**Title**: Predicting Patient-Reported Outcomes Following Upper Extremity Fractures Using Artificial Neural Networks

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**Research Question/Hypothesis**: Predicting patient reported outcomes (PROs) has been difficult due to its complexity and association with mental, social, and physical health. Newer statistical models, such as neural networks (NNs), may be able to help. The objectives of this study are to evaluate and compare the predictive capabilities of NNs to predict patient reported outcomes after upper extremity fracture.

**Methodolog**y: 744 patients with an isolated upper extremity fracture were enrolled. Demographic and injury-specific information were collected. PROs were collected at baseline and 9 months post-injury. Our dataset was splint into a training and test dataset. Using our training set, we created both a linear regression and a neural network to predict the PROs at 9 months. The linear regression and neural network were then tested for accuracy on our test dataset. Accuracy was defined as predicting 9-month PROs within the minimal clinical important difference (MCID) of their actual 9m PRO result.

**Primary Results**: The best neural network model outperformed the best linear regression model for predicting qDash (85% vs. 77%), PROMIS PF (74% vs. 70%), PROMIS PI (72% vs. 69%), and Pain (86% vs. 77%). When using a smaller dataset to prevent overfitting (NN-29), the neural network also outperformed the linear regression for predicting qDash (83% vs. 73%), PROMIS PF (68% vs. 765%), PROMIS PI (66% vs. 62%), and Pain (78% vs. 65%). The explanatory variables most important in predicting 9m PROs in the NN include symptoms of depression, anxiety, kinesiophobia, and the presence of social support.

**Implications/Conclusion**: Supervised machine-learning, specifically neural networks, can provide better performance than linear models at predicting PROs. This improvement increases with an increased number of variables and data, but further research is needed to balance model performance with overfitting.