Developing computational models for predicting diagnoses of depression

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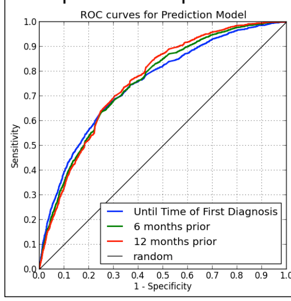
Introduction

- About 14% of individuals worldwide have major depression. Despite its prevalence, diagnosing depression is a challenge: primary care physicians identify ~50% of depression cases.[1]
- Mining of electronic health records (EHR) data has proven useful in predicting diagnoses of other disorders.
- We present a model that predicts the risk of a patient becoming diagnosed with depression, using both structured and unstructured EHR data.

Preliminary Results

time of first diagnosis: our estimate of when the doctor first diagnoses the patient with depression; calculated as the first point in the patient's medical history at which both a depression ICD-9 code and drug term have occurred



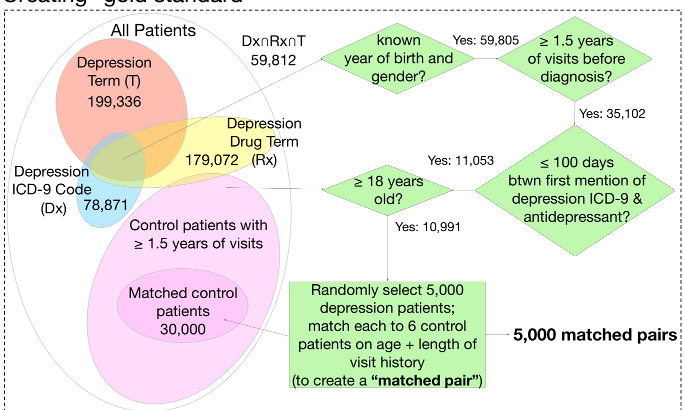
Top features, based on information gain, when training the model:

Cutoff Point	AUC
time of first diagnosis	0.754
6-month cutoff	0.756
12-month cutoff	0.762

Feature	Description	IG	% Dep	% Control
ICD-9 V72.3	Gynecological examination	0.009	15.1%	4.7%
Drug ingredient	Acellular pertussis vaccine	0.008	8.9%	22.5%
Drug ingredient	Tetanus toxoid vaccine	0.008	9.6%	23.3%
ICD-9 V06.1	Vaccination of DTP-DTaP	0.006	6.9%	17.9%
ICD-9 V04.8	Need for prophylactic vaccination	0.005	10.0%	3.3%
ICD-9 780.79	Other malaise and fatigue	0.005	20.7%	10.7%
Drug ingredient	Vitamin d	0.005	9.3%	19.4%
ICD-9 300.00	Anxiety state, unspecified	0.004	11.5%	4.7%
ICD-9 780.52	Insomnia, unspecified	0.004	13.0%	5.9%

Methods and Workflow

Creating "gold standard"



Gather features

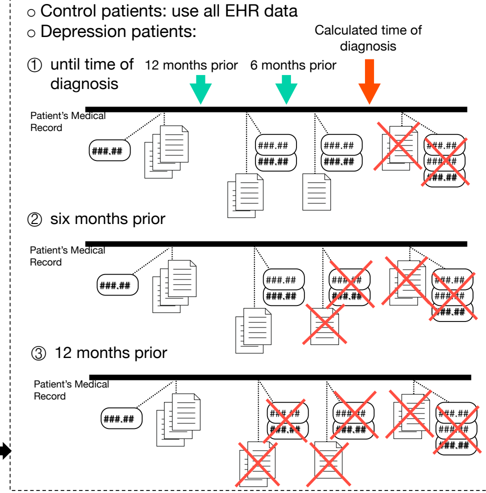
- gender
- billing codes (ICD-9 codes)
- visit history density (# visits/year)
- disease and drug ingredient note terms

Training phase

Naive Bayes model, with feature selection based on information gain

Test phase

- Three separate test sets:
  - Control patients: use all EHR data
  - Depression patients:



Conclusions

- Our results suggest the use of EHR can improve the timely diagnosis of depression. Even a year before being diagnosed, patients show patterns in their medical history that our model can detect.
- The accuracy of our predictive model rivals that of primary care physicians, who have a sensitivity of 50% and a specificity of 80% in diagnosing depression.[1]
- Our model has the potential to:
  1. serve as a screening tool in identifying high-risk patients for closer examination, and
  2. enable better cohort building for clinical studies on depression.

Ongoing Work

- Evaluate the portability of the model by testing it on an external dataset of approximately 17,000 patients, treated for depression and scored using the Patient Health Questionnaire (PHQ-9).
- Develop models to predict severity of depression and treatment outcomes, using this new dataset. Early results are promising; we achieve an average AUC of 0.73 for predicting severity and 0.70 for predicting treatment effectiveness.

Literature Cited

1. Mitchell AJ, Vaze A, Rao S. Clinical diagnosis of depression in primary care: a meta-analysis. Lancet 2009;374:609-19.

Acknowledgements

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