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Live Machine Learning Centered Architecture System to optimize Lumbar Stenosis Surgical Outcome

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Introduction

Patients with neurogenic claudication who undergo lumbar laminectomy have varying degree of success.1–4 Furthermore, it is difficult to identify patients who would benefit from surgery versus who would not. Our goal in this study is to optimize patient selection, create a parallel artificial-intelligence system which works seamlessly with the surgeon that helps with patient selection, and provide value-based care.

Methods

We retrospectively reviewed 4121 cases of patients who underwent lumbar laminectomy at the Cleveland clinic hospitals between the years 2007-2017. Of those, we identified ~200-3300 patients who had enough data for the outcomes. Our objectives includes EuroQol five-dimensional (EQ-5D), back pain visual analogue scale (VAS), right leg VAS, left leg VAS, patient health questionnaire (PHQ9), pain disability questionnaire (PDQ), readmission, venous thromboembolism, costs, and reimbursements. We used Python for analysis relying on Tensorflow, Keras, XGBoost, and Scikit-Learn for machine-learning model creation.5

Results

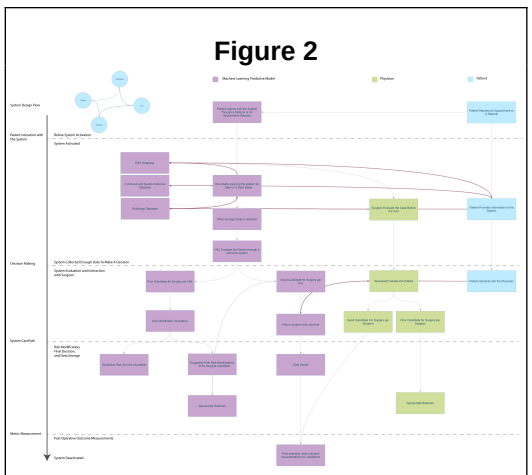
Our baseline success rate, defined by EQ-5D minimal clinically important difference (MCID), was 50%. Utilizing our system, we predict an improvement of at least to 75% in patient selection accuracy (50% improvement). This was validated retrospectively. We have analyzed >120 variables which included demographics, comorbidities, medications, laboratory, quality, and functional data. The data showed unaware associations between variables, such as laboratory values and indirect-compliance measures, and outcomes. This provided us an opportunity to provide adjustment goals to the modifiable variables for the predicted failed surgical patients to become surgical candidates. We also described how we embedded the system into electronic medical records and daily provider routine (Figures 1&2). We created a simulated cost saving analysis based on the above care path vs. the current system.

Figure 1

Conclusions

With the rising healthcare expenditures, it is necessary to center patient management on value-based medicine. This system can offer us a 50% improvement in patient selection accuracy and lower costs; hence, value-based medicine.

Figure 2



System Architecture

Learning Objectives

By the conclusion of this session, participants should be able to:

1.Understand how this system can improve the success rate by 50% for surgical management of patients with neurogenic claudication caused by lumbar stenosis utilizing machine learning and big data.

2.Understand how to design a framework to embed complex machine learning system into electronic medical record.

3.Understand how this system can provide value-based care by both optimizing outcome and minimizing costs.

References

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