Dementia is one of the major causes of mortality and morbidity in older people worldwide. However, dementia and mild cognitive impairment (MCI) are under-diagnosed. Early detection of cognitive decline may be critical to the efforts to stop dementia progression, including Alzheimer’s disease (AD) and AD-related dementias (ADRD). even though Early and accurate diagnosis of such diseases can be addressed by proposing new tools and models that can help early diagnosis of these patients. The new methods would predict patients who are likely to have early symptoms of cognitive impairment related diseases and need referral to specialists for further assessment as well as recommending the necessary specialty diagnostic procedures for these patients.

The problem of predicting the patients with cognitive impairment using machine learning and deep learning models has previously been studied in previous research [1,2]. Because diseases characterized by cognitive impairment require a clinical diagnosis of impairment, there are limited data available as inputs for predictive machine learning models. In our prior work, we developed a model to predict the procedures (primarily lab and imaging tests) that would be ordered by an endocrinologist based on a patient’s. We have previously studied the problem of predicting the necessary diagnostic procedures for the patients referred to Endocrine specialty [3]. Another related work by this team is ClinicNet which uses a feed-forward neural network to automate inpatient electronic order checklists [4]. In this proposed project, we seek to implement this approach for improving dementia diagnosis. Our specific aims are:

**Aim 1:** **To** **analyze** **electronic health records patterns and develop a prediction model to order specialty referrals for cognitive impairment (Mild Cognitive Impairment and Alzheimer’s Disease).**

*Hypothesis:* Machine learning models can identify possible diagnosis of cognitive impairment diseases and recommend referrals to the specialists more accurately than standard models and diagnosis-based checklists.

*Approach:* The proposed prediction model is based on learning low-dimensional deep representation (deep embedding learning) of the lab orders, diagnosis codes.

**Aim2: To develop an automated and explainable model that predicts the necessary diagnostic procedures for cognitive impairment (Mild Cognitive Impairment and Alzheimer’s Disease).**

*Hypothesis:* Recommender system approach can model the necessary diagnostic tests more accurately than the current clinical guidelines used by primary care providers.

*Approach:* The proposed recommendation model uses the joint KNN graph of the patients and providers with low-dimensional representation of the medical record elements as input.

The proposed approach would result in early detection of MCI and ADdisease by recommending appropriate diagnostic tests but also would result in fewer in-person visits for each patient and provides *timely specialty access to more patients*. This strategy will likely improve the quality of care, reduce burden on caregivers of dementia patients, lead to efficient use of the healthcare resources and allow patients and families to be better prepared for managing life with an extremely challenging disease like dementia.

**References:**

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