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Original Study

Functional Recovery Within a Formal Home Care Program

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A B S T R A C T

Objective: To identify home care clients with substantial functional deficits who had capacity to improve and, thus, for whom recovery goals should be articulated.
Design: Retrospective longitudinal analysis of an international home care database.
Setting and participants: 523,907 persons receiving home care, having 2 assessments, on average, 8 months apart.
Measures: Recovery algorithm variables included counts of dependencies of activities of daily living (ADL) and instrumental ADL (IADL) tasks, hospitalization in the last 30 days, functional decline in the last 90 days, and self-belief in one's capacity to improve. Primary dependent variable was improvement in the IADL-ADL Functional Hierarchy Scale.
Results: The Recovery Algorithm has 7 graded levels: the top 3 represent approximately 9% of home care clients, whereas the bottom level (where recovery is least likely to occur) includes 60% of home care clients (many with higher counts of extensive ADL or IADL dependencies). The improvement rates rise from 6.9% to 47.2% across the 7 levels of the algorithm. This relationship between change in IADL-ADL Functional Hierarchy Scale scores and Recovery Algorithm levels remained strong across age categories and cognitive performance levels. Higher rates of improvement occurred for persons who received physical therapy.
Conclusions/Implications: The Recovery Algorithm is based on a mix of positive risk indicators and the person's challenged baseline functional status. For persons with higher scores on the algorithm, recovery is expected and should be considered in care plan goals. In addition, use of physical therapy increases the probability of recovery.

For most who receive home care services, compromised functional status is a reality of everyday life.[1–3] Reversing decline and achieving greater functional independence is important not only for the individual but also for family members. Among home care service recipients, there is no clear understanding of who might improve, who will stay the same, or who will decline. The objective of this article is to identify subsets of home care clients who, though they have substantially compromised functional status, have the potential for at least partial functional recovery. Focusing on these subsets and assessing their subsequent functional recovery provides an agency with a working strategy to maximize recovery. This approach will provide a grounded rationale for provision of higher levels of home

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Availability of data and material: The data set analyzed for the current project is available within the interRAI international fellowship per agreements with governments, and interested persons can contact the lead author on how mutual reanalysis can be arranged.

J.N. Morris, K. Berg, E.P. Howard, and P.V. Jonsson are members of interRAI.

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care and physical therapy services for a subset of frail older adults living at home.

Two recuperative forces are key to such recovery. First, frail home care recipients will openly express belief that for them, functional recovery is possible—which in turn, may translate into a commitment to work toward positive change. Motivation of this sort has been associated with physical resilience.[4] Second, for other home care clients, their compromised functional status will be of recent origin, and rebound to a more independent status may seem possible. Working within these 2 recuperative parameters, we posit a model for who is likely to recover.

The widely used interRAI Home Care (RAI-HC) assessment provides a foundation to assess function and model recovery potential for home care clients. Consistent with the focused geriatric assessment model (often referred to as Comprehensive Geriatric Assessment or CGA), it is used to assist with planning care, monitoring outcomes, quality improvement, and research.[5] Implementation of the RAI-HC by a multidisciplinary home care team was associated with improvement in function and delayed use of hospital and nursing home, resulting in cost savings overall.[6] A recent review of interventions or applications of the interRAI HC noted that diverse studies demonstrated improvement in a wide array of health-related areas, including function, cognition, hospitalization, and mortality.[7] Therefore, the objective of this study was to develop a recovery algorithm to identify persons with significant deficits in performing daily activities who receive home care and have the capacity for functional recovery.

Methods

Design and Sample

A longitudinal analysis of interRAI Home Care person-level assessments available in a cross-national data archive was completed to achieve our project aims.

The sample was composed of 523,907 clients with baseline and follow-up interRAI Home Care assessments from a variety of service agencies around the world. The follow-up assessments occurred on average after 8 months, reflecting that most persons were long-stay home care clients. The large bulk of data came from North American agencies, with smaller amounts from agencies in Europe, New Zealand, and elsewhere. The data from Canada represented all long-stay home care clients in the Provinces of Ontario and Manitoba. The home care data in the United States came mainly from all state supported home care clients in Massachusetts, Michigan, and Georgia.

Data were provided pursuant to an agreement with interRAI to make use of its accumulated, cross-national home care data holdings to do research of this type. The analyses were covered by approval from the Hebrew Senior Life, Institute for Aging Research, Institutional Review Board, and completed using SPSS version 20.0.

The interRAI HC assessment includes a number of embedded scales that could be considered in this type of effort, including a cognitive performance scale,[8] ADL hierarchy and ADL long form,[9] pain scale,[10] and mood scale.[11] The Cognitive Performance Scale (CPS) has been validated and cross-walked to Mini-Mental State scores.[12,13] The scales as well as individual items have shown very good reliability.[14] Individual ADL and IADL items are scored across a 7-point scale with zero as fully independent and 6, totally dependent.

The IADL-ADL Functional Hierarchy scale has a score range from zero (independent in IADL and ADL) to 11 (dependent in all IADL and ADL).[15] Items included in the Functional Hierarchy scale are broad in scope, capturing a diverse array of functional tasks crucial to daily living. Included are measures of personal hygiene, locomotion, toilet use, eating, meal preparation, shopping, managing finances, managing medications, and ordinary housework. A subset of items in the IADL-ADL Functional Hierarchy was used in creating the Recovery Algorithm.

Study Independent Variables

The operational definitions of compromised functional status in ADL (basic activities of daily living) and IADL (instrumental activities of daily living) are as follows:

ADL: count of 1 is added for each item where the person receives full help from others in completing personal hygiene, locomotion, toilet use, and eating.
IADL: count of 1 is added for each of 3 instrumental tasks of daily living—meal preparation, ordinary housework, and shopping for food and household items where the person was rated as needing full help from others in carrying out the tasks.

In addition, 3 other interRAI HC items were used to assess whether there is an increased likelihood of subsequent functional improvement. The first reflects whether the home care service recipient believes he or she is capable of increased functional independence. The second is a measure of whether the person had been in a hospital within 30 days of baseline assessment. The third is a baseline assessment of whether the person's ADL status had become worse as compared to status 90 days ago.

Changed Functional Status

The dependent functional measure used in this article is the interRAI IADL-ADL Functional Hierarchy Scale.[15] Functional assessments were, on average, 8 months apart. Change between the 2 measurements can be recoded in 3 ways for analyses: first, a measure of change, where the time 2 (follow-up) score is subtracted from the time 1 (baseline) score. When displayed in this manner, a positive score indicates functional improvement, a score of 0 indicates no change, and a negative score indicates functional decline. Second, the change score may be recoded so a score of 1 indicates functional improvement has occurred and a score of 0 indicates no improvement; used in this way, persons with a score of 0 at baseline cannot improve, and when this is the case the improvement ADL score is set to missing. Third, the change score can be recoded so a score of 1 indicates worsening function and a score of 0 indicates no decline—note that when used in this way persons with a score of 11 (the highest possible score on the IADL-ADL Functional Hierarchy scale) at baseline cannot decline, and when this is the case, the worsening ADL score is set to missing.

Analytical Strategies

We first evaluated all independent variables to ensure that they had the anticipated relationship to functional improvement. Subsequently, we describe how the recovery algorithm relates to improvement and worsening forms of dependent change variables.

Developing the Recovery Algorithm

Development of the Recovery Algorithm was guided by previous research in predicting functional improvement in long-term and community-based care.[15] A conceptual model was constructed using 5 independent measures. The count of ADL extensive deficits took precedence over IADL deficits, and the person's belief that he or she could improve was the starting point in understanding the likelihood of subsequent functional recovery.

The Recovery Algorithm was next assessed against the improvement on the IADL-ADL Functional Hierarchy Scale. We also examined the magnitude of change in the scale for those who improved, and for

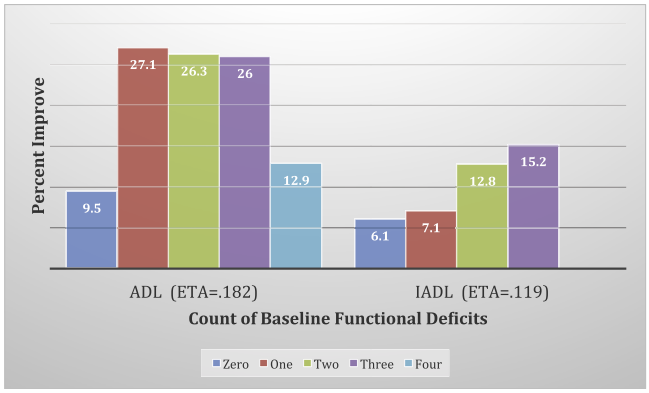


Fig. 1. IADL-ADL Functional Hierarchy Improvement by count of Substantial Baseline ADL and IADL Deficits (both $P < .001$).

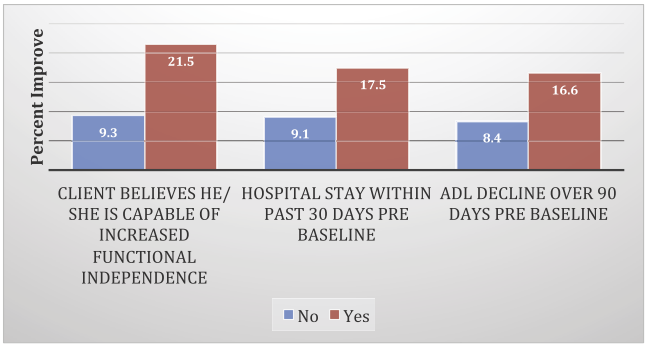


Fig. 2. IADL-ADL Functional Hierarchy Improvement for Components of Recovery-Risk Algorithm (all $P < .001$).

those who declined in physical function. The next set of analyses assessed the role of therapeutic services in further expediting recovery across the model. Here, therapeutic measure was scored as follows: no therapy services, occupational therapy only (OT), physical therapy only (PT), and receipt of both OT and PT services.

Results

Of the sample cohort, 58.8% were female and 36.2% were married. The median age was 77.5 years, 14% were younger than 65 years and 13.6% were aged 90 years or older. Approximately 18.4% were enrolled expressly in home care for post-hospitalization recovery and 8.6% were hospitalized in the week prior to home care admission. Those persons hospitalized 8 to 14 days before entering home care represented 8.2% of the sample, with 9.9% within 15 to 30 days. At baseline assessment, 37.4% were cognitively intact (score 0 on CPS), and 17.6% had only a minor functional deficit.

Figure 1 displays the proportion of persons in each category of the counts of dependencies in ADL and IADL who improved on the IADL-ADL Functional Hierarchy Scale representing 2 of the 5 independent variables used to create the Recovery Algorithm, namely, total dependence in 1 or more ADL and total dependence in 2 or more targeted IADL (ordinary housework, meal preparation, and shopping). IADL problem counts showed a clear trend, with higher problem counts achieving higher rates of functional improvement. ADL problem counts showed higher rates for the middle 3 categories. Figure 2 addresses the remaining 3 independent variables and displays the proportion of individuals who improved in IADL-ADL Functional Hierarchy Scale scores by each of the baseline factors: perceived capacity to improve, hospital stay in the past 30 days, and functional decline in the past 90 days. One or more of these factors could apply to each person. Again, when the condition is present, functional improvement rates were higher.

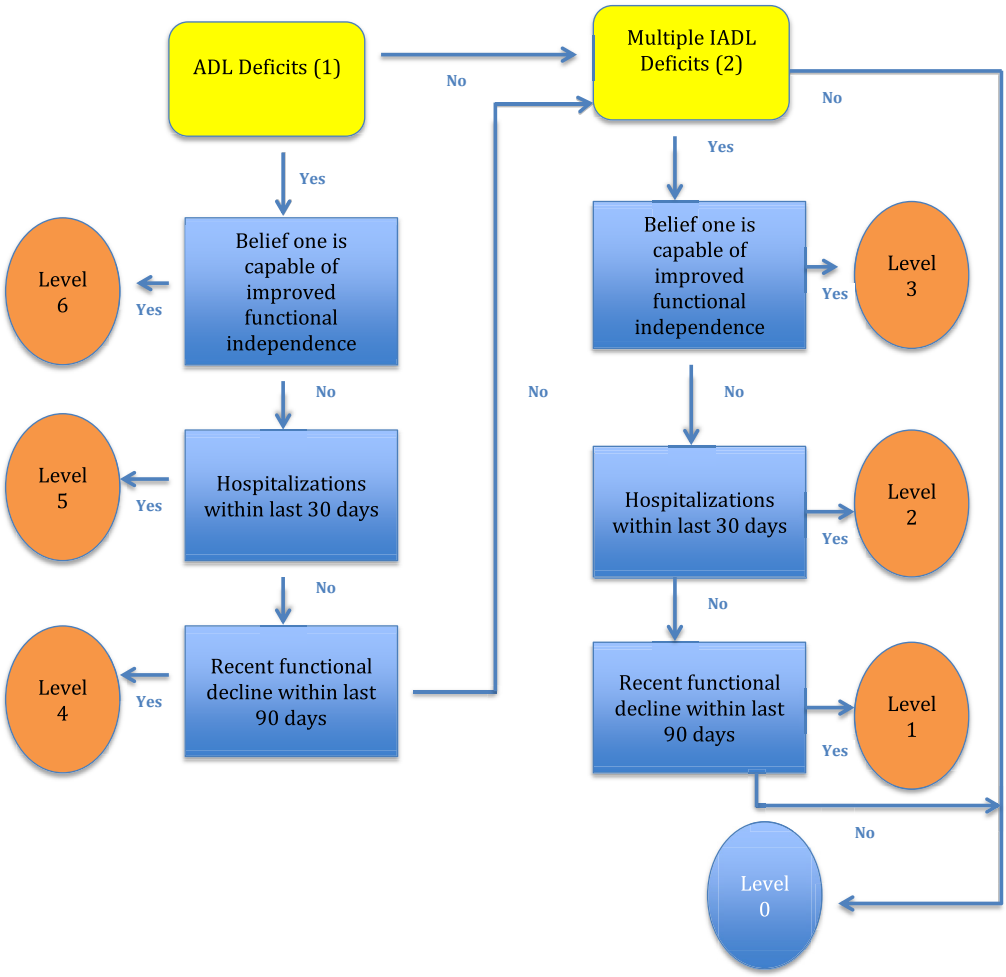
Figure 3 illustrates the logic and levels of the Recovery Algorithm. The process to create the algorithm is straightforward. We first pass through the ADL counts 3 times, with each stratum indicated by the joint presence of ADL deficits and one of the 3 baseline recovery factors. The most responsive risk category, where the highest functional recovery rate is expected, includes persons with 1 or more ADL dependency who also believe that they can become more independent. The next 2 categories bring together ADL dependencies and recent hospitalization, and then ADL dependencies and recent functional decline. Following the passage through the ADL deficit strata, we proceed with a similar process for the 3 strata for the IADL deficit variable (representing persons who have the recovery factors but are not dependent in ADL at baseline)—in each case limiting the sample passed through the model to those left after the earlier steps. Finally, the seventh category represents persons for whom there is no expectation of improvement. Note that this last category included a mix of persons with and without ADL and IADL deficits; 45% have either IADL or ADL deficits as measured on the 2 brief counts used in creating the recovery model.

Table 1 displays key information for the Recovery Algorithm, including the percentage of persons in each category, the mean functional improvement (for those who improve), the mean functional decline (for those who decline), and the mean functional change. Scores 3 through 6 on the Recovery Algorithm, representing about 19% of the client cohort, exhibit the highest rates of recovery and positive change. They also represent the lowest rates of functional decline. Category 3 has about an equal proportion of persons who decline as improve. Category 6, at the most positive end of the spectrum, has about 4.7 persons who improve for every 1 person who declines. In fact, nearly half of these persons (47.2%) improve.

Figure 4 displays the cross-walk between the categories of the Recovery Algorithm and the presence or absence of OT and PT services. For the lowest Recovery Algorithm categories, the introduction of therapies played little role in elevating the functional improvement level. For the remaining Recovery categories, OT by itself had little impact in elevating a person's functional improvement score. Even when OT and PT were together, there is little indication of a unique increase based on OT in functional improvement scores. PT, in contrast, whether alone or in conjunction with OT, translated into a significant increase in functional improvement rates. For example, in the highest of the Recovery Algorithm categories (group 6) when PT is present, more than 50% of persons improved in function. When PT was not present, the rate dropped to about 40%. Finally, the percentage of persons receiving PT rose steadily across the categories of the Recovery Algorithm, progressing as follows: 9.2%, 12.6%, 16.8%, 31.0%, 30.0%, 24.5%, and 53.8%.

Discussion

The Recovery Algorithm, derived from items found within the interRAI Home Care Assessment System, helps identify home care clients who require assistance with ADL and IADL but nonetheless have the potential to recover some degree of functional independence, regardless of age and cognitive status. With IADL, category 0, there is a decrease in the functional score of 0.44. Persons in categories 1 and 2 and categories 4 and 5 do not decline, their scores remaining stable [changes of 0.01, −0.05 (categories 1 and 2), and 0.02 and −0.01 (categories 4 and 5), respectively]. Categories 3 and 6 demonstrate the most improvement in IADL with functional score changes of −0.24 and −0.76. Considering ADL, persons in categories 1, 2, and 3 have no ADL impairment at baseline, and there is no opportunity for



(1) ADL- Totally dependent on one or more of the following: locomotion in home, eating, toilet use, personal hygiene
(2) IADL- Total dependence on others for two or more of the following: ordinary housework, meal preparation, shopping

Fig. 3. Recovery algorithm.

improvement. Categories 4, 5, and 6 of the Recovery Algorithm all have evidence of improvement with functional change scores of −0.34, −1.77, and −3.62. Greatest recovery in functional ability occurs for those in categories 5 and 6.

The benefits of the algorithm are that it may be derived at scheduled intervals for clients throughout the world, and staff at home care agencies can take necessary supportive action. The validity of the Recovery Algorithm was supported by the relationship between categories of the Algorithm and improvement in ADL and IADL function as measured by the IADL-ADL Functional Hierarchy Scale. Baseline factors that informed the algorithm were as follows: the person's belief that he or she could improve, a hospitalization in the past

Table 1
Percentage Who Improve and Decline and the Mean Change Scores Within Each Category of the Functional Hierarchy

Recovery Scale Score	Percentage of Persons in Each Category	Percentage of Persons Who Improve ($\eta = 0.278$, $P < .001$)	Percentage of Persons Who Decline ($\eta = 0.118$, $P < .001$)	Mean Functional Change Score —Negative Scores Indicate Improvement ($\eta = 0.274$, $P < .001$, mean = 0.389, SD = 1.477)
0. Lowest recovery potential	60.5	6.9	33.2	0.614
1	13.9	9.2	33.2	0.454
2	6.2	13.8	28.8	0.306
3	10.2	21.7	21.5	−0.003
4	4.4	26.2	23.1	−0.303
5	1.7	30.0	19.4	−0.399
6. Highest recovery potential	3.1	47.2	10.0	−1.243

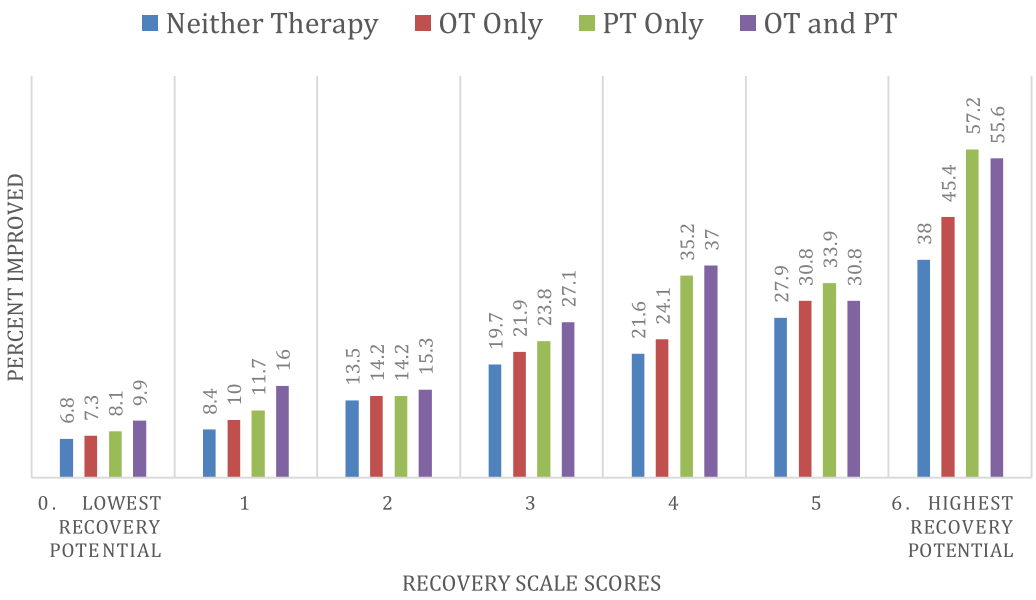


Fig. 4. Functional improvement distribution by recovery scale score and receipt of therapeutic services.

30 days, and functional decline in the past 90 days. Each factor is routinely collected in the interRAI home care assessment. Personal belief in the potential to improve has been a key variable in prior studies.[16] Positive belief may reflect optimism or higher motivation to participate in treatments such as PT.

In the year post-hospitalization, functional improvement is more likely early in the post-acute period but some may also decline following initial improvement.[17] We are unable to determine whether individuals in this study had initial improvement followed by decline but are encouraged that, at 8-month assessments, we were able to identify improvement. The degree of improvement based on a standard deviation change model is quite impressive for the 3 highest categories of the Recovery Algorithm: going from .21, .27, and .84 of a standard deviation. The Scale itself includes 5 IADL and 4 ADL, and thus, a single degree of movement may reflect changes in other ADL and IADL. Improvement rates are even higher for those who receive PT.

The results here suggest that formal PT is beneficial to improving function in a population with substantial functional deficits. Our findings are consistent with an Ontario study of long-stay home care clients where receipt of PT and OT was associated with functional improvement, longer time to institutionalization or hospitalization, and higher probability of discharge from home care.[18] A Belgian study found that OT was effective in delaying institutionalization in frail older people.[19] Other studies have found that restorative approaches are associated with health system savings.[20,21] There is a need to further elucidate which patients may require specialized professional interventions vs those who will improve with programs of more general restorative approaches.

Functional decline without a recent hospitalization was associated with improvement in physical function. This point is worthy of emphasis given that in some jurisdictions, individuals' posthospital care and established clinical care pathways are more highly associated with receiving PT or OT.[22] The Recovery Algorithm should assist in highlighting the potential for recovery among frail older adults.

We acknowledge that some persons with baseline assessments did not have a follow-up, either because they improved to the point of not needing services, or they experienced adverse events such as institutionalization or death. Enrollment in a formal home care service program has sometimes been seen as a step into a downward spiral, a step that, for many, will translate into continued decline and misery. Yet, as suggested in this research, for some, there is another path, and that is the path to improvement in function and less dependence on others.

Conclusions and Relevance

Recovery from a decline in functional performance appears predicated on 2 key factors: the self-perception that recovery is possible and the length of time wherein a person has declined functional status. Home care recipients who perceive recovery is possible are more likely to experience an improved functional status. Compliance and adherence to treatment regimes may be supported by a positive perspective that improvement will occur. Furthermore, the longer one has a compromised functional status, the harder it is to rebound; recovery is most likely to occur when a patient's compromised functional status is of recent origin. Assessing for functional recovery within a subset of frail older adults receiving home care services provides some justification of the benefits of such services, enabling a focus on those services most appropriate for frail older adults living at home.

The developed Recovery Algorithm refutes the seemingly inevitable "story of loss" and suggests promise for frail older adults with substantial functional deficits but who have the potential to make improvements in function. PT, in particular, was instrumental in ensuring a patient's recovery, while less impact was assessed from OT efforts. It is also important to note that functional improvement rates on the Recovery Algorithm increased with age. There is evidence home care services may be beneficial toward functional recovery and, consequently, improvements may be realistic care plan goals for frail individuals. Those on the lowest end of the Recovery Algorithm still show signs of functional decline. Research is needed to better address their needs.

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