A Low-Vision Rehabilitation Program for Patients With Mild Cognitive Deficits

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IMPORTANCE We are unaware of any standardized protocols within low-vision rehabilitation (LVR) to address cognitive impairment.

OBJECTIVE To design and pilot-test an LVR program for patients with macular disease and cognitive deficits.

DESIGN The Memory or Reasoning Enhanced Low Vision Rehabilitation (MORE-LVR) program was created by a team representing optometry, occupational therapy, ophthalmology, neuropsychology, and geriatrics. This pilot study compares outcomes before and after participation in the MORE-LVR program.

SETTING Eligible patients were recruited from an LVR clinic from October 1, 2010, through March 31, 2011.

PARTICIPANTS Twelve patients completed the intervention, and 11 companions attended at least 1 training session.

INTERVENTION Key components of the MORE-LVR intervention are as follows: (1) repetitive training with a therapist twice weekly during a 6-week period, (2) simplified training experience addressing no more than 3 individualized goals in a minimally distracting environment, and (3) involvement of an informal companion (friend or family member).

MAIN OUTCOME MEASURES Version 2000 National Eye Institute Vision Function Questionnaire–25; timed performance measures, Telephone Interview for Cognitive Status-modified (TICS-m), Logical Memory tests, satisfaction with activities of daily living, and goal attainment scales.

RESULTS Twelve patients without dementia (mean age, 84.5 years; 75% female) who screened positive for cognitive deficits completed the MORE-LVR program. Participants demonstrated improved mean (SD) scores on the National Eye Institute’s Visual Function Questionnaire–25 composite score (47.2 [16.3] to 54.8 [13.8], \(P = .01\)) and near-activities score (21.5 [14.0] to 41.0 [23.1], \(P = .02\)), timed performance measures (writing a grocery list \(P = .03\), filling in a crossword puzzle answer \(P = .003\)), a score indicating satisfaction with independence \(P = .05\), and logical memory \(P = .02\). All patients and companions reported progress toward at least 1 individualized goal; more than 70% reported progress toward all 3 goals.

CONCLUSIONS AND RELEVANCE This pilot study demonstrates feasibility of an LVR program for patients with macular disease and mild cognitive deficits. Participants demonstrated improvements in vision-related function and cognitive measures and expressed high satisfaction. Future work is needed to determine whether MORE-LVR is superior to usual outpatient LVR for persons with coexisting visual and cognitive impairments.

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Low vision, typically defined as chronic visual impairment that limits daily activities and cannot be corrected by medical, surgical, or refractive intervention, is a major cause of disability. Among adults in the United States, low vision often results from glaucoma, cataracts, and (most commonly) macular diseases. Despite advances in the treatment of these conditions, many patients experience visual impairments that interfere with daily function for the remainder of their lives. The incidence and prevalence of these diseases increase with age, and because people older than 65 and 80 years constitute increasing proportions of the population, the number of Americans with low vision is increasing.

A mainstay of treatment for individuals with low vision is low-vision rehabilitation (LVR), which is a multidisciplinary service that aims to maximize the patient’s quality of life and ability to perform activities of daily living. Typically, LVR involves rehabilitation therapy (training and education) and vision assistive equipment (VAE). Standards of care have been published for the main professions that provide LVR services: ophthalmology, optometry, vision rehabilitation therapy, and occupational therapy. However, considerable variability exists in the models of care and breadth of services provided by outpatient LVR clinics. Moreover, the intensity, duration, location, and specific components of LVR are individualized based on each patient’s personal goals, needs, and rate of progress.

Older patients’ visual challenges are often compounded by physical frailty and nonophthalmologic comorbidities. On the one hand, LVR’s inherent adaptability makes it well suited to accommodate patients with comorbid medical problems. On the other hand, because rehabilitation interventions require patients’ participation and engagement, opportunities frequently arise for coexisting medical problems to interfere with adherence and treatment success. The ability to provide maximally effective, patient-centered LVR depends, in part, on standardized approaches for detecting and accommodating the most commonly encountered conditions.

One medical condition that is especially common and potentially problematic among older LVR recipients is cognitive impairment. Cognitive impairment is more common and more rapidly progressive among older adults with vision impairment compared with their peers with intact vision. In particular, age-related macular degeneration has been associated with increased risk of dementia and lower cognitive scores. More than 40% of older (>65 years) patients with macular disease who were seen in an outpatient LVR clinic had cognitive deficits per objective testing. Although one study found that LVR patients with cognitive impairment gained similar visual acuity improvement from low-vision aids, we found that cognitive deficits were associated with worse visual function trajectories among older patients receiving outpatient LVR. Low-vision patients with comorbid cognitive deficits and their family members perceive unmet needs in LVR, and LVR practitioners express uncertainty about how to accommodate cognitive impairment.

We are unaware of any standardized protocols within LVR to address cognitive impairment. Our objective was to design and pilot-test an enhanced LVR program to detect and better accommodate cognitive deficits among patients presenting for outpatient LVR services. We describe the development of the Memory or Reasoning Enhanced Low Vision Rehabilitation (MORE-LVR) program and provide results from a single-center study.

**Methods**

The studies were approved by the Duke Institutional Review Board, and all participants provided informed consent.

**Development of the MORE-LVR Intervention**

As a first step, our team performed a content analysis of 624 interviews of 98 older LVR patients and 85 patient companions; details of data collection have been previously published. In a new analysis of that qualitative data, we identified 4 key cognitive deficits that commonly pose challenges in LVR: short-term memory deficits, executive dysfunction, communication barriers, and slow processing speed. To develop strategies to better accommodate each cognitive deficit, we abstracted potential solutions from the interviews. Patient- and companion-generated suggestions were vetted among multidisciplinary team members, who proposed additional strategies. We reviewed the literature relevant to improving health service provision in patients with cognitive challenges. Literature was retrieved on such topics as health literacy, informal caregiver roles, and innovative models of geriatrics care and rehabilitation.

This iterative process produced MORE-LVR, an enhanced LVR program for appropriately screened patients. Patients with cognitive deficits but sufficient cognitive capacity to potentially benefit from educational interventions are appropriate candidates for the MORE-LVR intervention.

MORE-LVR is a 6-week LVR program with 3 primary components (Table 1). The first component is frequent face-to-face training sessions with an occupational therapist (OT) who has expertise in low-vision therapy. The second MORE-LVR component is a simplified training experience, whereby training sessions occur in a quiet, minimally distracting environment and maintain a focused educational agenda. At the outset of MORE-LVR, the participant and OT agree on a maximum of 3 functional goals to address during the 6-week intervention (eg, writing checks, reading the newspaper, taking medications, and/or using the stovetop). The third component of MORE-LVR is a protocol to involve a cognitively and visually intact companion, who may be a friend or family member.

**Pilot Study of MORE-LVR**

**Population**

We recruited persons who presented to the Duke Low Vision Clinic for initial evaluation from October 1, 2010, through March 31, 2011. Inclusion criteria were (1) age of 65 years or older, (2) primary ophthalmologic diagnosis of macular disease, (3) positive screen for cognitive deficit (Figure 1), (4) English fluency, (5) a suitable companion, and (6) at least 1 individualized goal that could be addressed by training the patient to use a closed
Table 1. Components of Memory or Reasoning Enhanced Low-Vision Rehabilitation

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<th>MORE-LVR Components</th>
<th>Key Features</th>
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<td>Frequent and repetitive sessions</td>
<td>Twice-weekly training sessions for 6 weeks At least 10 h of one-on-one training (may occur in clinic or home setting) Standard method to assess and reinforce learning at every session “Teach-back” technique Customized take-home documents</td>
<td>We recommend that the primary practitioner be an occupational therapist with low-vision certification. The practitioner exercises judgment in outlining objectives for each session, number of goals to address per session, and best strategy to achieve goals.</td>
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<td>Simplified training experience</td>
<td>Address only 3 predefined, individualized functional goals during the 6-week intervention Conducive environment (quiet, minimal distractions) Materials are simple, large font Practitioner speaks audibly, avoids jargon</td>
<td>When possible, a single strategy should be selected to address multiple functional goals (eg, mastery of a closed circuit television may enable 2 or 3 of the individualized goals).</td>
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<td>Companion involvement</td>
<td>Protocol for selecting and engaging companion Weekly home practice opportunities to be completed by patient and companion Video to standardize companion training</td>
<td>Companion should be cognitively and visually intact. Protocol was designed to minimize burden on companion, although additional companion participation is welcomed.</td>
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Abbreviation: MORE-LVR, Memory or Reasoning Enhanced Low Vision Rehabilitation.

Figure 1. Cognitive Deficit Screening Form Items From the Cognitive Screen Are Adapted From the Wechsler Memory Scale III-Revised Word List A and the /F/A/S/ Verbal Fluency Test

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The screen was designed to be brief and easy to administer and score. Poor word recall has been linked to worse functional trajectories among low-vision rehabilitation patients, and older adults with macular disease have been shown to exhibit low scores on tests of verbal fluency. The screen is positive if the patient performs below the cut point for word recall or verbal fluency.

Data Collection
Data were collected from patients and companions before intervention (within 2 weeks before the first MORE-LVR session) and after intervention (within 1 week after the final MORE-LVR session). At each time point, participants were administered surveys and interviews by research personnel who were not involved in the rehabilitation intervention.

Measures
Demographic and health-related data were determined by self-report. Ophthalmologic history and visual acuity measures were abstracted from the medical record. Neurocognitive tests included the TICS-m administered in person (not by telephone), Wechsler Memory Scale–Revised Logical Memory I (Immediate) and II (Delayed), and a 15-item version of the Geriatric Depression Scale. The TICS-m is a 50-point global cognitive screening tool for dementia that does not involve vision-mediated tasks (eg, drawing and reading). In the Logical Memory test, 2 short stories are read aloud to the patient, and the patient’s score reflects how many details of the story are recalled immediately (immediate score) and approximately 30 minutes later (delayed score).

Patients were administered the Version 2000 National Eye Institute Vision Function Questionnaire–25 (VFQ-25), a well-validated tool for measuring the influence of visual symptoms on generic health domains and tasks of daily living. Individual items can be combined to derive a composite score or subscale; possible scores on each scale are 0 to 100, with higher scores indicating better function. Five VFQ-25 subscales were evaluated in this study: near-activities, distance-activities, role difficulties, dependency, and social functioning.

We assessed patients’ satisfaction with their ability to perform 8 instrumental activities of daily living: prepare meals, circuit television (CCTV). The CCTV training seemed well suited to piloting the MORE-LVR model because CCTV mastery enables many near-activities, yet cognitive deficits frequently challenge CCTV training. Participants who lacked access to a CCTV were loaned one during the study period and were enrolled in a raffle to receive a CCTV. We excluded patients with severe cognitive impairment (Telephone Interview for Cognitive Status—modified [TICS-m] score <20) who would be unlikely to gain meaningful benefit despite enhanced rehabilitation protocols.

Companions were required to meet the following eligibility criteria: (1) willingness to support the patient’s rehabilitation efforts per MORE-LVR protocol, (2) English fluency, and (3) cognitively intact (no known or suspected dementia and <6 errors on the Short Portable Mental Status Questionnaire).

Abbreviation: MORE-LVR, Memory or Reasoning Enhanced Low Vision Rehabilitation.
do housework, do laundry, manage medications, get places beyond walking distance, shop, manage money, and use the telephone. Patients indicated how satisfied or dissatisfied they were with their ability to perform each task on a scale of −3 (very dissatisfied), −2 (somewhat dissatisfied), −1 (a little dissatisfied), 0 (neutral), +1 (a little satisfied), +2 (somewhat satisfied), or +3 (very satisfied). Summing these scores produced a scale with a range of −24 to +24.

We assessed 4 timed performance measures: looking up a number in a telephone book, finding a recipe in a cookbook and answering questions about it (eg, what to set oven to and how much flour to use), filling in a crossword puzzle answer, and writing a 4-item grocery list. Under standardized conditions, patients were read instructions for each task and timed with a stopwatch, allowing up to 5 minutes to complete each task accurately using a CCTV or other VAE as desired.

Patients and companions ranked the patient’s progress toward attaining the 3 individualized, predefined LVR goals. For each goal, participants indicated whether the patient had progressed not at all (0), a little (1), a lot but not completely (2), or completely (3). Summing these scores across the 3 individualized goals provides the individual goal attainment score, with a possible range of 0 to 9. Before MORE-LVR, participants ranked progress from the time of vision-related activity limitation. After MORE-LVR, participants ranked progress during the rehabilitation program.

**Statistical Analysis**

Descriptive statistics (proportions, means, and standard deviations) were used to characterize the cohort. Preintervention and postintervention measures were compared with the Wilcoxon signed rank test (α < .05).

**Results**

**Enrollment in the MORE-LVR Program**

Initially, study personnel screened all new patients who were 65 years or older with macular disease. In the first 5 recruitment days, 9 of 14 patients screened positive and 6 of them enrolled in the study. Subsequently, to assess the feasibility of incorporating the brief cognitive screen into new patients’ standard evaluation, clinical staff administered the screen and notified study personnel of positive screens. Study personnel were notified of 22 positive screens; 8 of those patients enrolled for a total of 14 enrollees (Figure 2). There were 2 dropouts: 1 patient dropped out before training because of worsening general health, and 1 patient dropped out at week 3, citing that her visual challenges were not significant enough to merit intense rehabilitation.

For 10 participants, cognitive impairment was confirmed on subsequent neurocognitive testing (ie, TICS-m global cognitive assessment scores ≤31 or Logical Memory scores at least 1 SD below the population mean). It is unknown whether the other 2 participants represented false-positive screening results or whether they had cognitive deficits (eg, executive dysfunction) that were not reflected by the additional cognitive tests we administered.

Of these patients, 6 were excluded and 11 declined to participate. Most patients who declined to participate lived more than 30 miles from the study center (and thus were not eligible for in-home training) and could not commit to twice-weekly visits. Two patients indicated that their medical health was too tenuous to participate in the rehabilitation program, whereas another patient was not able to participate because of her duties as a caregiver. Fourteen patients enrolled in the study, and 12 completed the Memory or Reasoning Enhanced Low Vision Rehabilitation intervention. CCTV indicates closed circuit television.

**Adherence to the MORE-LVR Protocol**

The 12 patients who completed the intervention received at least 10 hours of one-on-one training sessions with the OT. More than 80% of weekly practice opportunities were returned. Educational agendas were restricted to 3 predefined goals per protocol. Four patients required longer than 6 weeks to complete 10 hours of training (mean [SD] duration for those patients was 10 [1] weeks with a maximum of 11 weeks); delays resulted from inclement weather, patients’ health events, and winter holidays. During their exit interview, 5 patients (41.7%) endorsed an “illness, injury, or stressful event that was significant enough to impact participation in the program” and 2 endorsed a visit to the emergency department. Level and quality of companion involvement were variable. Eleven companions attended at least 1 training session. One companion withdrew before signing the consent form (this patient was allowed to continue intervention), and 1 companion was incarcerated at week 4.

**Pilot Study Outcomes**

Table 2 and Table 3 summarize the characteristics of the patients and companions at baseline. All patients were white, 9 of 12 were female, and 11 of 12 were 80 years or older (mean [SD] age, 84.5 [4.7] years). They had medically complex conditions, endorsing a mean of 4 of 13 chronic medical conditions (besides vision or cognitive impairments). Eight of 11 companions (72.7%) were of a younger generation, and 4 of 11 (36.4%) were employed.

Table 4 compares the preintervention and postintervention measures of visual function and cognition. Patients achieved statistically significant improvements on the VFQ-25 composite score (47.2 [16.3] to 54.8 [13.8], P = .01) and near-activities score (21.5 [14.0] to 41.0 [23.1], P = .02) but not on the
social functioning score (56.3 [37.6] to 80.3 [21.7], P = .06). Patients demonstrated improvement in the instrumental activities of daily living satisfaction score (P = .05), with mean (SD) scores of 1.4 (12.0) before the intervention (indicating dissatisfaction) and 6.1 (9.9) after the intervention (indicating satisfaction). The mean (SD) time required to accurately fill in a crossword puzzle answer decreased from 205 (103) seconds to 123 (92) seconds (P = .003), and the mean (SD) time to write a grocery list decreased from 155 (116) seconds to 99 (62) seconds. As shown in Figure 3, we also observed qualitative improvements in these performance measures. We did not observe significant differences in the time required to locate specific information in a telephone book or a cook book. Performance on tests of logical memory improved. Before MORE-LVR, patients recalled a mean (SD) of 13.0 (8.6) items from the brief narrative, whereas they recalled a mean (SD) of 18.7 (12.4) items (P = .02) after participation in MORE-LVR. Global cognition and depression scores did not change significantly. All patients and companions endorsed progress toward at least 1 goal, whereas three-quarters endorsed progress toward all 3 pre-defined goals (Table 5).

Discussion

This study demonstrates feasibility and potential efficacy of an enhanced LVR program for older adults with macular disease and cognitive impairments. Patients who received MORE-LVR experienced improvements in measures of visual function (VFQ-25), patient-reported satisfaction and goal attainment scores, timed performance measures, and logical memory tests. Every patient and companion endorsed progress toward pre-defined goals.

The mean VFQ-25 improvements observed (7.6 points on the composite score and 19.5 points on the near-activities score) may be clinically significant, according to previous work indicating that 4- to 6-point changes correspond to relevant outcomes.44,45 However, the VFQ-25 was not designed as a metric for low-vision outcomes, and recent Rasch analyses in low-vision populations suggest some psychometric problems with the instrument’s traditional scaling structure.46,47 In addition, the VFQ-25 scores are influenced by factors besides vision populations suggest some psychometric problems with the instrument’s traditional scaling structure.46,47 In addition, the VFQ-25 scores are influenced by factors besides vision outcomes.44,45 However, the VFQ-25 was not designed as a metric for low-vision outcomes, and recent Rasch analyses in low-vision populations suggest some psychometric problems with the instrument’s traditional scaling structure.46,47 In addition, the VFQ-25 scores are influenced 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We are encouraged that the current study, although small and uncontrolled, found improvements in subjective measures (reported by patients and companions) and objective measures of function and memory. Improvements in memory scores may reflect retesting phenomenon but were not unexpected. We hypothesized that participation in the intensive LVR program would provide some cognitive rehabilitation. Although patients improved in speed and clarity of writing, patients did not become faster on tasks that involved finding information in a book. Such visual scanning tasks may entail greater cognitive demand or more advanced skills, such as use of preferred retinal loci. Future work is needed to refine strategies that promote independence in these tasks for persons with coexisting vision and cognitive deficits.

Larger, controlled studies are needed to determine whether MORE-LVR is superior to usual outpatient LVR for appropriate patients. One issue will be that MORE-LVR, compared with standard LVR, entails some complexity and requires extra time from practitioners. In addition to logging 10 hours of face-to-face sessions with each patient, practitioners would need to familiarize themselves with materials and receive training in cognitive screening, protocols to engage companions, teach-back techniques, and other methods. Future studies will need to consider these start-up costs associated with implementing a MORE-LVR program within a typical LVR clinic. However, given the prevalence of cognitive impairments among LVR patients and evidence that standard LVR may fail to meet their needs despite high resource utilization, the benefit may justify the added complexities of implementing a MORE-LVR program.

Another important consideration related to implementation of MORE-LVR is how to target patients most likely to benefit—those with cognitive deficits but without advanced dementia. We designed a cognitive screen that is brief and easy to administer, assesses key cognitive domains that threaten rehabilitation success, and contains specific items linked to poor functional outcomes in LVR. Because routine administration of more extensive neurocognitive testing is likely impractical, clinical judgment will be required to recognize and exclude patients with advanced dementia.

We sought to design a program that is inherently flexible (eg, goals are individualized, training may occur in clinic or home setting, and OT directs pace of training) yet offers standardized materials and 3 easily reproducible components. We also considered the economic sustainability of the program. Although VAE acquisition and vision rehabilitation therapist–rendered training are noncovered services in low-vision treatment, OT services are reimbursable. Ten hours of MORE-LVR training is provided by an OT, whereas practice at home is aided by an unpaid, informal caregiver. The integration of informal companions in health care processes is increasingly recognized as a promising means to improve cost-effectiveness and quality of care for older adults. Suitable companions were almost always available for eligible participants, and many enrolled patients resided with their companion. For the pilot study, all patients received CCTV training (and a loaner CCTV, if needed), but the MORE-LVR model does not necessarily require CCTV training. Future research should investigate the degree to which MORE-LVR success is dependent on VAE access.

Several limitations should be noted. First, it is possible that similar improvements would have occurred among patients receiving usual or no LVR. Second, we did not collect detailed...
These examples, taken from 2 different participants, demonstrate postintervention improvement on 2 near-vision tasks: filling in a crossword puzzle and writing a grocery list. Instructions were read aloud to patients, who were allowed to use a closed circuit television (CCTV) or other vision assistive equipment to complete each task. After participation in MORE-LVR, the patients completed the tasks more quickly, and the result is more legible. The second patient had a tremor in addition to low vision; her writing improved after receiving training from the occupational therapist relevant to both the tremor and central vision loss. A strength of the MORE-LVR program is that it provides sufficient one-on-one attention from an occupational therapist to address the complex interactions of multiple comorbidities on patients’ ability to achieve their vision-related goals.

information about the intervention sessions (eg, proportion that occurred in home vs clinic). It will be important to examine such factors in future, controlled trials. Third, most cog-

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Low-Vision Rehabilitation Program


