

Iowa Initiative for Artificial Intelligence

Final Report

Project title:	Identification of a signature predictive of fall injury and 30-day readmission for a fall in an elderly patient cohort
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Date:	June 27, 2021
Were specific aims fulfilled:	YES
Readiness for extramural proposal?	Not quite, we will need to first publish these results. We foresee at least two publications with this project (Aim 1a and Aim 2). On average, from preparation to acceptance, it takes 6 months to one year minimum to get a publication out. While we do have a fair amount of publications on falls, readmission for falls, and frailty, we do not have any publication using AI, getting those out first will be required if we decide to pursue the AI /ML route.
If yes ... Planned submission date	We do not have a specific deadline.
Funding agency	We plan to target NIH, ACL, and AHRQ funding, maybe PCORI
Grant mechanism	Not defined yet, to be discussed as we may need additional pilot funds to get to extramural funding.
If no ... Why not? What went wrong?	Nothing went wrong per se, it was just a very challenging project, to be able to apply for funding we need to publish in this field. The goal would be to develop an AP (based on Aim 1a findings) that could be used by physicians (mostly PCPs) to assess risk of fall in their patients and refer them to fall prevention programs. To be successful we need: 1- publish the data 2- engage physicians (PCPs) and fall prevention program providers (our injury prevention specialist can really help with the last part and through her collaboration with the Fall coalition we may even be able to connect PCPs and fall prevention providers) 3- Engage stakeholders (insurance company covering Medicaid) 4- Demonstrate feasibility

Brief summary of accomplished results:

The project consists of two aims:

- Aim 1a: In patients ≥ 65 years old, examine the patient elements to determine the signature for patients presenting with a fall injury.
- Aim 1b: In patients ≥ 65 years old, what is the mortality risk of patients presenting with a fall injury.
- Aim 2: Among patients ≥ 65 years old who requires readmission within 30 days, examine the patient to determine the signature for patients who require readmission for fall-related injuries versus those who require readmission for another non-fall traumatic injuries.

We achieved the initial aims outlined in the proposal, specifically:

We conducted two study phases for each aim. In the first phase, we evaluated performance of various machine learning models including random forest, linear regression, XGBoost, decision tree, and naïve bayes in their successful prediction of cases. The two best performing models were used in the second study phase to find signature elements of those patients.

For Aim 1a, based on the random forest model, age, frailty, sex, and number of chronic conditions are the most important variables for predicting if a patient is presented for a fall injury or not. Using the logistic regression model, we found out that older people, women, and those with a history of alcohol abuse, and depression are more likely to present with a for a fall injury.

For Aim 1b, based on the random forest model, severity of illness, history of renal failure, fluid and electrolyte disorders, and frailty are the most important variables for predicting a mortality risk level of a patient admitted for a fall injury. Based on the logistic regression model, we found out that patients admitted for a fall injury with high severity of illness and a history of renal failure, metastatic cancer, and solid tumor without metastasis are at a higher risk of death.

The initial goal of Aim 2 was to examine to determine the signature for patients who require readmission within 30 days following initial hospitalization for fall related injuries. However, due to the scarceness of the positive class (approximately 7% of total samples), i.e., those who experienced a readmission within 30 days following initial hospitalization, we decided to narrow down the scope of the study aim as stated above. Based on the random forest model, four of the most predictive variables to predict whether a readmitted patient will present for a fall-related injury are median household income for patient's ZIP Code, frailty, age, and hospital bed size. Using the logistic regression model, older patients those with a history of alcohol abuse, AIDS, and past fall-related injuries are more likely to require readmission within 30 days following initial hospitalization for fall related injuries.

Limitations:

The NRD is mainly composed of categorical variables with very few continuous/ordinal variables. However, this would be true with a majority of healthcare related databases. Since the goal of this pilot project was to find a signature that predicts fall risk and readmission post fall, approaches could be taken to improve our modeling.

1- To improve our modeling, we could propose to utilize other Generative AI models adapted to the NRD dataset.

2- To better define our predictive signature using the current model, we would need to:

a- Using the results of the random forest model, do risk stratification of the five top predictors for Aim 1a and Aim 2 outcomes.

b- Look at subgroup analysis to identify characteristics leading to higher propensity of falls (Aim 1a) or readmission within 30 days (Aim 2).

Ideas/aims for future extramural project:

The results obtained during this pilot grant are not directly generalizable and, as is, pertain to the NRD dataset used here. These results with the addition of the proposed work above (risk stratification and subgroup analysis) could be utilized to develop a funding proposal with two aims:

Aim 1. To determine whether our model could be applied to another database such as the National Trauma Data Bank (NTDB) which also contain ordinal variables such as vitals on admission.

Aim 2. To develop a prospective, observational multicenter study collecting information on all trauma patients 65 and older admitted to the trauma service and following them up to 30 days post discharge.

Such approach would allow us to

1- Refine our model using the NTDB

2- The prospective study would allow us to assess feasibility and utility of this tool for providers.

Publications resulting from project:

Public health papers for each Aim 1 and Aim 2:

We foresee at least two publications from a healthcare standpoint:

- Publication #1 : Using Machine learning to identify predictors of admission for fall in older adults
- Publication # 2: Identifying predictors of 30-day readmission for older adults initially admitted for a fall: an analysis of the national readmission database using AI