

Prediction of Future Health Care Utilization Through Note-Extracted Psychosocial Factors

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Abstract

Psychosocial factors are known to have adverse health impacts, but are rarely measured; using natural language processing, we extracted factors that identified a higher risk segment of older adults with multimorbidity. We find these extracted features are highly predictive of future emergency department visits and hospitalizations, although only marginal prediction gains are seen compared to other models without these factors. Combining these extraction techniques with other measures of social determinants may help catalyze population health efforts to mitigate these health impacts.

Keywords:

multimorbidity, psychosocial, biopsychosocial

Introduction

Over one-fourth of Americans, and three-fourths of those over 65, live with multiple chronic conditions, or multimorbidity (≥ 2 multiple chronic conditions).^{1,2} However, physical conditions alone are often not the major contributor to poor health outcomes; rather, social and behavioral factors contribute significantly to worsened quality of life, increased disability, exacerbations of illness, and premature mortality.³ These psychosocial complexities (e.g., social isolation, food insecurity, financial insecurity) are also social determinants of health and contribute powerfully to racial/ethnic disparities in outcomes among older adults. There is growing awareness of the importance of understanding and managing the most impactful constructs – which we term **psychosocial vital signs** – in conjunction with biomedical problems that patients develop.^{4,5}

From the biopsychosocial perspective,⁶ uncovering the interconnections, overlap, and causal pathways between biomedical, psychological, and social processes remain important gaps. And as of yet, these represent untapped opportunities to identify best practices that address the specific and unique barriers to effective chronic disease management for older adults with complex care needs.⁷ Key psychosocial vital signs for this cohort – those related to illness complications and increased disability – include social isolation, chronic stress, financial insecurity, housing, and food insecurity, among others

Despite their potential utility, assessment of these concepts are infrequent in clinical care, despite their relationship to health. Validated questionnaires have shown significant promise in assessing social and psychological constructs, but their implementation outside of research settings is limited. The National Academy of Medicine assessed behavioral and social constructs that were feasible, available, and scientifically acceptable, and several groups have worked to try to implement collec-

tion of these constructs in care settings.⁸ Initial results, however, are promising but limited⁹⁻¹¹; entering and reviewing structured data has a significant cost in the time of medical professionals, and recent work we have done has shown that adding structured entry forms rarely leads to consistent capture. Without reliable data, we can't help overburdened clinical teams know when it is crucial to collect or obtain this information and when to include it in care decisions. We and others find these vital signs embedded in narrative notes. However, Greenwald et al. demonstrated that one could mine the narrative notes using simple keywords and consistently find a number of social and behavioral issues in inpatients;¹² and Feller reports success in detecting these concepts in HIV patients.¹³

Our objective was to extract these psychosocial factors: social isolation, chronic stress, housing insecurity, and financial insecurity, from chart notes using natural language processing and predict their impact on healthcare utilization for patients with multimorbidity.

Methods

We completed a cohort study to understand the benefit of extracting 4 key psychosocial variables on prediction of future utilization within a health system. All data were extracted from the Electronic Health Record (EHR) as either structured (from discrete clinical fields) or unstructured (from narrative notes) data.

Patients were part of the initial population if they were 65 and older and seen during 2016-2017 at a large academic health system; the health system sees 350,000 unique patients per year with roughly 1 million visits to > 90 ambulatory clinics, 2 hospitals, and 2 Emergency Departments.

Results

In all, 74,340 patients were eligible; the majority were female (54%) and white (89%). Those with psychosocial factors were older, had higher baseline utilization, and more chronic illnesses. The four psychosocial factors all independently predicted future utilization (ORs=1.27 to 2.77, c-statistics=0.63-.77). Accounting for demographics, specific conditions, and previous utilization, 3 of 4 of the extracted factors remained predictive (ORs= 1.13 to 1.86) for future utilization; compared to models with no psychosocial factors, they had small increases in discrimination but were highly predictive for key segments of the multimorbid populations.

Conclusions

Psychosocial factors extracted from natural language processing were predictive of hospitalization, ED visits, and deaths, even when accounting for comorbidities, age, sex, race, and previous utilization. The net benefit to the models, however, was small compared to those without psychosocial factors, with only 1-3 / 100 additional patients accurately predicted. Individual models with predefined populations showed strong prediction for unadjusted models predicting onset of conditions associated with the psychosocial factors (stress – atherosclerotic cardiovascular disease; social isolation – depression), but mixed results in focused models adjusted for other factors. For instance, patients with diabetes had better prediction models for hospitalizations from homelessness and financial insecurity, but not for depression and social isolation.

In all, psychosocial concepts extracted from natural language processing of clinical notes were highly predictive of future utilization and death, even without other factors about the patients. These approaches may help us understand the vast disparities in health care and improve our systems of health and health care.

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