A Predictive Model to Determine the Effectiveness of Intervention on Low Back Pain

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A Predictive Model to Determine the Effectiveness of Intervention on Low Back Pain

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Background and Purpose

The Oswestry Disability Index (ODI) is a multidisciplinary, worldwide tool translated into 24 different languages, and is used in the evaluation of the effectiveness of interventions in the treatment of low back pain.[1] Most recently it was found to be reported in 46.5% of physical therapy studies related to chronic low back pain.[2] Compared to the Roland-Morris Disability Questionnaire, it demonstrates superior reliability and measurement error.[3] However, there is no consensus on a value for the minimal clinically important difference.[4] Some authors have advocated for a percent improvement such as a 50% or 30% change.[4] Others have suggested 17-, 10-, or 5-point changes.[4] Still others recommend any score below a 20% as indicating improvement.[4] Most recently, for patients with pregnancy-related low back pain the important change in the Oswestry was determined to be 3.1 points.[5]

Description

This report offers a different perspective to evaluate patients based upon a linear model of expected improvement. This model uses past performance of patients categorized by $ODI_{INITIAL}$ to predict the ODI_{FINAL} of patients with similar $ODI_{INITIAL}$ scores. This method combines the benefits of a percentage-based and a point-based MCID. At low $ODI_{INITIAL}$ scores, the clinically meaningful improvement is potentially smaller, while for a larger $ODI_{INITIAL}$ score, the clinically meaningful improvement may require a greater numerical change.

To create a predictive model based upon collected data of a convenience sample of 551 patients, the patients were categorized based upon their $ODI_{INITIAL}$. The categories with at least 15 members were retained to create the model (Figure 1), and the average ODI_{FINAL} was determined for each category (Table 1). This average was plotted against the respective $ODI_{INITIAL}$ to determine the line of best fit to create the predictive model (Figure 2).

The derived equation was $ODI_{PREDICTED\ FINAL} = 0.6538^{*}\ ODI_{INITIAL} + 0.0087$ with an R2 value of 0.81. The validity of this model was tested prospectively against a separate convenience sample of 630 patients. In this sample, the $ODI_{PREDICTED\ FINAL}$ was graphed against the ODI_{FINAL} with an R^2 of 0.42 (Figure 3). Additionally, for each patient, the ODI_{FINAL} was subtracted from $ODI_{PREDICTED\ FINAL}$ to determine the residuals. The average residual was 0.008 ± 0.148.

Summary of Use

The predictive model on the population level demonstrated moderate average predictive performance, while performance at the individual patient level may vary considerably as demonstrated by high standard deviation of the residuals. This model may be used at the population level to determine the effectiveness of interventions in a group or to compare the performance of separate locations within a larger entity. The $ODI_{PREDICTED\ FINAL}$ for each $ODI_{INITIAL}$ score can be seen in Table 2. Additional research is necessary to determine factors that would reduce the variance of the predictions and improve the applicability of the tool to individual patients. Factors including age, depression, and catastrophizing have been shown to be important factors in predictive modeling for improvement in women undergoing physical therapy for chronic neck pain.[6] These factors may prove to demonstrate importance in predictive modeling in patients with low back pain.

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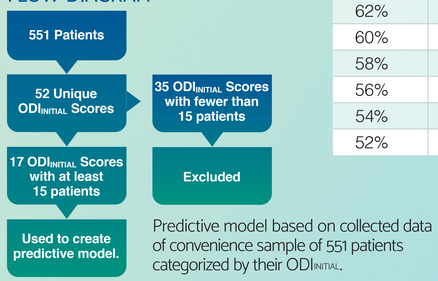
TABLE 1: AVERAGE IMPROVEMENT OF PATIENTS BASED UPON STARTING ODI SCORE

Number of Patients	$ODI_{INITIAL}$	Average ODI_{FINAL}
17	58%	41%
17	48%	28%
24	46%	35%
28	44%	29%
21	42%	27%
19	40%	20%
24	38%	25%
19	36%	23%
20	34%	24%
18	32%	30%
22	30%	27%
24	28%	18%
28	26%	16%
21	24%	15%
18	22%	12%
19	20%	15%
15	14%	10%

FIGURE 1: MODEL DEVELOPMENT FLOW DIAGRAM



Predictive model based on collected data of convenience sample of 551 patients categorized by their $ODI_{INITIAL}$.

TABLE 2: FINAL PREDICTIVE MODEL

$ODI_{INITIAL}$	Predicted ODI_{FINAL}	Predicted Δ	$ODI_{INITIAL}$	Predicted ODI_{FINAL}	Predicted Δ
100%	66.3%	33.8%	50%	33.6%	16.4%
98%	64.9%	33.1%	48%	32.3%	15.7%
96%	63.6%	32.4%	46%	30.9%	15.1%
94%	62.3%	31.7%	44%	29.6%	14.4%
92%	61.0%	31.0%	42%	28.3%	13.7%
90%	59.7%	30.3%	40%	27.0%	13.0%
88%	58.4%	29.6%	38%	25.7%	12.3%
86%	57.1%	28.9%	36%	24.4%	11.6%
84%	55.8%	28.2%	34%	23.1%	10.9%
82%	54.5%	27.5%	32%	21.8%	10.2%
80%	53.2%	26.8%	30%	20.5%	9.5%
78%	51.9%	26.1%	28%	19.2%	8.8%
76%	50.6%	25.4%	26%	17.9%	8.1%
74%	49.3%	24.7%	24%	16.6%	7.4%
72%	47.9%	24.1%	22%	15.3%	6.7%
70%	46.6%	23.4%	20%	13.9%	6.1%
68%	45.3%	22.7%	18%	12.6%	5.4%
66%	44.0%	22.0%	16%	11.3%	4.7%
64%	42.7%	21.3%	14%	10.0%	4.0%
62%	41.4%	20.6%	12%	8.7%	3.3%
60%	40.1%	19.9%	10%	7.4%	2.6%
58%	38.8%	19.2%	8%	6.1%	1.9%
56%	37.5%	18.5%	6%	4.8%	1.2%
54%	36.2%	17.8%	4%	3.5%	0.5%
52%	34.9%	17.1%	2%	2.2%	-0.2%

FIGURE 2: ODI PREDICTIVE MODEL

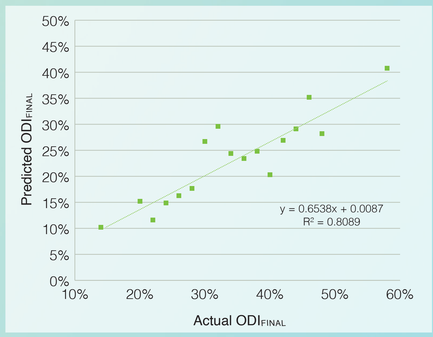
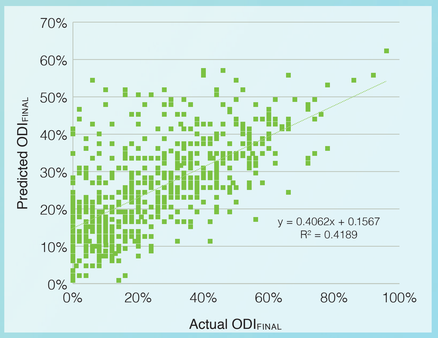


FIGURE 3: PREDICTED VERSUS ACTUAL ODI_{FINAL} (MODEL VERIFICATION)



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