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Application of Machine Learning Techniques to Examine Social Service Needs Among Hispanic Family Caregivers of Persons with Dementia

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Abstract. We applied machine learning algorithms to examine the relationship between demographics and outcomes of the social work services used by Hispanic family caregivers of persons with dementia recruited for a clinical trial in New York City. The social work service needs were largely concentrated on instrumental support to gain access to the healthcare system rather than other concrete services (e.g., housing or food programs) or to address psychological needs among the caregivers with relatively higher income. A finding from the machine learning approach was that among those who receive medical-related social work services, frequent users (≥ 10 times) with high family friend support(>4) were more likely than frequent users without such support to have their issues resolved (Accuracy: 81.9%, AUC: 0.82, F-measure: 0.86 by J48). Even though half of the participants received social work services multiple times, the needs of the caregivers remained unmet unless they sought social work services frequently (more than ten times).

Keywords. dementia caregiving, disparities, machine learning, aging, social work

1. Introduction

Hispanics are the fastest expanding population in the U.S. 21.5 million Hispanic elderly, comprising over one-fourth of the U.S. older population (28.6%) are expected to live longer, with a life expectancy of 84 years by 2060. Yet Hispanics develop Alzheimer's

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or dementia symptoms 4-7 years earlier and 1.5 times more frequently than other ethnic groups [1]. Hispanic family caregivers of persons with dementia often do not receive an adequate amount of instrumental social support for various reasons, including cultural and language barriers, limited services and lack of awareness. Despite 55 years of federal endeavors to improve living standards for the poor, minority group members still suffer from higher poverty rates (21.2% Black, 18.3% Hispanics of any race) than non-Hispanic White people (8.7%) [1]. Consequently, Hispanic family caregivers of dementia patients face challenges stemming from socio-economic structural inequality and disparities. Social Welfare Programs and Services intend to fulfill various human needs, including access to affordable healthcare, food, shelter, justice and mental health. Nevertheless, little is known about the types and intensity of Social Welfare Programs and Services needs among Hispanic family dementia caregivers living in New York City, where one in three people is Hispanic [1, 2]. Therefore, this study aims to apply a machine learning approach to build a model for predicting the likelihood of resolution of issues [defined by social workers] among Hispanic family caregivers of persons with dementia who received aid and assistance from Social Welfare Programs and Services [2].

2. Methods

The local Institutional Review Board approved this study [2]. We applied machine learning techniques to the data set, a survey of 221 family caregivers from a clinical trial from 2014 to 2016 [2], to build a model for predicting the resolution of issues among Hispanic family caregivers of persons with dementia who received social work services [1-3]. In this clinical trial comparing two behavioral interventions for family caregivers, all participants were offered referral to a case manager to address social services. We used R 3.5.1 and Weka 3.8 to conduct analytics. The outcome variable was dichotomized as yes or no self-rated by an experienced social worker ["case resolved" corresponded to a "Yes"]. Missing values on education (5.6%) and family and friend support (5.6%) were imputed with the mean. First, a caregiving and behavior expert selected 58 of 4,248 demographic, behavioral and physio-psycho-social variables as relevant to the outcome of social work service based on the literature [1-3]. During feature selection, we applied a machine learning algorithm in Weka 3.8, which evaluates the importance of attributes by the predictive ability of each feature, considering redundancy between them. We applied correlation, entropy, and learner-based techniques to check algorithm dependency, and selected 13 final variables based on the criteria of clinical meaningfulness from an understanding of the literature on social work service and caregiving [2,3]. Correlation-based attribute evaluator of Weka 3.8 with default configuration (T-1.798E308-N-1) was chosen. Next, we iteratively applied C4.5 algorithms to build the models for predicting the resolution of issues among Hispanic family caregivers of persons with dementia who received social work services [4]. For cross-validation (10-fold), the dataset was randomly divided into training and evaluating datasets for the model validation before applying the algorithms. We chose the final models based on the model accuracy, interpretability, clinical meaningfulness, and the area under the receiver operating characteristic curve (AUC). Lastly, caregiving behavioral science experts interpreted the models according to clinical meaningfulness.

3. Results

From May 12, 2014, to June 28, 2016, 72 of 221 clinical trial enrollees accepted a social work service referral (Figure 1). All participants were Hispanic. The average age of the caregivers was 57.3 ± 11.7 , and the average age of the care-receiver was 78.1 ± 9.8 . Most of the participants were female (83.3%) with an annual income of fewer than 40,000 USD (81.2%). There were no significant differences in demographics and health status between the two (the social work service accept group and the non-accept group) The participants used 19 different types of Social Welfare Programs and Services a total of 1702 times (Figure 1). More than half of the participants (N=41, 56.9%) requested the social work services ten or more times within six months. Unmet needs were reported by 37.5% of participants even after receiving social work services. A finding from the machine learning approach was that the participants who received medical care-related social services (≤ 2 times) were more likely to have their issues resolved after receiving services. Among those who received medical-related services, frequent users (≥ 10 times) with high family friend support (>4) were more likely to have their issues resolved, while frequent users without family friend support were less likely (Accuracy: 81.9%, AUC: 0.82, F-measure: 0.86 by J48) (Figure 2).

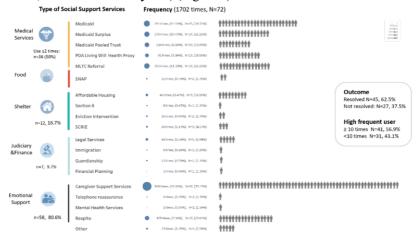


Figure 1. Social work service needs among Hispanic family caregivers of a person with dementia

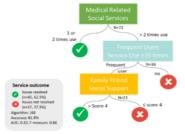


Figure 2. Relation of social work service usage and resolutions of the issues among Hispanic family caregivers of a person with dementia

4. Discussion and Conclusion

We examined the relationships between demographic, psycho-social, and behavioral factors and the resolution of issues among Hispanic family caregivers of persons with dementia who received social work services from Social Welfare Programs and Service in New York City. The participants who used medical-related social work services once or twice (n=36) evidenced a favorable outcome, with their issues resolved, after using theses services (n=33, 94.3%). On the contrary, the rest of the participants who used medical-related social work services more than twice for six months were less likely to have their issues resolved unless they used the social work service ten or more times with support of family/friend. In other words, this finding reflects that social work services used less than ten times were not enough to accomplish favorable service outcomes for the Hispanic family dementia caregivers who did not have adequate family/friends support [1-3]. In considering this finding, subsequence studies to search for costeffective ways of supplying a sufficient number of social work services (i.e., ten or more times of in-person service use) may benefit the rapidly growing Hispanic family dementia caregiving population [1-3]. For example, technology-based communicational interventions for the family caregivers of dementia patients may provide cost-effective and practical options to overcome cost barriers of the space and time necessary for inperson social work service implementation [1, 2]. Consistent with findings from other studies [1-3], this study confirms the importance of family/friend support in the problem solving attributed to the dementia caregiving tasks among Hispanic family dementia caregivers. The sample in this study is limited to the participants who enrolled in an existing clinical trial in New York City [2]. While the small sample size, short study duration and limited measures and analyses of the efficacy of the social services limit the generalizability of the study findings, they do provide a close look at the relationship between the need for medically related social services, other social services and support from family and friends. In conclusion, we investigated the use behavior of social work services in Social Welfare Programs and Services among the Hispanic family dementia caregivers participating in a clinical trial in New York City [2]. The social work service needs were largely concentrated on instrumental support to gain access to the healthcare system rather than other concrete or psychological needs among the caregivers with relatively higher income. Even though half of the participants received social work services multiple times, the needs of the caregivers remained unmet unless they sought social work services at least ten times augmented by family/friends support.

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