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Pros and Cons of Clinical Prediction Rules

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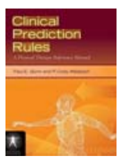
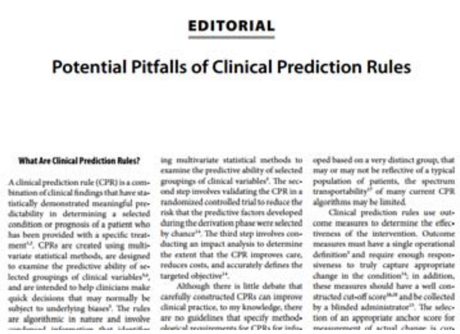
Clinical Prediction Rules

- Clinical prediction rules are algorithmic decision tool (that uses parsimonious clinical findings) designed to aid clinicians in determining a diagnosis, prognosis, or likely response to an intervention.



Glynn P, Weisbach C. Clinical Prediction Rules: A Physical Therapy Reference Manual. 2010.

JMMT 2008



EDITORIAL

Potential Pitfalls of Clinical Prediction Rules

What Are Clinical Prediction Rules?

A clinical prediction rule (CPR) is a combination of clinical findings that have statistically demonstrated meaningful predictability in determining a selected condition or prognosis of a patient who has been provided with a specific treatment[1,2]. CPRs are created using multivariate statistical methods, are designed to examine the predictive ability of selected groupings of clinical variables[3,4], and are intended to help clinicians make quick decisions that may normally be subject to underlying biases[5]. The rules are algorithmic in nature and involve ing multivariate statistical methods to examine the predictive ability of selected groupings of clinical variables[5]. The second step involves validating the CPR in a randomized controlled trial to reduce the risk that the predictive factors developed during the derivation phase were selected by chance[14]. The third step involves conducting an impact analysis to determine the extent that the CPR improves care, reduces costs, and accurately defines the targeted objective[14].

Although there is little debate that carefully constructed CPRs can improve clinical practice, to my knowledge, there are no guidelines that specify method- oped based on a very distinct group, that may or may not be reflective of a typical population of patients, the spectrum transportability[17] of many current CPR algorithms may be limited.

Clinical prediction rules use outcome measures to determine the effectiveness of the intervention. Outcome measures must have a single operational definition[3] and require enough responsiveness to truly capture appropriate change in the condition[14]; in addition, these measures should have a well constructed cut-off score[18,19] and be collected by a blinded administrator[21]. The selection of an appropriate anchor score for

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Editorial

Enthusiasm for prescriptive clinical prediction rules (eg, back pain and more): a quick word of caution

Robin Haskins,[1] Chad Cook[2]

INTRODUCTION
Prescriptive clinical prediction rules (CPRs) are commonly used in rehabilitation practice. Multiple systematic reviews have noted concern about the value of these rules and the violations of these tools. More recently, additional concerns have been outlined involving modelling errors, poor precision and fragility of the rules. This editorial outlines updated concerns about prescriptive clinical predication rules.

CPRs use baseline criteria called treat-

DIFFERENT COMPARISON TREATMENTS MAY LEAD TO DISSIMILAR OUTCOMES DURING VALIDATION
In CPR validation studies, the outcomes of a treatment are compared against a comparator (eg, another treatment, placebo, etc). Changing the comparator in a validation study may lead to different estimates of the CPR utility. This is because a CPR does not identify those who will get the (absolute) best outcomes following an intervention. Instead, it identifies those

creation. Typically, an outcome is dichotomised and the predictors are run against a cut point, typically a minimal clinically important change score that discriminates a basic level of success or lack of success within the outcome measure. Changing the cut point in a model consisting of the same sample of patients will lead to different predictors during modelling of a CPR.[3] For example, using five different Oswestry Disability Index threshold measures that have been advocated, authors[5] were able to demonstrate that they could create five distinct CPRs from the same sample of patients.

MOST CPRS HAVE MONSTROUSLY WIDE CIS IMPLYING A LACK OF PRECISION—ALWAYS READ THE FINE PRINT
A well-recognised limitation of CPR development studies is that they are

Pros of Clinical Prediction Rules

It is a Sophisticated method to Pattern Results

- Clinical reasoning and treatment decision making methods used by clinicians are highly complex and decisions are rarely based on a *single* parameter (Boyd, 2011; Kassirer, 2010).
- CPR's cluster multiple parameters

Boyd GW. Education debate: clinical diagnostic reasoning. Intern Med J 2011;41:573-6.
Kassirer JP. Teaching clinical reasoning: case-based and case coached. Acad Med 2010;85:1118-24.

Clinical Examples?

- SOB + Chest Pressure + Left Arm Pain =
- Elderly women + Fall + Inability to weight bear + ER deformity of the hip =
- LBP + Immobility + Fear + Inactivity =

Some Clinical prediction rules have clinical sensibility

- Pain during walking/standing, pain relief during sitting, bilateral leg pain, leg pain worse than back pain, older age = ?
- Unilateral OA, multi-plane hip ROM loss, weakness of the hip, duration of symptoms of < 1 year, reduced gait speed = ?

Cook et al. Physiother Research International. 2011
Wright et al. Phys Ther. 2011.

Clinical prediction rules have been used in clinical practice and have been effective

- Canadian C-Spine Rules
- Ottawa Ankle Rules
- Wells Criteria for DVT
- PERC score for reducing mortality

Gandara E, Wells PS. Clin Chest Med. 2010 Dec;31(4):629-39.

Good Clinical prediction rules typically outperform paternalistic care

- Paternalistic care
- Computerized decision typically beats the clinician, especially when the outcome is complex
- *Not you*? That's paternalistic thinking!

Ruland et al. J Am Med Inform Assoc. 2010 Jul-Aug;17(4):403-10.

J Occup Rehabil
DOI 10.1007/s10926-013-9430-4

Development of a Computer-Based Clinical Decision Support Tool for Selecting Appropriate Rehabilitation Interventions for Injured Workers

Douglas P. Gross · Jing Zhang · Ivan Steenstra · Susan Barnsley · Calvin Haws · Tyler Amell · Greg McIntosh · Juliette Cooper · Osmar Zaiane

- Baseline clinician classification accuracy was high (ROC = 0.86) for selecting programs that lead to successful return-to-work. Classification performance for machine learning techniques outperformed the clinician baseline classification (ROC = 0.94).

Gross et al. J Occup Rehabil. 2013 Mar 7. [Epub ahead of print]

Cons of Clinical Prediction Rules

Most CPRs are Derivation Only

- Development of the rule—establishing the independent and combined effect of explanatory variables (or clinical predictors), which can be symptoms, signs, or diagnostic tests
- Generated through some form of regression analysis

(Reminder) All derived prescriptive rules are a reflection of treatment effect

- May be prognostic
- May be reflective of a bogus outcome measure
- May be spurious (Left Hip replacement)

Kamper SJ, Maher CG, Hancock MJ, Koes BW, Croft PR, Hay E.
Best Pract Res Clin Rheumatol. 2010 Apr;24(2):181-91.

Sample is not Generalizable

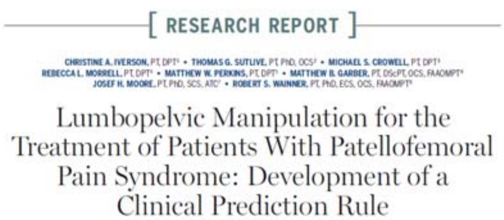
- Inclusion criteria is too specific (18 to 60 but mean in the low thirties, ODI >20)
- Population is dissimilar to clinical population routinely seen

More?

- Most use tools that have low inter-rater reliability
- Most do not report accuracy
- Most have very wide confidence intervals
- Many are “so-what” studies

Haskins R, Rivett DA, Osmotherly PG. Clinical prediction rules in the physiotherapy management of low back pain: A systematic review. Man Ther 2011 Jun 3. [Epub ahead of print]

Sample Size is too Small


[RESEARCH REPORT]

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Lumbopelvic Manipulation for the Treatment of Patients With Patellofemoral Pain Syndrome: Development of a Clinical Prediction Rule

- N=49…..~27 variables

Regression Modeling with Small Sample Sizes is not Robust

- Predictive Modeling (CPRs) are exceptionally Fragile with Prescriptive Studies

Many Lack Clinical Sensibility

- Left hip for total hip replacement?
- Bilateral involvement for benefit of manipulation of the cervical spine
- Low back pain leads to poorer prognosis for shoulder disorders

Getting Published does not mean it is valid

- There are 3 million papers published each year, *not all of them are good*
- The "peer review" system has problems
- Self-serving cliques of reviewers, who are more likely to review each others' grant proposals and publications favorably
- Some journals are fixated on these studies
- Journals need papers; they are more flexible

Lohsiriwat V, Lohsiriwat S. J Med Assoc Thai. 2007 Oct;90(10):2238-43.

The CPR Fails to Capture all Those who Benefit

- CPRs only capture a percentage of people who would benefit or would be diagnosed by the condition (tend to be specific, not sensitive)
- Thus, with a sensitivity of 63%, the Manip CPR captured 63 of the 100 subjects who benefitted from manipulation. 37% were missed by the CPR

CPRs are Used as clinical decision making models

- CPR's are NOT clinical decision making models
- CPR's represent a finding within the clinical decision making process
- CPRs are usually very specific and should be used in context with *other findings and near the end of the examination*

Prescriptive CPRs

- Prescriptive CPRs are more difficult to design and publish
- Are more difficult to find significance because the outcome measure is malleable (and different among studies)
- Frequently inappropriately derived (single arm studies), and the results are prognostic, versus prescriptive
- Bottom Line: **There is trouble here**.

Kent P, Hancock M, Petersen DH, Mjøsund HL. Clinimetrics corner: choosing appropriate study designs for particular questions about treatment subgroups. J Man Manip Ther. 2010 Sep;18(3):147-52.

The Outcome Measure is Malleable

- OMERACT-OARSI Criteria
- PASS (Patient Acceptable Symptom State)
- GRoC (change of 5)
- No Surgery (versus went to surgery)
- MCID's

- Results suggested that different "CPRs" were developed from same sample using different outcomes measures!!!

Wright A, et al. Predictors of response to physical therapy intervention in patients with primary hip osteoarthritis: a comparison of predictive modeling based on varying response criterion. IFOMPT Submission, 2012.

When Different Outcomes are Used

Model	Variables	Individual *P* value	Coefficient *T* value	Model F value	Model Adjusted R^2	Model *P* value
ODI Change Score	•Lower initial ODI	<0.01	9.7			
	•Met CPR	0.04	-2.1			
	•HEP compliance	0.07	-1.8			
	•Shorter duration sxs	0.01	-2.5			
	•Younger age	<0.01	-3.6	24.0	46.2	*P*<0.01
NPRS Change Score	•Lower initial NPRS	<0.01	14.9			
	•Lower initial ODI	0.01	-2.4			
	•Met CPR	<0.01	-3.5			
	•Shorter duration Sxs	<0.01	-3.9			
	•HEP compliance	0.06	-1.8			
	•Diagnosis	<0.01	-2.6	46.6	67	*P*<0.01
Total Visits	•Met CPR	<0.01	2.8	8.3	0.5	*P*<0.01
Rate of Recovery (0 to 100%)	•Lower initial NPRS	0.09	1.7			
	•Met CPR	0.01	-2.6			
	•No irritability	0.03	2.3			
	•Shorter duration Sxs	<0.01	-3.8	7.7	16.7	*P*<0.01

Physical Therapy
Journal of the American Physical Therapy Association and de Fysiotherapeut

PTJ

Which Prognostic Factors for Low Back Pain Are Generic Predictors of Outcome Across a Range of Recovery Domains?
Chad E. Cook, Kenneth E. Learman, Bryan J. O'Halloran, Christopher R. Showalter, Vincent J. Kabbaz, Adam P. Goode and Alexis A. Wright
PHYS THER. 2013; 93:32-40.
Originally published online August 9, 2012
doi: 10.2522/ptj.20120216

- Different rules for different outcomes measures.
- Hope we pick the right one!!!

Different minimally important clinical difference (MCID) scores lead to different clinical prediction rules for the Oswestry disability index for the same sample of patients

Julie Schwind, Kenneth Learman, Bryan O'Halloran, Christopher Showalter, Chad Cook

Walsh University, North Canton, OH, USA

Different CPRs for different MCID's. Hope we pick the right one!!

Schwind et al. J Man Manip Ther. 2013;21:71-78.

When Different MCID's are Used

Model	Variables	Individual P value	Odds Ratio (95% Confidence Interval)	Nagelkerke R^2	Model P value	% Correct
ODI 50% Change (N=149)	Met CPR Younger Age Diagnosis	0.005 0.003 0.014	2.916 (1.380-6.163) 1.041 (1.014-1.069) 0.385(0.180-0.824)	0.231	0.000	57.0%
ODI 30% Change (N=149)	Lower Baseline FABQ Shorter Symptom Duration Younger Age Diagnosis	0.044 0.012 0.001 0.012	1.039 (1.001-1.079) 1.008 (1.002-1.014) 1.054 (1.023-1.087) 0.337 (0.144-0.788)	0.214	0.000	70.5%
ODI 17pt. Change (N=116)[a]	Lower Baseline ODI Shorter Symptom Duration Diagnosis Met CPR	0.010 0.064 0.063 0.007	0.954 (0.921-0.989) 1.009 (0.999-1.020) 0.441 (0.186-1.046) 3.387 (1.402-8.182)	0.245	0.000	48.3%
ODI 10pt. Change (N=138)[b]	Lower Baseline ODI Younger Age Diagnosis	0.002 0.020 0.091	0.951 (0.921-0.981) 1.035 (1.005-1.065) 0.490 (0.215-1.120)	0.172	0.001	66.7%
ODI 5pt. Change (N=144)[c]	Lower Baseline ODI Younger Age Diagnosis	0.008 0.043 0.082	0.956 (0.924-0.989) 1.034 (1.001-1.068) 0.442 (0.176-1.110)	0.139	0.006	79.2%
ODI Final ≤ 20% (N=107)[d]	Lower Baseline ODI Younger Age Shorter Symptom Duration Diagnosis Met CPR	0.000 0.002 0.083 0.061 0.029	1.113 (1.055-1.175) 1.064 (1.023-1.105) 1.009 (0.999-1.018) 0.366 (0.128-1.047) 3.288 (1.130-9.566)	0.491	0.000	56.1%

Prescriptive Concerns

- *Some* (Beattie and Nelson 2006; Chaitow, 2010) *have expressed concern regarding the indiscriminate use of CPRs and the potential undermining of clinical reasoning during the care of a patient.*

We didn't find that

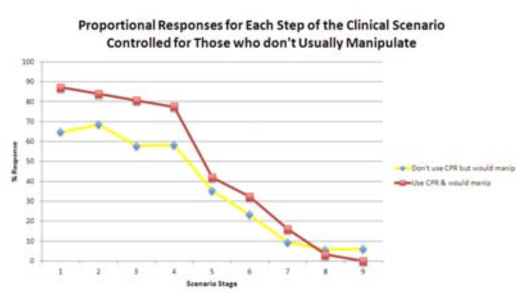

Figure 1. Trend Line Involving those who Manipulation and Either Use or Don't Use the Clinical Prediction Rule, for Each Scenario (in percentages of those who would manipulate).

Learman K, Showalter C, Cook C. Does the Use of a Prescriptive Clinical Prediction Rule Increase the Likelihood of Applying Inappropriate Treatments? Man Ther. 2012;

Decision Making

- There are no situations in which one single decision point answers the care questions for the patient
- Decisions have multiple trigger or "fork" points.
- 1 CPR meets only 1 fork point

- *"Statistical predictions do not form a clinical decision, but instead, **inform** a clinical decision"*

Swets JA, Dawes RM, Monahan J. Better decisions through science. Sci Am. 2000 Oct;283(4): 82-7.

Thank You