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Risk Stratification of Patients with Elbow, Wrist, or Hand Orthopedic Impairments Seeking Outpatient Therapy Services

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Abstract

Rational, Aims and Objectives: Patients who experience Elbow, Wrist, and Hand (EWH) musculoskeletal pain are frequently seen in therapy. Our aim was to identify characteristics of patients associated with responding well to therapy with low visit utilization and those of patients who respond poorly despite high visit utilization.

Methods: This is a cross-sectional study. Information collected between January 2013 and December 2016 pertaining to a sample of 89,422 patients in 3,400 therapy clinics in the United States for EWH impairments was analyzed. Multinomial regression analysis was used to identify characteristics associated to a response. All statistical values were considered significant at the $p<.05$ level, 95% CI.

Results: Based on odds ratios, the immutable characteristic that was significant of low-risk of a poor outcome categorization was no history of surgery. Significant mutable characteristics included acuity of less than 22 days, no medication use, and payer source. When compared to private insurance, individuals at low-risk of a poor outcome were more likely to use private companies than worker's compensation/litigation/automotive. Conversely, they were more likely to have Medicare/Medicaid than to use private insurance. Based on odds ratios, immutable characteristics of those in the high-risk category were being female, having greater than three comorbidities, and history of surgery. Mutable characteristics of those in the high-risk category were acuity of 22 days or greater, exercising less than 3 times a week, medication use, and payer source. Individuals who were at high-risk of a poor outcome were more likely to use worker's compensation/litigation/ automotive compared to having private insurance.

Conclusion: Significant characteristics were found, which allow for the identification of patients who may benefit from rehabilitation services versus those whose care should include a multidisciplinary approach. Further research is needed on the prognosis of patients seeking rehabilitation for EWH diagnoses related to cost and cost/benefit ratios.

Introduction

Musculoskeletal disorders, including elbow, wrist, and hand impairments, are the second most common disability worldwide and place a large burden on the health care system [1,2]. Musculoskeletal disorders involving the upper extremity are among the leading work-related health concerns in the United States, accounting for up to 30% of all injuries requiring time away from work [3]. The cost of medical care and lost work time associated with lateral and medial epicondylitis is more than $22 billion annually in the United States [4]. Furthermore, carpal tunnel syndrome, with prevalence estimates ranging from 2.7% to 7.8%, is one of the costliest work-related upper extremity disorders, accounting for direct and indirect costs in excess of $2 billion per year in the United States [4]. A complex range of physical, psychosocial, and occupational factors interact and influence an individual's response and subsequent rehabilitation and recovery from musculoskeletal disorders [1]. When treating such disorders, some patients benefit from conservative treatment while others do not. In order to effectively manage musculoskeletal disorders and predict the course of progression, it is essential to identify factors

that help determine outcomes [5].

Research suggests that elbow, wrist, and hand pain is common; however, literature focusing on prognostic factors is underdeveloped [6]. Only a few studies have examined characteristics associated with treatment outcomes of patients with elbow, wrist, and hand impairments. Moreover, diverse diagnoses and etiologies have been studied, and results differ in regard to characteristics found to be significantly related to a better outcome [5,6]. If clinicians could identify patients that are at high risk of a low functional recovery despite more treatment sessions versus those patients who are at low risk of a poor functional recovery with fewer treatment sessions, this may assist with stratifying resources and save healthcare dollars [7]. The aim of this study was to identify characteristics (i.e. age, sex, comorbidities, acuity of symptoms, surgical history, exercise status, payer type, medication use, functional status at intake, total visits, and total episode duration) associated with high functional recovery. Based on previous studies examining these characteristics of patients with diverse impairments (i.e. shoulder[8], knee[7], and neck[9]), we hypothesize that we can predict poor outcomes despite a high number of visits, as well as, favorable outcomes despite a low number of visits in patients with elbow, wrist, and hand pain who seek therapy.

Methods

Participants

This study involves analysis of survey question data that was de-identified and provided by Focus on Therapeutic Outcomes, Inc. (FOTO) (Knoxville, TN, USA). FOTO is a web based patient assessment system that reports functional status measures. It is used nationwide in 3,400 clinics by 15,000 clinicians. Data were selected from the FOTO database if patients a) were 18 years old or older; b) were treated for an orthopedic impairment of the elbow, wrist, and/or hand; c) received outpatient therapy; and d) completed the Elbow, Wrist, and Hand Computer Adaptive Test (EWH CAT). Individuals with missing data were removed and not used in the model. Each patient at participating clinics was asked whether they would be willing to submit their data to FOTO. Data only from those who have consented is submitted to FOTO. The Institutional Review Board (IRB) at Augusta University granted a waiver of need for IRB approval for this study since all data was deidentified when obtained by the investigators.

Coding of Variables

The following continuous patient variables were categorized as follows: all variables were treated as categorical except Functional Status (FS) code, which were coded as continuous. Dichotomous variables included age (18 to 50 years of age and 51-89 years of age; dichotomized by dividing the age range of participants approximately in half); sex (male, female); comorbidities (0-2 conditions, 3 or more conditions), and medication use (no, yes). Onset of symptoms, defined as the number of days from when the patient first notices the condition being treated until the day of the therapy intake evaluation, was recoded as 1=acute (<22 days) and 2=chronic (22 days or greater) [7-9]. History of surgery was classified into two categories, 'none' (no) and '1 or greater' (yes). Exercise status prior to being seen by therapy was sorted into 1=less than 3 times a week and 2=at least 3 times a week. Numerous payer sources were represented. We grouped these payer sources analogous to the groupings used by Rodeghero and colleagues [8] in a similar study examining shoulder diagnoses. Automotive, litigation, and workers compensation were recoded as (1), Medicare and Medicaid as (2), and all others as (3). Percentage of change in function was computed by change of the baseline functional score on the EWH CAT and discharge functional score on the EWH CAT and multiplying by 100. This resulted in a favorable or unfavorable percentage change.

Risk Stratification Profile

To represent groups at each end of the sample's distribution, we created a variable for prognosis. This unique variable represented groups that present with a low risk of a poor functional outcome with minimal total visits and a group that presents with a high risk of a poor overall functional outcome even though they received multiple therapy visits. To create the variable of prognosis, we compared the percentage of change in functional status and total visits. Based on previous studies, the group at the high risk of a poor outcome was the highest 30% for total visits and the bottom 30% for functional outcome [7-9]. The group that represented a low risk of poor outcome was the highest 30% for functional outcome and the bottom 30% of total visits. All other individuals who were neither at increased nor decreased risk of poor outcomes were placed in the medium risk group (Figure 1).

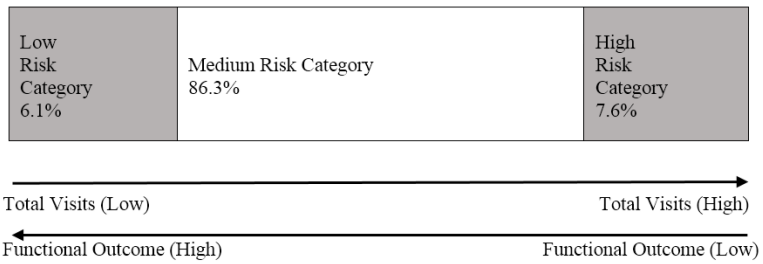

Figure 1: Risk Stratification of Low, Medium, and High-Risk Categories.

Data Analyses

All analyses were performed using the Statistical Package for the Social Sciences, Version 22.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics are reported for each of the variables (functional status, age, sex, comorbidities, acuity of symptoms, surgical history, exercise status, payer type, medication use, functional status at intake, and total visits). Univariate multinomial regression analyses were used to predict the probability of category membership for a dependent variable with two or greater classifications, based on multiple independent variables. Maximum likelihood estimation was used to estimate model parameters. Multicollinearity was evaluated by analyzing correlation matrixes, Variance Inflation Factors (VIFs), and tolerance values for each independent variable. A correlational finding of R>0.7 between independent variables was used to assess the potential of multicollinearity [10]. Findings in the univariate analyses that yielded p values of 0.20 and under were included in a hierarchical multivariate multinomial predictive model. For predictive factors to be considered significant a p-value of .05 or less was required.

Results

Descriptive representation of the complete sample, as well as the sample categorized according to risk is outlined in (Table 1).

Variable		Total sample/ frequency (%)	High risk of poor outcome (n=6820)	Moderate Risk (77183)	Low risk of poor outcome (5419)
Age	18-50 years	34438 (38.5%)	2699 (39.6%)	29679 (38.5%)	2060 (38.0%)
	51-89 years	54984 (61.5%)	4121 (60.4%)	47504 (61.5%)	3359 (62.0%)
Sex	Male	34592 (38.7%)	2745 (40.2%)	29665 (38.4%)	2182 (40.3%)
	Female	54830 (61.3%)	4075 (59.8%)	47518 (61.6%)	3237 (59.7%)
Co-morbidities	0-2	44278 (49.5%)	3233 (47.4%)	38328 (49.7%)	2717 (50.1%)
	3 or more	45144 (50.5%)	3587 (52.6%)	38855 (50.3%)	2702 (49.9%)
Acuity	<22 days	13998 (15.7%)	56 (.8%)	11176 (14.5%)	2766 (51.0%)
	>22 days	75424 (84.3%)	6764 (99.2%)	66007 (85.5%)	2653 (49.0%)
Surgical history	None	52003 (58.2%)	4256 (62.4%)	44563 (57.7%)	3184 (58.8%)
	One or more	37419 (41.8%)	2564 (37.6%)	32620 (42.3%)	2235 (41.2%)
Exercise status	< 3 times/week	52060 (58.2%)	3859 (56.6%)	44999 (58.3%)	3202 (59.1%)
	> 3 times/week	37362 (41.8%)	2961 (43.4%)	32184 (41.7%)	2217 (40.9%)
Payer source*	Group A	13072 (14.6%)	1138 (16.7%)	11218 (14.5%)	716 (13.2%)
	Group B	25285 (28.3%)	1815 (26.6%)	21809 (28.3%)	1661 (30.7%)
	Group C	51065 (57.1%)	3867 (56.7%)	44156 (57.2%)	3042 (56.1%)
Medication use	No	58506 (65.4%)	4187 (61.4%)	50557 (65.5%)	3762 (69.4%)
	Yes	30916 (34.6%)	2633 (38.6%)	26626 (34.5%)	1657 (30.6%)
		mean (SD)	mean (SD)	mean (SD)	mean (SD)
FSCH		20.84 (14.20)	4.40 (2.27)	21.27 (13.68)	35.38 (9.94)
Total visits		11.82 (9.11)	17.48 (8.95)	11.88 (9.04)	3.87 (1.05)

*Abbreviations: FSCH = Functional Status Change Score

Table 1: Descriptive Variables.

Chi-square analyses indicated a significant ($p < .001$) difference between the frequencies in each risk category (i.e. low, moderate, and high) for each of the variables except exercise (i.e. age, sex, co-morbidities, acuity, surgical history, payer source, and medication). One-way ANOVAs indicated a significant difference ($p < .001$) between risk categories in the means for change in functional status and total number of visits. Post-hoc Tukey tests revealed that differences existed between all risk groups for both change in functional status and total visits. Our initial univariate multinomial regression modeling is shown in (Table 2).

Variable	Level	Odds Ratio, 95%CI (L, U)	p-value
Age	High risk	1.03 (.98, 1.09)	0.21
	Low risk	1.10 (.95, 1.08)	0.69
Sex	High risk	.88 (.83, .92)	<.01
	Low risk	.99 (.94, 1.05)	0.8
Co-morbidities	High risk	.89 (.85, .94)	<.01
	Low risk	1.01 (.95, 1.07)	0.79
Acuity	High risk	0.05 (.04, .06)	<.01
	Low risk	6.22 (5.87, 6.59)	<.01
Surgical history	High risk	1.33 (1.26, 1.40)	<.01
	Low risk	.87 (.82, .93)	<.01
Exercise status	High risk	.94 (.89, .96)	<.01
	Low risk	1.02 (.96, 1.08)	0.62
Payer source*	High risk	a; 1.18 (1.11, 1.27)	<.01
		b; .97 (.91, 1.02)	0.23
	Low risk	a; .88 (.81, .96)	<.01
		b; 1.07 (1.00, 1.14)	0.04
Medication use	High risk	.85 (.80, .89)	<.01
	Low risk	1.10 (1.03, 1.17)	<.01
*Group A = Auto Insurance, Litigation, or Workman's Comp, Group B = Medicare and Medicaid (Comparison Group = All Others).			

Table 2: Initial Model Including All Variables Hypothesized to Influence Outcomes.

Statistically significant immutable characteristics of high risk of a poor outcome (moderate risk as referent variable) were being female (OR = 0.88; 95% CI 0.83-0.92), having a history of surgery (OR = 1.33; 95% CI 1.26-1.40), and having greater than three comorbidities (OR = .89; 95% CI 0.85-0.94). Statistically significant mutable characteristics of high risk of a poor outcome (moderate risk as referent variable) were payer source of auto insurance, litigation, or workman's compensation compared to private companies (OR = 1.18; 95% CI 1.11- 1.27), acuity equal to or greater than 22 days (OR = 0.05; 95% CI 0.04-0.06), exercising less than 3 times a week (OR = 0.94; 95% CI 0.89-0.96), and medication use (OR = 0.85; 95% CI 0.80-0.89).

Age was not a significant characteristic of high risk of a poor outcome (OR = 1.03; 95% CI 0.98-1.09) or low risk of a poor outcome (OR = 1.10; 95% CI 0.95-1.08) and, therefore, was removed from the model. There was one immutable characteristic of low risk of a poor outcome, no prior surgeries (OR = 0.87; 95% CI 0.82-0.93). Mutable characteristics of low risk of a poor outcome included payer source of auto insurance, litigation, or workman's compensation compared to private companies (OR = .88; 95% CI 0.81-0.96) and Medicaid/Medicare compared to private companies (OR = 1.07; 95% CI 1.00- 1.14). acuity less than 22 days (OR = 6.22; 95% CI 5.87-6.59) and no medication use (OR = 1.10; 95% CI 1.03-1.17). Each independent variable presented acceptable tolerance levels and Variance Inflation Factor (VIF), as well as, low item to total-item correlations (<0.20). For our final hierarchical univariate multinomial logistic regression model (Table 3), all variables were significant for either high risk of a poor outcome or low risk of a poor outcome.

Variable	Level	Odds Ratio, 95%CI (L, U)	p-value
Gender	High risk	.88 (.83, .92)	<.01
	Low risk	.99 (.94, 1.05)	0.77
Co-morbidities	High risk	.89 (.85, .94)	<.01
	Low risk	1.01 (.96, 1.07)	0.7
Acuity	High risk	0.05 (.04, .06)	<.01
	Low risk	6.22 (5.87, 6.59)	<.01
Surgical history	High risk	1.33 (1.26, 1.40)	<.01
	Low risk	.87 (.82, .93)	<.01
Exercise status	High risk	.94 (.89, .96)	0.01
	Low risk	1.02 (.96, 1.08)	0.63
Payer source*	High risk	a; 1.18 (1.11, 1.27)	<.01
		b; .97 (.91, 1.02)	0.22
	Low risk	a; .88 (.81, .96)	0.01
		b; 1.07 (1.00, 1.14)	0.04
Medication use	High risk	.85 (.80, .89)	<.01
	Low risk	1.10 (1.03, 1.17)	0.01
*Group A = Auto Insurance, Litigation, or Workman's Comp, Group B = Medicare and Medicaid (Comparison Group = All Others).			

Table 3: Final Model Including Only Variables Significant in Initial Model.

As with the initial model, the referent variable was moderate risk. Immutable variables associated with high risk of poor outcome category were being female (OR = 0.88; 95% CI 0.83-0.92) and having a history of surgery (OR = 1.33; 95% CI 1.26-1.40). Several mutable variables were associated with a high risk of poor outcome category. These included having greater than 3 comorbidities (OR = .89; 95% CI 0.85-0.94), payer source of auto insurance, litigation, or workman's compensation compared to private companies (OR = 1.18; 95% CI 1.11-1.27), acuity of 22 days or greater (OR = 0.05; 95% CI 0.04-0.06), exercising less than 3 times a week (OR = 0.94; 95% CI 0.89-0.96), and no medication use (OR = 0.85; 95% CI 0.80-0.89). The only immutable variable significantly associated with the low risk of a poor outcome category was no history of surgery (OR = 0.87; 95% CI 0.82-0.93). Three mutable variables were significantly associated with the low risk of a poor outcome category including acuity less than 22 days (OR = 6.22; 95% CI 5.87- 6.59), no medication use (OR = 1.10; 95% CI 1.03-1.17), and payer source of auto insurance, litigation, or workman's compensation compared to private companies (OR = .88; 95% CI 0.81-0.96), and Medicaid/Medicare compared to private companies (OR = 1.07; 95% CI 1.00-1.14).

Discussion

Clinics and therapists routinely struggle with determining the appropriate treatment strategy for patients because forecasting patient outcomes based on time and intervention is such an enormous task. The main objective of our study was to use data from clinics around the nation to investigate characteristics of patients with elbow, wrist, and hand diagnoses who were more or less likely to have favorable outcomes. Three immutable variables were found to be associated with the likelihood of a poorer outcome: being female, having greater than three comorbidities, and having a history of surgery. Four mutable variables were found to be associated with the likelihood of a poorer outcome: acuity of 22 days or greater, exercising less than 3 times a week, no medication use, and payer source. When compared to private insurance, individuals at low risk of a poor outcome were more likely to use private companies than worker's compensation, litigation, or automotive. Conversely, they were more likely to have Medicare or Medicaid than to use private insurance. One immutable variable was significantly associated with a greater probability of a good outcome: no history of surgery. Three mutable variables were significantly associated with a greater probability of a good outcome: no medication use, shorter acuity, and payer source. Individuals who were at high risk of a poor outcome, were more likely to use worker's compensation, litigation, or automotive compared to having private insurance.

These findings for the high risk of a poor outcome are similar to that of other musculoskeletal disorders [7-9]. Having greater

than 3 comorbidities was also identified as a prognostic indicator of a high risk of a poor outcome with patients with shoulder pain [8]. Rodeghero and colleagues [8] also report patients with more acute symptoms, no surgical history, and Medicare/Medicaid as a payer source were more likely to have high outcomes with low visits. In contrast, studies with patients with knee pain [7], back pain [11], and neck pain [9] have reported that individuals with Medicare and Medicaid are less likely to be exceptional responders to therapy intervention. Consistent with findings of Salamh and colleagues [7] using patients who experience knee pain, our results indicate that females are at high risk of a poor outcome. One might conjecture that the reason being female is associated with poorer outcomes is because females in the sample were generally older. Moreover, having a surgical history and more comorbidities generally indicates worse health status which might have contributed to poorer outcomes. Likewise, greater acuity and getting less exercise per week could be related to poorer health status in general making recovery more challenging. There could possibly be an age relationship as well with payer source, as those with poorer outcomes tended to fall in the Medicare group. Conversely, variables associated with a better outcome, such as no medication use and shorter acuity, could be indicative of better health overall making recovery less difficult.

Our analyses generated significant models that might assist in the identification of patients who would require less rehabilitation (those with low risk of a poor outcome) and others who may respond poorly to extensive rehabilitation (those with high risk of a poor outcome). The group of patients with low risk of a poor outcome achieved significant change in functional status with very few visits. Conversely, the patients categorized as high risk of a poor outcome had limited improvement in functional status despite numerous visits. Identifying the variables predictive of outcomes could be of benefit in guiding the plan of care for individuals at high risk of a poor outcome. This does not in any way suggest that treatment should not be given to individuals with potential for a bad prognosis. However, it does suggest that a treatment approach different from traditional rehabilitation may be required (e.g. longer duration with goals for maintenance) and/or additional consults (e.g. for psychiatry/counseling or medication management) may be necessary. Due to the increased use of rehabilitation services throughout the nation, efficient and effective medical care is crucial. As previously noted, musculoskeletal disorders, including elbow, wrist, and hand impairments, are the second most common disability worldwide [1,2] and the leading work-related health concerns in the United States [3]. The growing financial demand placed on the healthcare system by these disorders should stimulate increased efforts to make care efficient.

There are several limitations related to our study. Previous studies have noted the inherent limitations associated with the use of retrospective data from a commercial database [12,13]. Our sample was comprised of patients extracted from a commercial database. The use of such a database presents threats to both internal and external validity. With such a large database, unknown extraneous variables (e.g. history, maturation, process of test administration, etc.) may compete with the independent variables selected to help explain the outcome of the study causing threats to internal validity. Unidentified selection bias may contribute to threats to external validity (i.e. generalizability to locations outside of the United States). Only patients with complete data on variables of interest were used for the analyses. There was no attempt to determine the amount of missing data for each group. Imputation of missing data for the independent variables was not conducted as this could potentially add further threats to validity. Moreover, information on the type of care received by the patients was not available in the dataset and, thus, could not be considered in interpretation of the findings. Although our sample was large, these findings are preliminary and, thus, should not be generalized to all patients with elbow, wrist, and hand diagnoses. Additionally, we did not control for multiple comparisons, although most of our results were highly significant (less than $p = .01$). Even though we considered many potential characteristics including those found significant in past studies [7-9], there are other potentially influential variables for which we did not have data on, such as socioeconomic status and type of treatment.

Future studies would be beneficial to validate the findings from our study. Knowledge of additional variables, such as types of treatment provided, would further help guide therapists in determining ideal treatment strategies for diverse individuals with elbow, wrist, and hand diagnoses. Supplementary knowledge about clinic types and locations might also add to predictive ability. Economic analysis of implementation of knowledge gained through this and other similar studies might elucidate any gains in efficiency of treatment.

Conclusions

This study explores predictive factors for patients receiving rehabilitation therapy for elbow, wrist, and hand diagnoses. Our analyses determined significant prognostic variables, allowing us to create models that could identify patients who were likely to benefit more from rehabilitation services versus those whose care might should include a more multidisciplinary approach. We are not suggesting withholding treatment from these individuals. However, knowledge of predictive factors early in treatment could be beneficial in prioritizing rehabilitation needs and acknowledging when consults for other services are needed. Further research is needed on the prognosis of patients seeking rehabilitation for elbow, wrist, and hand diagnoses related to cost, timing of care and cost/benefit ratios. Our study seems to indicate that while some patients require minimal resources and achieve excellent outcomes; others improve very little despite utilizing extensive resources.

References

1. Walker-Bone K, Linaker CH (2016) Prediction of prognosis for people off sick with upper extremity musculoskeletal disorders. Occup Environ Med 73: 805-806.

2. Southerst D, Yu H, Randhawa K, Côté P, D'Angelo K, et al. (2015) The effectiveness of manual therapy for the management of musculoskeletal disorders of the upper and lower extremities: a systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration. Chiropr Man Therap 23: 30.

3. Gardner BT, Dale AM, VanDillen L, Franzblau A, Evanoff BA (2008) Predictors of upper extremity symptoms and functional impairment among workers employed for 6 months in a new job. Am J Ind Med 51: 932-940.

4. Menta R, Randhawa K, Cote P, Wong JJ, Yu H, et al. (2015) The effectiveness of exercise for the management of musculoskeletal disorders and injuries of the elbow, forearm, wrist, and hand: a systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) collaboration. J Manipulative Physiol Ther 38: 507-520.

5. Armijo-Olivo S, Woodhouse LJ, Steenstra IA, Gross DP (2016) Predictive value of the DASH tool for predicting return to work of injured workers with musculoskeletal disorders of the upper extremity. Occup Environ Med 73: 807-815.

6. Whibley D, Martin KR, Lovell K, Jones GT (2015) A systematic review of prognostic factors for distal upper limb pain. Br J Pain 9: 241-255.

7. Salamh PA, Reiman M, Cleland J, Mintken P, Rodeghero J, et al. (2017) Risk Stratification for 4,837 Individuals with Knee Pain Who Receive Physical Therapy Treatment. Musculoskeletal Care 15: 122-130.

8. Rodeghero JR, Cleland JA, Mintken PE, Cook CE (2017) Risk stratification of patients with shoulder pain seen in physical therapy practice. J Eval Clin Pract 23: 257-263.

9. Cook C, Rodeghero J, Cleland J, Mintken P (2015) A Preliminary Risk Stratification Model for Individuals with Neck Pain. Musculoskeletal Care 2015.

10. Shen J, Gao S (2008) A Solution to Separation and Multicollinearity in Multiple Logistic Regression. J Data Sci 6: 515-531.

11. Rodeghero JR, Cook CE, Cleland JA, Mintken PE (2015) Risk stratification of patients with low back pain seen in physical therapy practice. Man Ther 20: 855-860.

12. Resnik L, Hart DL (2003) Using clinical outcomes to identify expert physical therapists. Phys Ther 83: 990-1002.

13. Childs JD, Harman JS, Rodeghero JR, Horn M, George SZ (2014) Implications of practice setting on clinical outcomes and efficiency of care in the delivery of physical therapy services. J Orthop Sports Phys Ther 44: 955-963.