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Development of an index to predict risk of nursing home placement for home and community-based waiver participants

Sandra L. Spoelstra, Charles W. Given

ABSTRACT

Aims: Nursing home placement (NHP) is costly, and the majority of older adults prefer to remain living in the community. The purpose of this research was to examine NHP among a cohort of participants in a home and community-based waiver program during 2002 to 2007 to develop a risk model for predicting who may transition to a nursing home. Methods: This longitudinal study was conducted on data from the minimum data set-home for care linked with medicaid claim files and death certificates. The sample included 6525 participants who had two assessments and survived through 2007 or had NHP. A risk index was developed to identify participants who had NHP. Results: Using the risk index, the probability of NHP was 50%, with sensitivity of 0.4 and specificity of 0.9. Forty percent of participants who had NHP were correctly identified. Conclusion: This NHP risk index may inform waiver agency personnel as to when participants may need more intense interventions, and consequently provide additional care to delay or prevent NHP when possible.

Keywords: Community-based elderly, Dually eligible, Medicare and medicaid, Nursing home placement, Risk index, Waiver program

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INTRODUCTION

With adults aged 65 and older currently comprising 15% of the population and growing exponentially, concern is mounting as to how to care for this growing demographic group [1]. It will be particularly important to find ways to deliver high-quality care tailored to the needs of these individuals in order to allow them to remain living in the community. These concerns are particularly relevant to State Medicaid programs serving the elderly who are medically indigent and therefore dually-eligible for coverage under both Medicare and Medicaid. Nursing home placement (NHP) is costly, averaging $70,000 a year. In the US, nursing home expenditures were $138.4 billion in 2012, and projected to exceed $200 billion annual by 2020 [2]. Beyond escalating financial concerns, there is a constellation of potentially negative outcomes associated with nursing home admission for older adults, such as infections, falls, and cognitive decline [3]. The majority of older adults prefer to remain living at home in the community, but are forced to transfer to a nursing home because community-based supports are inadequate to meet their needs [4]. This necessitates more research to identify factors that predict NHP in these dually-eligible Medicare and Medicaid beneficiaries, and for the development of strategies to support and retain the

elderly in their homes and communities. In response to these issues, the goal of this research was to develop and test a risk index that would predict the likelihood of participants from a Home and Community Based Waiver (HCBW) transferring to a nursing home from data in the Minimum Data Set for Home Care (MDS-HC [version 2]) assessment. A NHP risk index could be used to alert care providers to those participants who are more likely to transfer to a nursing home, and to consider adjusting services to enable these individuals to remain in their home. Given that the majority of HCBW participants are a frail, vulnerable elderly population, the needs of some individuals may be better served through NHP. However, with this risk index, HCBWs would be able to identify those clients at higher risk of NHP, and modify care to prevent NHP. This should allow such decisions to be made in an evidence-based manner, considering the needs of participants and the abilities of their caregivers.

Predictors of Nursing Home Placement

Several factors consistently emerge as predictors of NHP in research literature. A meta-analysis of 77 longitudinal studies examining community-dwelling elderly found that advanced age, female gender, education level, low socioeconomic status, unavailability of informal care, living alone, no spouse, three or more dependencies in activities of daily living (ADLs), cognitive impairment, and prior NHP were significant predictors of transfer to a nursing home [3]. These predictors are confirmed by several well-executed systematic reviews [5–8]. In addition, other predictors include: low net worth, a greater number of prescription medications, low levels of social support, greater need for assistance with instrumental activities of daily living (IADLs), and dementia [5, 6, 9]. In other work, prior hospitalization and certain chronic conditions, such as diabetes and hypertension, have been associated with increased NHP [10]. Rates of placement also differ by racial groups, with whites more likely to be placed in a nursing home regardless of other factors [5]. Thus, predictors of NHP appear to be consistent across studies.

Delaying Nursing Home Placement in Dually-Eligible Home Waiver Participants

Two studies set in health maintenance organizations focused on delaying transfers to nursing homes among frail, low-income, dually-eligible older adults found that use of community-based services delayed NHP [11, 12]. When these studies were completed and community-based services were discontinued, the rate of NHP increased by 40%. Predictors of risk of NHP among the dually-eligible may be particularly important, as these individuals tend to be in worse health, use a disproportionate amount of resources, and are substantially more likely to be institutionalized [13]. Cost-saving strategies in programs for dually-eligible older adults may be attainable if interventions can be identified to target those factors that place these individuals at increased risk for NHP [14].

The Present Study

Candidate variables were identified from literature review and applied to the MDS-HC data. We capitalize on the longitudinal nature of these data to construct the risk index by examining cognition, ADL, and fall variable and how the change between the next to last and last assessment increases risk of NHP. Different gradations of change in each variable are examined and the sensitivity and specificity of the risk index are reported. For this study, we identified HCBW participants who had NHP within two years and compared them to those who remained in the program over two years. We chose two years as our time cut-point as the majority of NHP happened within two years of community-based placement (64%, or 2426 out of 3794 candidates), and the assumption that participants who remained in the program for more than two years would be considered as successfully preventing NHP. From these analyses, we present an index that care providers can utilize to identify participants at greater risk of NHP. In addition, care providers can examine which factors are contributing to risk and how change in services may delay or prevent NHP.

MATERIALS AND METHODS

Sample and Setting

In this research, we identified a cohort of persons 65 years of age and older who entered the HCBW program in 2002 to 2007. To be eligible for the federal 1915(c) HCBW program in the State of Michigan, participants must meet Medicaid-defined nursing facility level-of-care criteria. This includes a need for assistance with ADLs and IADLs, to be at or below 300% of Federal poverty level, and to have a caregiver who agrees to provide assistance to the participant at home. We examined these five years as complete data were available and it represented a period where the HCBW program had limited changes in financing and policy [15].

Following completion of a data use agreement and Institutional Review Board approvals from the university and state, socio-demographic information, date of enrollment, and information from the MDS-HC assessment were obtained from the state data warehouse. These data were linked with the Medicaid claim files and death certificate information. Figure 1 shows how the sample for this analysis was separated from the larger HCBW population. First, all eligible HCBW participants were compared against death certificate information from the Michigan Department of Community Health Vital Records to identify participants who died while in the HCBW and 3983 deceased individuals were removed

from the study. To examine changes in cognitive, ADLs, and falls, two MDS-HC assessments were required for each participant. Thus, 1729 participants with only one assessment were removed. Next, we removed 1567 that had enrolled in the program after December 31, 2005 and did not have 24 months of service. Finally, 764 were removed from the study as they were lost to follow-up (i.e., no information was found on whether they stayed in the HCBW program or went to nursing home; nor was there a death certificate prior to the end of 2007). This left the total analysis sample for this study to be 6525.

Instrument and Measures

The MDS-HC is a person-centered assessment with uniform standards for the collection of essential nursing data assessing multiple domains modified from the nursing home version, and is used to inform and guide comprehensive care and service planning for community-dwelling elderly [16]. The information gathered on the MDS-HC is from self-report by the participant with clinical validation by a Registered Nurse, and is collected during a home visit on entry into the HCBW and then every 180 days thereafter. The MDS-HC has been widely tested, much of this work done in the State of Michigan HCBW program [17, 18]. In addition, the MDS-HC has been tested and used as a comprehensive assessment of conditions among the frail elderly, and has been supported through comparative analyses [19].

Further, testing and reporting of the physical functioning and cognitive status instruments have undergone independent tests prior to their incorporation into the assessment [16, 20]. The claims files consisted of bills submitted, and thus represent charges for services. The vital statistics provided dates of death.

Variables Examined in this Study

Table 1 lists the candidate predictor variables. Age, gender, race, physical and cognitive function, falls, and caregiver information were from the MDS-HC. Hospitalizations and prior NHP were from the Medicaid claim files. Physical function was measured using five ADL items (dressing, eating, toileting, personal hygiene, and bathing) on the MDS-HC; for which reliability and scalar properties have been tested [16]. ADL scores for each of the five factors ranged from 0 for independent, 1 for supervision, 2 for limited assistance, 3 for extensive assistance, 4 for total dependence, to 5 for activity did not occur. ADL dependency was defined as those with scores of 2 or more. The measurement of cognitive status in the MDS-HC is based on an instrument developed by Morris et al. [20]; and scores ranged from 0 to 6. For the index in this study, a score of 2 or greater was considered to be cognitively impaired. Falls were based on a question from the MDS-HC which asked participants to recall the number of falls that occurred in the past 180 days.

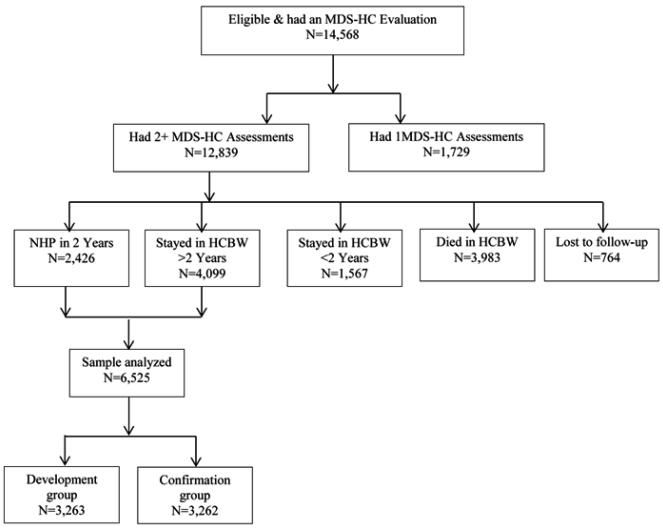


Figure 1: CONSORT chart of analysis sample.

To assess declines in physical function, cognition, and increased numbers of falls, we examined two different models. In the 2-level model, deterioration was defined as a decline in ADLs (increased number of ADL dependency), cognition (increase in the cognitive scale), and increased numbers of falls comparing the next to last and last assessment, with each treated as yes or no. However, the 2-level model had a limitation. For example, using this definition of deterioration, two participants might both be defined as having no deterioration, if one remained independent and the other was fully dependent at the last and second to last MDS-HC assessment. To avoid this issue, a 3-level approach to assess change was evaluated. All cases with no deterioration were further divided into whether participants had ADL dependencies, two or more cognitive performance deficits, or had falls reported at the last MDS-HC assessment. The remaining cases were either independent at both MDS-HC assessments or improved at the final assessment when compared with their second to last assessment. Few of the cases examined reported improvement in any of these three dimensions (ADLs, cognition, or falls). Table 2 compared the rate of NHP for the two years according to each of the measurement approaches (2-level model and 3-level model). The numbers of hospitalizations in the last 90 days were examined comparing the Medicaid claim files with reports of hospitalization on the MDS-HC assessment. Each indicator had limitations. The inpatient claim files were largely shadow claims, since Medicare was the primary payer, thus, the number and frequency of admissions may be under reported. The Medicare claims were not available. The number of admissions reported in the MDS-HC assessment may be misleading, due to failure to recall an admission or possibly over reporting by a participant or their informal caregivers. When the two independent indicators were compared regarding

hospitalization in the last 90 days prior to last assessment: 9.9% (n=648) reported having been hospitalized in Medicaid claim files, while 18.1% (n=1183) reported being hospitalized in the MDS-HC assessment. From these comparisons, we decided to retain hospitalizations based on inpatient files since this was the more conservative. Plus, the newer version of MDS-HC used in the HCBW no longer collects information on hospitalizations and the goal was to use this risk index in the clinical setting.

The mean time interval in months between the last two contacts for those who subsequently transferred to a nursing home was 3.22 (standard deviation [SD] 1.22), with a median of three months. Similarly, for those who remained in the program, the mean time interval in months between the last two contacts were 3.33 (SD 1.12), with a median of three months. Thus, any differences in deterioration or increase among those who had NHP were not due to a differential time interval between MDS-HC assessments.

Finally, the primary dependent variable, permanent NHP within two years was assessed by examining all claim files for a change in level of service from the HCBW program to nursing home. If a participant no longer had HCBW services and began to receive services from a nursing home within 24 months, this participant was defined as transferred to NH in the two year time period. Other participants continuously receiving HCBW service for over 24 months were defined as staying in the program for over two years.

Analyses

We analyzed the data using SAS® 9.2 software with logistic procedures. NHP status over the two years (yes versus no) was the primary outcome of interest. To develop and validate the risk index, we first split our sample into half by using a simple random sampling technique. The first half contained 3263 beneficiaries and was used to develop the risk index (the development sample). The second half contained 3262 beneficiaries and was used to validate the risk index (the confirmation sample). In the development sample, all candidate risk factors (as in Table 1), except for ADLs, cognitive status, and falls, which were entered in the model (given Table 2) and included as predictor variables with transfer to a nursing home within two years as the dependent variable in the logistic model. By using the backward model selection method, those risk factors that remained in the model all had a significant impact (p <0.05) on NHP within two years. Two risk indexes were generated based on the summed beta weights multiplied by the risk factors for either deterioration alone (the 2-level model) or deterioration and dependency (the 3-level model). We then added five points to each participant's index score so that all scores were positive. Then we applied the same sets of estimated beta weights from the development sample to the confirmation sample, computed the risk indices, and compared the association of predicted probabilities and observed responses between the development sample and the confirmation sample. Mann-Whitney non parametric methods were used to compare statistical differences between 2-level model and 3-level model.

RESULTS

Among the analysis sample of 6525 elderly in the HCBW program, 2426 (37%) transferred to NHP within two years. Table 1 lists factors in the MDS-HC data that were potential candidates for predicting risk of NHP by participants who had NHP or remained in the program. Those participants at high risk of NHP were over 75 years of age, of Caucasian race, had prior nursing home stays, wished to reside in another setting, were more likely to have been hospitalized in the last 90 days, and reported behavioral problems at the last assessment. Each of these indicators produced between 10–25% greater rates of NHP. Caregiver relationships and the living arrangements (living together or in separate households) did not have an impact on NHP. However, caregivers who reported they were unable to continue caring activities or who were angry with the caregiving situation had a considerably greater percentage of NHP.

As given in Table 2, changes between the next to last and the last MDS-HC assessment are compared according to rates of NHP. It appears that in the 3-level model, deterioration in cognitive status and physical function is more sensitive indicator of NHP than the level of dependence alone at the last observations. In contrast, having no deterioration in falls, but reported falls at the last MDS-HC assessment produced similar rates of NHPs (45.7%) comparable to the change in numbers of falls (46%).

Table 3 contains the results of the two logistic models for predicting NHP from the development sample. The first panel in the table includes the optimized variables from Table 1 plus the 2-level of change of cognitive status, ADLs, and reported falls. The second panel in the table includes these same variables with cognition, ADLs, and falls entered as 3-level of change. In both panels, the beta weights and standard errors along with the p-value for each variable are presented. The contribution of the fixed variables changed very little across the two panels. In the second panel, when participants who remained independent or improved were compared with those who had not deteriorated but improved at the last observations, those who deteriorated had significantly greater associations with NHP.

The association of predicted probabilities and observed responses for the development sample and the confirmation sample for each model were listed in Table 4. The c-value, which is the Area under Curve (AUC) of receiver operating curves (ROCs), is the percentage of concordance plus a half percentage of ties for the development sample for the 2-level model which was 0.72

Table 1: Descriptive statistics of socio-demographic by whether participants stayed in HCBW or transferred to a nursing home within two years of admission to the HCBW

Characteristics	Stayed in the HCBW Program N=4099 (62.8%)	Transferred to NH Within 2 yrs N=2426 (37.2%)
Age		
Younger than 75 (N=2376)	1759 (42.9%)	617 (25.4%)
75+ (N=4149)	2340 (57.1%)	1809 (74.6%)
Gender		
Male (N=1779)	1113 (27.2%)	666 (27.5%)
Female (N=4590)	2881 (70.3%)	1709 (70.5%)
No Responder (N=156)	105 (2.6%)	51 (2.1%)
Race		
Caucasian (N=4924)	3002 (73.2%)	1922 (79.2%)
Black (N=1381)	969 (23.6%)	412 (17.0%)
Other (N=220)	128 (3.1%)	92 (3.8%)
Had Been NH Before Last Assess		
No (N=4893)	3331 (81.3%)	1562 (64.4%)
Yes (N=1632)	768 (18.7%)	864 (35.6%)
Want Another Living at Last Access		
No (N=6053)	3968 (96.9%)	2085 (86.2%)
Yes (N=461)	127 (3.1%)	334 (13.8%)
Hospitalized 90 Days Prior to Last Access		
No (N=5877)	3771 (92.0%)	2106 (86.8%)
Yes (N=648)	328 (8.0%)	320 (13.2%)
Had Behavior Problem at Last Access		
No (N=6386)	4048 (98.8%)	2338 (96.4%)
Yes (N=139)	51 (1.2%)	88 (3.6%)
Caregiver Relationship with Beneficiaries		
Child/Child-in-Law (N=3739)	2361 (60.7%)	1378 (59.4%)
Spouse (N=941)	574 (14.8%)	367 (15.8%)
Other (N=1530)	954 (24.5%)	576 (24.8%)
Caregiver Live with Beneficiaries		
No (N=3658)	2334 (57.6%)	1324 (56.2%)
Yes (N=2496)	1534 (37.8%)	962 (40.8%)
No Such Cg (N=256)	186 (4.6%)	70(3.0%)
Caregiver Not Satisfied With Support		
No (N=5580)	3525 (96.0%)	2055 (93.2%)
Yes (N=297)	146 (4.0%)	151 (6.8%)
Caregiver Feels Angry		
No (N=5270)	3416 (93.1%)	1854 (84.0%)
Yes (N=607)	255 (7.0%)	352 (16.0%)
Cognitive Impaired at Last Assess*		
No (N=3184)	2281 (55.7%)	903 (37.3%)
Yes (N=3334)	1815 (44.3%)	1519 (62.7%)
# of ADL Dependency at Last Assess		
0 (N=1054)	769 (18.8%)	285 (11.8%)
1 (N=1621)	1059 (25.8%)	562 (23.2%)
2 (N=1076)	638 (15.6%)	438 (18.1%)
3 (N=1004)	630 (15.4%)	374 (15.4%)
4 (N=1188)	664(16.2%)	524 (21.6%)
5 (N=582)	339 (8.3%)	243 (10.0%)
# of Falls at Last Assess		
0 (N=4772)	3151 (76.9%)	1621 (66.9%)
1 (N=1006)	566 (13.8%)	440 (18.2%)
2+ (N=741)	380 (9.3%)	361 (14.9%)

*Based on John N. Morris's definition, cognitive performance score as 2+ is impaired.

Table 2: Comparing rate of NHP in two years by 2-levels of change and 3-levels of change variables comparing the next last assessment and the last assessment

Variables	Stayed in the HCBW Program N=4099 (62.8%)	Transferred to NH within two years N=2426 (37.2%)
Cognitive Deteriorated**		
No	3896 (95.2%)	2152 (89.1%)
Yes	198 (4.8%)	264 (10.9%)
Cognitive Deteriorated** (N=462)	198 (4.8%)	264 (10.9%)
No Deterioration, Impaired at Last Ass (N=2981)	1682 (41.1%)	1299 (53.6%)
Improved/Intact at Last Ass (N=3075)	2216 (54.1%)	859 (35.5%)
ADL Deteriorated**		
No (N=5832)	3801 (92.8%)	2031 (83.8%)
Yes (N=690)	296 (7.22%)	394 (16.2%)
ADL Deteriorated** (N=690)	296 (7.2%)	394 (16.2%)
No Deterioration, Dependent at least 1 activities (N=4781)	3034 (74.0%)	1747 (72.0%)
Improved / Independent (N=1054)	769 (18.8%)	285 (11.8%)
Increase # of Falls		
No (N=5575)	3585 (87.6%)	1990 (82.1%)
Yes (N=944)	510 (12.5%)	434 (17.9%)
Falls Increased (N=944)	510 (12.5%)	434 (17.9%)
Did not increased, Had Falls at Last Assess (N=803)	436 (10.6%)	367 (15.2%)
Improved /No Falls at Last (N=4772)	3151 (76.9%)	1621 (66.9%)

**Increased cognitive performance score was defined as deteriorated in cognitive skills and increase number of ADL dependency was defined as deteriorated in ADL.

Table 3: Comparing weight (Betas) of NHP by each level of risk index developed from deterioration only and from deterioration and dependency in development group

	Deterioration Only (2-level model)				Deterioration and Dependency (3-level model)			
	Level	Beta	Std. Err	p-Value	Level	Beta	Std. Err	*p*-Value
Intercept		-1.25	0.23	<0.0001		-1.79	0.26	<0.0001
Age	76+	0.88	0.09	<0.0001	76+	0.81	0.09	<0.0001
	65 to 75	0	-	Ref	65 to 75	0	-	Ref
Race	Black	-0.86	0.24	0.0003	Black	-0.87	0.24	0.0003
	Caucasian	-0.40	0.22	0.07	Caucasian	-0.38	0.22	0.0869
	Other	0	-	Ref	Other	0	-	Ref
Had Being NH Before	Yes	0.63	0.09	<0.0001	Yes	0.58	0.10	<0.0001
	No	0	-	Ref	No	0	-	Ref
Want Another Living	Yes	1.46	0.17	<0.0001	Yes	1.39	0.17	<0.0001
	No	0	-	Ref	No	0	-	Ref
Had Behavior Problem	Yes	0.71	0.30	0.02	Yes	0.55	0.31	0.0713
	No	0	-	Ref	No	0	-	Ref
Hospitalized 90 days Prior	Yes	0.65	0.13	<0.0001	Yes	0.65	0.14	<0.0001
	No	0	-	Ref	No	0	-	Ref
Cg Unable to Continue	Yes	0.37	0.13	0.0034	Yes	0.32	0.13	0.0118
	No	0	-	Ref	No	0	-	Ref
Cg Feel Angry	Yes	0.71	0.14	<0.0001	Yes	0.59	0.14	<0.0001
	No	0	-	Ref	No	0	-	Ref

Table 3: *(Continued)*

Increased Cognitive Performance Score	Yes	0.55	0.17	0.0008	Deteriorated	0.87	0.17	<0.0001
					No Deter. Impaired at last	0.59	0.09	<0.0001
	No	0	-	Ref	Intact at last assess	0	-	Ref
Increased Number of ADL Dependency	Yes	0.75	0.14	<0.0001	Deteriorated	1.00	0.17	<0.0001
					No Deter. Dep1+ at last	0.31	0.13	0.0150
	No	0	-	Ref	Independent at last assess	0	-	Ref.
Increased Falls	Yes	0.11	0.12	0.3419	Increased Falls	0.18	0.12	0.15
	No	0	-	Ref	No increased. had falls	0.36	0.13	0.0044
					No Falls at last assess	0	-	Ref

Std. Err, Standard Error

and 0.73 for 3-level model. In the confirmation sample, the c-value for the 2-level model was 0.70 and 0.72 for 3-level model. In order to determine which index might be a better predictor of NHP, the ROCs were utilized to compare the 3-level model to the 2-level model in the confirmation sample (Figure 2); using NHP in the two years as the outcome and each index as the predictor. The ROC contrast test showed that the index generated from the 3-level model produced a significantly better area under the curve (0.70 versus 0.72; $p<0.01$). In later analysis, we used this index to generate graphs of estimating probabilities by index; and the estimated probability with its sensitivity and specificity (Figures 2 and 3). Furthermore, to illustrate how the change of index explained the change rate of NHP, we categorized the risk index into seven levels, increasing each level by a magnitude of 0.5. We then summarized each level according to the proportion of participants who entered a NH. Figure 3 presents the relationship between a 0.5 unit increase in the risk index and the probability that participants transfer to a nursing home. Beginning with scores of 4.0 to 4.49, each half unit increase in the risk index produces around a 10% increase in the rate of NHP. As the risk index increases from 2.5–6.0, the rate of NHP increased from 21–77%.

Figure 4 presents the correspondence between NHP and the risk index. Table 5 presents the correspondence of probability, sensitivity, and specificity. Assuming a score of 5 on the risk index, the probability of transferring to a NH is approximately 50%. Using this 50%, we then turn to Figure 4 to examine the sensitivity and specificity of this score, and found a sensitivity of approximately 0.4 and specificity close to 0.9 in this example. This means that for a risk index score greater than or equal to 5, we will correctly identify 40% of those participants who will actually transfer to a NH. In contrast, for those participants with a score of less than 5 we will correctly identify 90% of those participants who are not going to transfer to a nursing home.

Table 4: Comparing the association of predicted probabilities and observed responses among the development and confirmation samples

Criteria	Development Sample		Confirmation Sample	
	2- levels	3-levels	2- levels	3-levels
Percent Concordant	69.9	72.3	68.5	70.9
Percent Discordant	25.7	26.1	27.5	27.7
Percent Tied	4.4	1.6	4.1	1.4
C	0.721	0.731	0.705	0.716

Table 5: The estimated probability, sensitivity and specificity by each cut points of nhp risk index

Risk Index	Probability	Sensitivity	Specificity
2	1.00	1.00	0.00
3	1.00	1.00	0.05
4	0.81	0.92	0.26
5	0.46	0.66	0.65
6	0.12	0.22	0.94
7	0.03	0.07	0.99
8	0.00	0.01	1.00

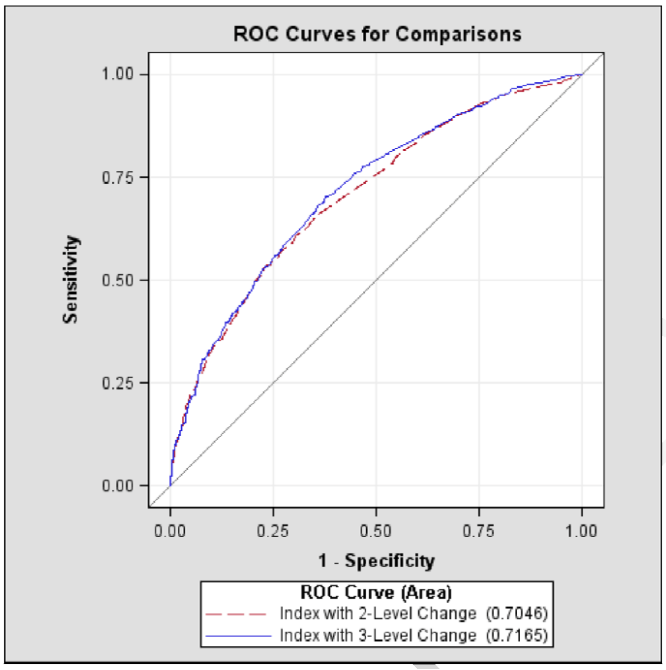
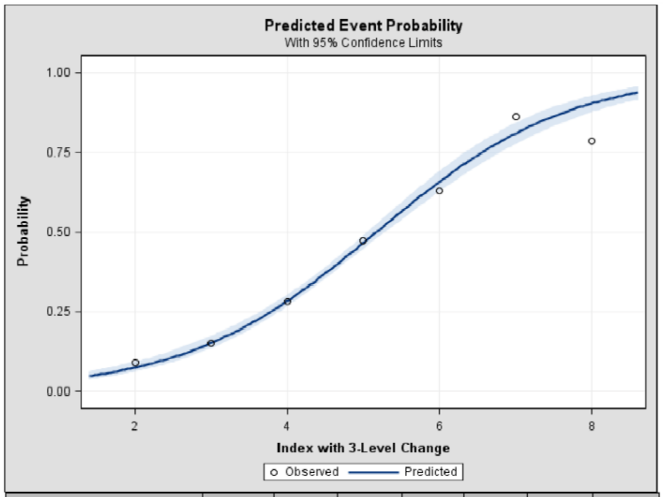


Figure 2: Comparing receiver operating curves (ROC) difference between risk index developed from deterioration only and risk index developed from deterioration and dependency.



Index with 3-Level of Change	2	3	4	5	6	7	8+
N of NHP (Observed)	1	92	317	529	184	76	11
Total Clients	11	612	1128	1117	292	88	14

Figure 3: Estimated probability with 95% CI of nursing home placement for risk index developed from deterioration and dependency.

DISCUSSION

The utility of this risk index for HCBW clinicians comes from the fact that this model can be easily be produced from information that is already being collected in the MDS-HC assessments. When collected on a laptop computer in the home, the NHP risk index could be calculated in real time. Information from the prior observation, paired with

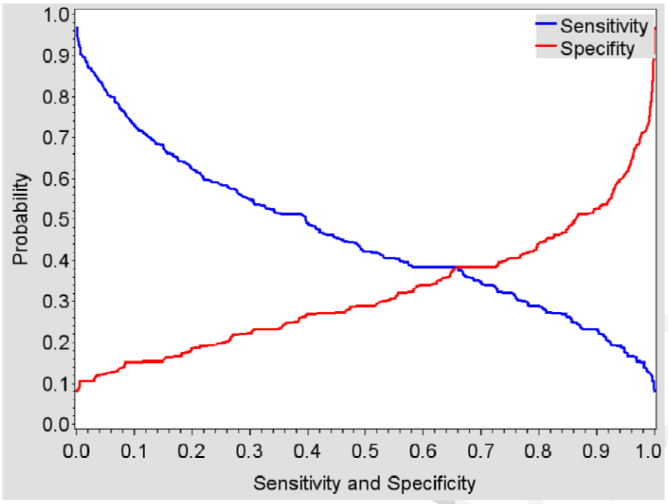


Figure 4: Estimated of probability of nursing home placement in 2 years, sensitivity and specificity.

current NHP risk index scores, could be used to produce a risk score that would reveal the rates of deterioration over consecutive assessments. This would offer HCBW clinicians an indication of change in the total NHP risk score and more significantly perhaps, reveal the specific dimensions that contributed to increasing risk. Thus, HCBW clinicians could target education and services for participants and their caregivers towards those areas with greater risk of NHP with the goal of delaying or preventing transfer to a nursing home. For example, if cognitive status was declining, then caregivers could be informed about how to manage persons with these declines. If a fall occurred, the HCBW clinician could add physical or occupational therapy to improve strength, obtain assistive devices (e.g., cane or walker), and modify the home for accessibility.

Moreover, by looking at the deterioration in a specific risk indicator, and pairing that increase against the beta weights, the HCBW clinician could obtain an indication of the strength of that indicator in predicting NHP. This is an important feature of this risk index. Not only does the HCBW clinician have an overall indicator of the risk of NHP, and the change in risk at each subsequent observation, but they can also review the specific mix of indicators and the strength of the contribution of each indicator to the overall index. For example, those who want another living arrangement had the highest weight on the index, a 30% increased chance of NHP. Assume a participant had an index score of 6.34, by using Figure 4, this participant would have a 72% chance of NHP, even when other factors are held at zero. The HCBW clinician could consider how to improve the participant's living arrangement to reduce the chance of NHP. This feature offers both a probabilistic and a clinical perspective for the HCBW clinician as they seek to more effectively manage participants and to make decisions about how to allocate their limited resources and if a participant may be better served in a nursing home.

Plots of the sensitivity and specificity, when taken together, offer HCBW clinicians a basis for engaging participants and their caregivers in strategies tailored to the higher items in the risk index in order to prevent a transfer to a nursing home. In part, this derives from the fact that around 20% of participants actually transferred to a nursing home with all risk factors contributing to the index as 0s (i.e., intercept only in logistic model, resulted in the index score of 3.09). This could assist with HCBW resource management and delay or prevent NHP.

The extent to which this index might guide resource allocation is not tested in this study. However, the data do indicate how it might be used to address these types of decisions. As we have pointed out above, such decisions should not rely solely on the overall score, but on the changes in each of the risk index components. This approach indicates that the HCBW clinician can then begin to temper the changes in the overall index targeting specific indicators. This allows the HCBW clinician to examine each participant and their caregiver on an individualized basis and tailor services accordingly. Increases in the same indicator may translate into very different decisions for each participant and their caregiver, and each case needs to be examined on an individualized basis by a clinician once the risk score is known.

In developing this index, we found that the 3-level model using deterioration and dependency was superior to the 2-level model that focused solely on deterioration. However, deterioration in function and cognition, and increases in falls were each associated with increased NHP. To assure that floor effects were addressed, i.e., patients had not reached the highest levels of deterioration on these variables at the next to last MDS-HC assessment, and thus, were unable to deteriorate further, we examined the prevalence of floor effects on each of these measures. Age was divided as 65 to 75, and 76 and older and then participants were classified according to no change, or change in one, two, or all three measures. This change score was then compared with the number and percent of cases with a maximum score on each measure (a score of 5 on the ADL index, 6 on cognitive performance, and 9+ on falls) at the next to last contact. Only 9% of all patients with no change had a maximum score on ADLs, and 1% had maximum scores on cognitive performance and falls at the next to last contact. For cases with deterioration in one, two, or three dimensions, the percent of cases with maximum scores were zero. Thus, we argue that few cases report maximum values on the next to last contact and thus there is no substantive impact of a pure floor effect on the risk index. Further, the 3-level index does account for deterioration, also reflects both sustained dependencies and sustained independence over the two observations. Alternatively, we argue that even among this old, vulnerable population, the possibility for changes in the index over consecutive intervals is substantial.

Limitations of this study include a sample from a Medicaid program that was somewhat homogenous as program admission criteria require ADLs and IADLs that are diminished. In addition, a limited number of other than Caucasians were included in our sample. Thus, findings may not be generalizable.

CONCLUSION

This index defining risk of transfer to a nursing home could be a valuable adjuvant to clinical observations. Home and community based waiver (HCBW) clinicians could access in real time the risk scores, and they could examine the likelihood that a score of this magnitude would result in a nursing home placement (NHP) prior to the next home visit. Consecutive scores would suggest the rate of deterioration, and could determine the dimensions contributing to the risk of NHP. More importantly, the sensitivity and specificity of this index would offer HCBW clinicians an indication of the likelihood that such a score would lead to an actual transfer to a nursing home or to remaining at home. This, together with clinical judgment by the HCBW clinicians, could inform decisions about offering additional services. Ultimately, this could lead to better understanding if increasing services would alter the decision to transfer to a nursing home or to remain at home living in the community. With the increasing pressure to lower costs of health care, especially for the dually eligible, efforts such as this capitalize on existing information, and deliver it to agencies so that they can make more informed decisions with respect to how to service participants in wavier programs.

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Guarantor
The corresponding author is the guarantor of submission.

Conflict of Interest
Authors declare no conflict of interest.

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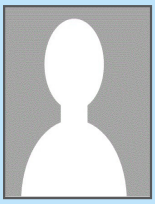

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