

Novel Use of Natural Language Processing (NLP) to Predict Restraint/Seclusion in an Adolescent Psychiatric Inpatient Unit

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Introduction

Considering the vast amount of unstructured data in nursing documentation from the electronic health record systems, natural language processing (NLP) was used to find an association with any antecedent factors and any contiguous sequences of two and three words/events related to aggressive behaviors for predicting restraint/seclusion in an adolescent psychiatric inpatient unit.

Objectives

The purposes of this study were (1) to apply an NLP method to develop a model for predicting the need for the use of restraint/seclusion based on analysis of EHR free text psychiatric nursing notes, and (2) to understand predictors of aggressive behavior within a context, by identifying any contiguous sequences of two and three words/events related to aggressive behaviors that might be potential antecedent factors, using NLP.

Methods

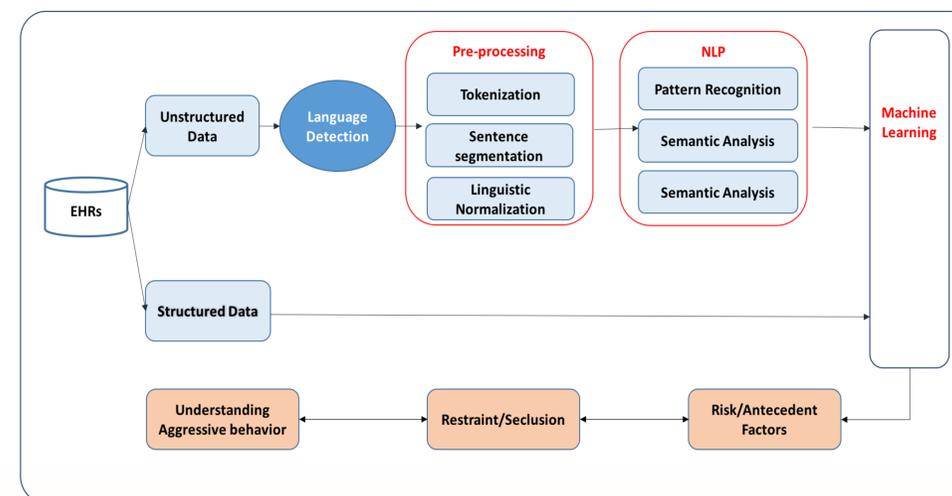
Research Design

An explorative and predictive quantitative design using data mining of secondary was conducted using patients' electronic health records collected between January 2017 and August 2017.

Sample and setting

The data (453 adolescent psychiatric inpatients,

80,000 clinical notes) was retrieved from the records of the Bradley hospital. Additionally, all paper-based data was entered manually for data analysis.



Data analysis

All the data were analyzed using two software R 3.4.2. (R Core Team, 2013) for data mining, and Python 3.6.3. (Python, 2017) for NLP, following Fayyad's KDD process (Fayyad, 1995). NLP was used to extract unstructured data, using Python 3.4.2 (with Python natural language toolkit, ver. NLTK 3.) in order work with human language data.

All identified patients' risk factors from NLP were analyzed by three different algorithms: two *shallow* models, including logistic regression and decision tree, and one *deep* model including Recurrent Neural Networks (RNN) with Long Short-Term Memory (LSTM). The NLP based algorithm identified all potential antecedent factors and contiguous sequences of two and three words/events in the free text.

Results

Among 453 adolescent psychiatric inpatients (age 12-18, average 14 years old, average length of stay: 18 days).

The NLP based algorithm identified all potential antecedent factors and contiguous sequences of two and three words/events in the free text. It included individual factors (diagnosis, length of stay), behaviors in response to stimuli/environment, affect refer to an emotional response (feelings/mood), cognitive process, and treatment factors (e.g., PRN medications).

Conclusions

NLP could extract meaningful data from narrative unstructured nursing text to predict/identify the need for the use of restraint/seclusion in psychiatric adolescent inpatient units. Multiple factors potentially could be used to provide early intervention for reducing the use of restraint/seclusion. In addition, we could better understand the aggressive behavior as a highly dynamic contextual problem.

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