * \mathrm{Cor}) * SD_{change} * \log{-}\mathrm{odds}(imp)$$

Cor = point biserial correlation between instrument change score and anchor
SD_{change} = standard deviation of the instrument change score
log-odds(imp) = log-odds of improvement = natural logarithm of [proportion improved/(1-proprotion improved)]

Terluin et al. J Clin Epidemiol. 2017

Linking measurement error to minimal important change (MIC)

Terwee et al. J Clin Epidemiol. 2008

MIC is conceptually different from SDC

SDC is the smallest change in score that you **CAN** detect with the instrument, above measurement error

MIC is the smallest change in score that you **WANT** to detect with the instrument

In individual patients SDC < MIC to distinguish important change from measurement error

Often this is not the case

21

An example

Comparative responsiveness and minimal change for the Oxford Elbow Score following surgery

Jill Dawson · Helen Doll · Irene Boller · Ray Fitzpatrick · Christopher Little · Jonathan Rees · Andrew Carr

Measurement error (SDC)

MIC

		ICC	Scaled SEM	Scaled MDC 90%	Best cut-point
Elbow pain					
OES					
Oxford Elbow Score	Function	0.89	8.23	18.73	5.0
	Pain	0.98	3.58	8.25	12.5
	Social-Psychological	0.87	8.51	18.85	12.5
	DASH	0.96[a]	4.06	9.33	−5.0

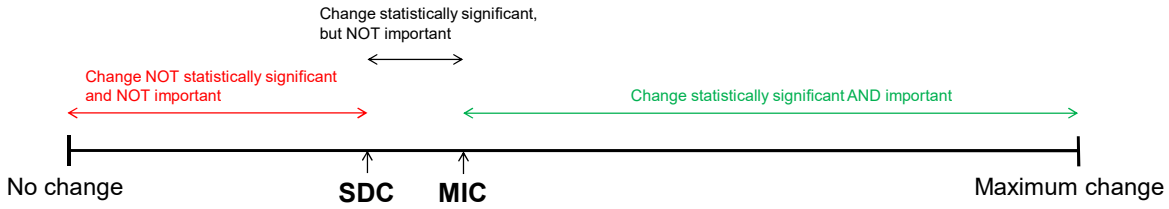
$OES_{function}$: SDC (19) is larger than MIC (5)
OES_{pain}: SDC (8) is smaller than MIC (12.5)

Therefore:
OES_{pain} can distinguish important change from measurement error whereas $OES_{function}$ can not.

22

SDC is smaller than MIC

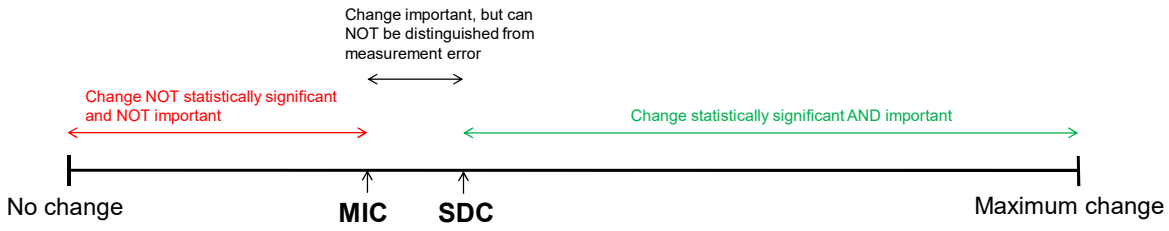
SDC and MIC are two reference points in the scale that can help interpret change scores



From example: OES_{pain} - SDC (8) is smaller than MIC (12.5)

23

SDC is larger than MIC



From example: $OES_{function}$ - SDC (19) is larger than MIC (5)

24

Taking type 1 error into account

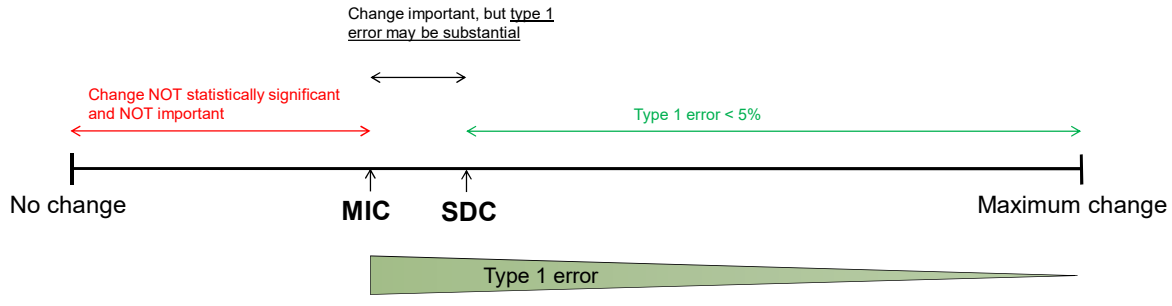
$$SDC_{agreement} = 1.96 \times \sqrt{2} \times SEM_{agreement}$$

- A patient who changed as much as the SDC has 'really' changed (statistically significant changed. However, there is a 5% probability (type I error) that in fact this patient has not changed
- Patients with change scores smaller than the SDC have a higher probability that they are in fact not changed (larger type 1 error)
- Thus if the SDC is larger than the MIC, there is a higher type 1 error if we call patients who changed as much as the MIC importantly improved

25

Taking type 1 error into account

SDC is larger than MIC



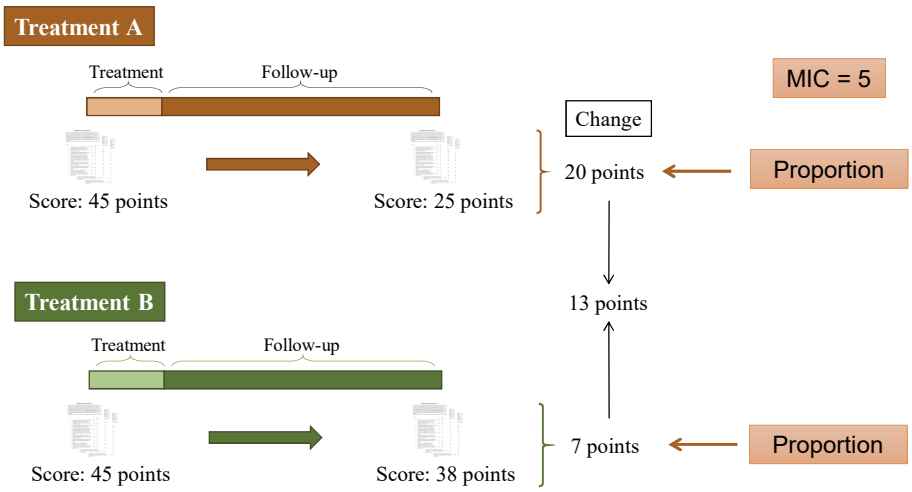
26

SDU

Linking minimal important change to numbers needed to treat (NNT)

27

MIC and RCT's



SDU

28

NNT – dichotomous outcome

	Treatment	
Control	*Better (0.48) x*	*Unchanged (0.52) y*
Better (0.28) a	0.13 (ax)	0.15 (ay)
Unchanged (0.72) b	0.35 (bx)	0.37 (by)

Better in the treatment group | Better in the control group

$$NNT = \frac{1}{bx - ay}$$

$$NNT = \frac{1}{0.35 - 0.15} = 5$$

Guyatt et al. (1998, 2002)

NNT – 3 outcomes

	Treatment		
Control	*Better (0.48) x*	*Unchanged (0.42) y*	*Worse (0.1) z*
Bedre (0.28) a	0.13 (ax)	0.12 (ay)	0.03 (az)
Unchanged (0.49) b	0.24 (bx)	0.21 (by)	0.05 (bz)
Worse (0.23) c	0.11 (cx)	0.10 (cy)	0.02 (cz)

Better in the treatment group | Better in the control group

$$NNT = \frac{1}{(bx + cx + cy) - (ay + az + bz)}$$

$$NNT = \frac{1}{(0.24 + 0.11 + 0.10) - (0.12 + 0.03 + 0.05)} = 4.2$$

Guyatt et al. (1998, 2002)

Summary

Interpretation

- Determination of MIC
- $MIC_{predictive}$ is the most precise metod to date
- Important when interpreting results from RCT's
- Can be used to calculate proportions and NNT

Thank you for listening