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Utilization and Abandonment of Low Vision Devices Prescribed on a Mobile Clinic

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Abstract

Significance.—Device utilization and abandonment for patients seen on a mobile clinic are explored. Findings are informative for resource allocation in a novel low vision rehabilitation (LVR) delivery model. This study also explores the relationships between device abandonment and LVR patient reported functional outcomes.

Purpose.—This prospective cohort study investigates low vision device utilization and abandonment in a novel mobile clinic delivery model.

Methods.—A device abandonment questionnaire was administered by telephone 3 months and 1 year post mobile clinic low vision rehabilitation (LVR). Participants (n=65) had previously met the U.S. definition of legal blindness, and were prescribed a total of 154 devices at their low vision consultative visits. Trends in device utilization and correlations with clinical and demographic participant characteristics, as well as functional outcomes as assessed by Massof Activity Inventory (AI), are explored.

Results.—An average of 2.6 device recommendations were made per participant. Digital magnification, optical magnifiers, and filters were most frequently recommended. At 3 months 29% of participants abandoned at least 1 device, although only 17% of received devices were abandoned. There was no significant difference in the number of devices used, abandoned, or not received at 3 months versus 1 year post-LVR. Devices prescribed for reading goals were most frequently used and least often abandoned, while glare control and distance magnification devices were more frequently abandoned. Neither patient characteristics nor AI change score were predictive of device abandonment. There was no significant difference in the odds of device abandonment in comparison to a previous study, which assessed academic outpatient LVR clinics using the same questionnaire.

Conclusions.—While more device recommendations are given per patient on the mobile clinic, there is no significant difference in device abandonment for patients seen on the mobile clinic versus other outpatient LVR delivery models

Keywords

low vision rehabilitation; visual impairment; low vision devices; access to care; mobile clinic

With the growing prevalence of age-related eye disease, demand for low vision rehabilitation has expanded.¹ Studies have demonstrated meaningful low vision rehabilitation patient outcomes in multiple clinical settings.^{2,3,4} However, device utilization is not always considered when evaluating low vision rehabilitation intervention effectiveness. Recommendation of devices to help patients achieve visually mediated goals is a critical component of low vision rehabilitation, and device nonuse may preclude patients from experiencing the full benefits of low vision rehabilitation.

Few studies have assessed post-rehabilitation utilization of devices in an outpatient population. One study explored abandonment of near devices approximately one year following low vision optometric exam. Hand magnifiers were most frequently recommended, and 19% of all devices were abandoned.⁵ Another study examined perceived usefulness and frequency of use for optical devices prescribed to first-time low vision rehabilitation patients who had age-related macular degeneration. Devices were reportedly used frequently and were nonbeneficial, with few abandoned 1 week, 1 month, and 3 months after low vision rehabilitation.⁶

Visual function questionnaire data has more commonly been used to assess low vision rehabilitation outcomes. Studies have demonstrated clinical effectiveness using these questionnaires in Veteran's Affairs hospital-based programs^{3,4} and private outpatient low vision rehabilitation clinics². However, visual function questionnaires do not evaluate device utilization, and functional outcome studies have not examined whether device recommendations made during low vision rehabilitation were obtained, utilized, or abandoned. Consequently, the relationship between functional outcome and device use is largely unknown.

Recently, a novel mobile clinic delivery model has been used to provide low vision rehabilitation in areas with a scarcity of low vision providers. This mobile clinic traveled to central locations in different communities to provide low vision rehabilitation for patients who would otherwise lack access. Mobile clinic low vision rehabilitation has been shown to expand access to care while producing clinically meaningful outcomes, comparable to other outpatient low vision rehabilitation clinic delivery models⁷. However, device abandonment has not yet been examined in this sample. Since the mobile clinic travelled to many communities, this delivery model may pose unique challenges in implementation of rehabilitation plans, especially with respect to low vision device receipt and training with prescribed devices. Here, outcomes of device recommendations for mobile clinic low vision rehabilitation patients are investigated, exploring prescribing patterns, receipt, utilization, and abandonment.

METHODS

Participant Enrollment

Enrollment took place between May 2015 and October 2016. Participants recruited for this study had previously been registered as legally blind according to 2014 U.S. Social Security standards (i.e. better eye visual acuity of worse than 0.70 log MAR (20/100 Snellen Equivalent) or visual field subtending less than 20 degrees in the widest diameter) and

scheduled for mobile clinic low vision rehabilitation when recruited. Participants had adequate hearing, English fluency, and cognitive function to provide consent and complete telephone questionnaires. They also were at least 14 years of age. All patients scheduled for mobile clinic low vision rehabilitation during the study period (n=174) were contacted by telephone to determine interest in study participation. Interested participants were enrolled in the study if inclusion criteria were met and at least one device recommendation was provided during initial mobile clinic low vision rehabilitation examination (n=65). Written informed consent was obtained from all participants at the time of mobile clinic low vision rehabilitation. Further detail on enrollment is available in a previous publication⁷. This study was approved by the New England College of Optometry Institutional Review Board and followed the tenets of the Declaration of Helsinki.

Mobile Clinic Low Vision Rehabilitation Intervention

Mobile clinic low vision rehabilitation was delivered to provide usual low vision optometric care, consisting of low vision entrance testing (distance visual acuity, Mars contrast sensitivity, finger counting visual field assessment, Amsler grid), trial frame refraction, reading assessment, device evaluation, and ocular health assessment. Care was provided by final year optometry students in collaboration with an experienced low vision provider and study author (NCR, AGM, or RJ). Near magnification starting points were determined with participants wearing appropriate near correction using the inverse of the MNRead critical print size, identified qualitatively by ear as the last line the patient read at maximum speed. Goal text size and distance acuity were used to determine distance magnification requirements. Final device recommendations were determined based on patient goals, magnification requirements, and patient performance with devices evaluated during the mobile clinic examination.

Mobile clinic low vision rehabilitation examinations culminated in provision of recommendations for devices, spectacles, training, and follow-up examination. Devices were acquired through a grant administered by the state commission for the blind, and as such, were obtained by participants at no personal cost. A number of common optical devices were kept in stock on the mobile clinic (e.g. hand magnifiers, stand magnifiers, certain telescopes), and could be dispensed at the conclusion of the low vision rehabilitation examination. Due to state coverage policies and the grant structure in place, devices that cost more than \$300 (USD) or were not in stock were requested through the usual approval process with the state commission for the blind. These devices, pending authorization, were delivered to participants at a later date.

Data Collection and Analysis

Data were collected using a device abandonment questionnaire, which was previously found to be repeatable in low vision patients presenting to academic outpatient low vision rehabilitation clinics in the United States⁵. The questionnaire was administered by telephone regarding a participant's use of a single device, and was thus administered multiple times to the same participant if he/she received multiple device recommendations. This questionnaire asked participants to report whether they had the device, how frequently it was used, what the device was used to do, and (if applicable) why they did not use the device. Demographic

and clinical examination data (i.e. visual acuity, Mars contrast sensitivity, age, and incoming diagnosis) were also collected during mobile clinic low vision rehabilitation examination.

Additional data were acquired through administration of a validated, psychometrically robust visual function questionnaire: the Massof Activity Inventory. The Activity Inventory was administered by telephone prior to low vision rehabilitation, 3 months post-rehabilitation, and 1 year post-rehabilitation. Data underwent Rasch analysis to generate measures of visual ability at each time point, allowing calculation of a change score (i.e. final visual ability minus baseline visual ability)⁸. While further details regarding Activity Inventory outcome measurements and results in the mobile clinic population have been reported elsewhere⁷, Activity Inventory results are examined here with respect to device use.

Data Analysis—The primary outcome measure in this study was device abandonment 3 months and 1 year post-rehabilitation. Secondary outcome measures included: device non-receipt, device utilization, and frequency of device use. Additional outcomes included the proportion of participants who benefitted from a spectacle prescription (i.e. subjective and/or objective improvement in vision after refraction) issued on the mobile clinic, spectacle abandonment, spectacle utilization, or spectacle non-receipt. The same statistical methods were used to assess outcome measures at 3 months and 1 year post-rehabilitation.

Summary statistics (e.g. totals, means) regarding the number of device recommendations, abandonment, use, or non-receipt were computed using Excel (<https://office.microsoft.com/excel/>). A two-tailed paired t-test at a 95% confidence level was used to explore differences in the number of devices reported as abandoned at 3 months and 1 year.

A multiple linear regression was performed using R statistical software (<https://www.r-project.org/>) to explore predictors of device abandonment. Possible predictors included in this analysis were patient characteristics of age, visual acuity, contrast sensitivity, number of systemic comorbidities, and overall Activity Inventory change score. Pearson correlation coefficients were calculated for device abandonment in participants with central versus peripheral vision loss, and for device abandonment and prior low vision rehabilitation experience.

Odds ratios were calculated using Excel (<https://office.microsoft.com/excel/>) to determine the odds of a participant abandoning one or more devices, as well as the odds of any mobile clinic device recommendation being abandoned. Odds were calculated in comparison with data extracted from Dougherty et al's 2011 paper⁵. Confidence intervals at a 95% level were constructed to determine whether odds ratios were significant (i.e. confidence interval did not include 1).

RESULTS

Participants and Recommendations

Participants (n=65) enrolled in this study had a mean better eye visual acuity of 0.93 log MAR (20/170 Snellen equivalent, median = 0.90 log MAR, interquartile range 0.49 – 1.09 log MAR) and a binocular Mars contrast sensitivity of 0.87 log CS (± 0.40). Of those who

enrolled, 11 qualified as legally blind based exclusively on visual field, while 48 qualified based on visual acuity. All participants with visual field loss presented to the mobile clinic with previous visual field results from their local eye care provider, with whom they maintained routine care. The 6 participants who did not meet the definition of legal blindness upon presentation to the mobile clinic were allowed to continue in the study, but were also advised to follow up with their local eye care provider to ensure appropriate service eligibility.

Mean age was 72.5 years and 47% of participants received their first low vision rehabilitation examination on the mobile clinic. Participants in this analysis had an average of 2.4 self-reported systemic comorbidities, most often including heart disease, neurological disorder, or psychosocial disorder. Further detail of sample demographics has previously been reported.⁷

Of those enrolled, 45% (n=29) benefitted from a spectacle prescription. While most of these recommendations were provided to optimize distance vision (n=22), many participants (n=18) also benefitted from an age-appropriate add which provided minimal appreciable magnification but was useful for daily living tasks (e.g. seeing food on a plate, maintaining focus of computer or electronic magnifier screen). There was no significant association between lack of prior low vision rehabilitation and benefit from spectacle prescription ($P=.29$, $t=.77$, $df=62$).

Recommendations for devices were provided to all participants, averaging 2.6 (median = 2, range 1–6) recommendations per participant. This is larger than the 1.4 device recommendations per participant seen in previous work⁵. A total of 154 devices were recommended. Digital magnification, optical magnifiers, and filters were most frequently recommended, while optical character recognition technology and use of a smartphone app were less common (Table 1).

Utilization 3 Months after Low Vision Rehabilitation

At 3 months, 65 participants provided data about 151 devices. Most devices were actively in use (n=100, 66% of all recommendations) while some had not yet been received (n=30, 20% of all recommendations) and fewer devices had been abandoned (n=21, 14% of all recommendations). Devices were most often in use and least often abandoned regardless of the number of device recommendations received per participant (Table 2). Of device recipients, 29% had abandoned 1 or more device. Overall, 17% of devices that were received by 3 months were also abandoned. Most devices that were prescribed for reading tasks (e.g. electronic or optical magnifiers) were used on a daily basis, and devices recommended for glare control or distance magnification accounted for most instances of abandonment.

No digital magnification devices were abandoned, with all either in use (n=15) or not yet received (n=17). All hand magnifiers had been received, with 37 actively in use and 1 abandoned. Of received devices, most spectacle-based magnification (n=6) and all stand magnifiers (n=2) were actively used. No optical character recognition technology had been obtained. While the majority of telescopes were in use at 3 months, they were also the most likely device to have been abandoned (Table 1).

Of the 29 spectacle prescriptions issued, 4 had been abandoned, while 13 (45%) were actively in use and 12 (41%) had not been obtained.

Utilization 1 Year after Low Vision Rehabilitation

One year post-rehabilitation device utilization was assessed across 51 participants regarding 99 devices. At one year, 68 devices were actively in use, while 15 had been abandoned and 16 were not yet received. Most devices continued to be in use irrespective of the number of device recommendations received per participant (Table 2). Participants lost to follow up at 1 year tended to have more systemic comorbidities and poorer contrast sensitivity than the rest of the sample, but these differences did not achieve statistical significance. Devices recommended for reading were most commonly used daily, with infrequent abandonment. Distance magnification devices were most often abandoned, while devices providing glare control were most often used on a daily to weekly basis (Figure 1).

Digital magnification and hand magnifiers continued to be most frequently used 1 year post-low vision rehabilitation, with infrequent abandonment (3 digital devices abandoned and 1 hand magnifier abandoned). Stand magnifiers and spectacle-based magnification continued to be in use by most participants for whom they were recommended, while telescopes were more often abandoned than used or not received (Table 1). There was no significant difference at 3 months versus 1 year in the proportion of devices abandoned ($P=.23$, $t=.82$, $df=16$), used ($P=.89$, $t=.38$, $df=16$), or not received ($P=.53$, $t=.60$, $df=16$).

Of those who completed 1 year post-rehabilitation data collection, 14 had received spectacle prescriptions at their initial low vision rehabilitation examination. Abandonment occurred in 3 participants, while most actively used their new spectacles ($n=7$, 50%) or had never received or pursued them ($n=6$, 43%).

Predicting Abandonment

A multiple linear regression was used to determine if device abandonment could be predicted by age, visual acuity, contrast sensitivity, number of systemic comorbidities, or overall Activity Inventory change score. None of these variables were significantly predictive of device abandonment at 3 months or 1 year. Additionally, Pearson correlation coefficient testing showed that there was no significant difference in device abandonment for patients with central versus peripheral vision loss. A similar number of recommendations per patient was seen for patients with central (mean = 2.2, median = 2 recommendations per patient) versus peripheral (mean = 2.5, median = 2 recommendations per patient) vision loss. A lack of prior low vision rehabilitation experience also was not predictive of device abandonment.

Within the study period, 26 participants were advised to return for a follow up mobile clinic low vision rehabilitation examination. Of participants who were noncompliant with recommended follow up schedule ($n=11$), 36% abandoned one or more device at 3 months, while 55% abandoned at least one device 1 year post-rehabilitation. For those who complied with follow up recommendations ($n=13$), 38% abandoned at least one device at 3 months while 31% abandoned at least one device at 1 year. Additional devices were prescribed during follow up mobile clinic low vision rehabilitation for 2 participants due to changes in

visual function or visual demands. One of these two participants was subsequently lost to follow up, while the remaining participant had received only one new device recommendation. Consequently, devices recommended at follow up were excluded from this analysis. A number of participants were also referred for additional training (i.e. 28 participants referred for orientation and mobility training, 16 referred for rehabilitation therapy). The number of therapy sessions each participant received varied and was determined by the therapist who provided services.

Evaluation in Comparison to Previous Work

In comparing the likelihood of participants abandoning one or more device, those seen on the mobile clinic had greater odds of abandoning at least one device than participants enrolled in Dougherty et al⁵, although the difference was not statistically significant. This was true at both 3 months (odds ratio = 1.5, 95% CI: .72 – 3.14) and one year (odds ratio = 1.37, 95% CI: .62 – 3.05).

The odds of any device being abandoned during the mobile clinic study period versus in Dougherty et al's study were also determined. Similar odds were seen at 3 months (odds ratio=.93, 95% CI: .48 – 1.79) and one year (odds ratio=.97, 95% CI: .47 – 2.01) in comparison to Dougherty et al. There was no significant difference in overall device abandonment.

DISCUSSION

This study found that abandonment occurred for 17% of received mobile clinic device recommendations at 3 months and 18% of received mobile clinic device recommendations at 1 year. Additionally, 29% of the mobile clinic study participants abandoned at least 1 recommended device. No significant difference in the odds of abandoning at least 1 device or of overall device abandonment was found in participants in the mobile clinic study versus participants in a study conducted in U.S. academic outpatient low vision rehabilitation clinics.⁵

The similar abandonment found in these studies is surprising in consideration of differing patient characteristics and care accessibility in the two samples. While participant demographics were similar in age and primary cause of visual impairment, those enrolled in the mobile clinic study had more severe visual impairment and therefore may have greater need for devices. Additionally, limited access to low vision rehabilitation care was the hallmark of participants enrolled in the mobile clinic study, as patients were seen on the mobile clinic due to a severe lack of low vision providers in their communities. This is reflected in the 47% of participants who experienced their first ever low vision rehabilitation examination on the mobile clinic despite their moderate to severe visual impairment.⁹

While inability to obtain low vision rehabilitation care and devices elsewhere would be expected to decrease the likelihood of abandonment, it also makes follow up low vision rehabilitation and training particularly challenging to implement, which could ultimately prevent successful device utilization. Providers may alter typical prescribing patterns and follow up protocol to best meet patient goals in a timely fashion, as the mobile clinic may

not return to a given community for several weeks. This is reflected in the increased number of device recommendations per patient given on the mobile clinic versus in academic outpatient low vision rehabilitation clinics⁵. The similarity in abandonment for patients seen on the mobile clinic versus other delivery models indicates that a modified management strategy may not have impacted successful device utilization. The lack of significant difference between abandonment and utilization of devices 3 months and 1 year post-rehabilitation also suggests that follow up examination was appropriate, and sufficient training was provided to allow consistent device use over time.

Overall, the majority of recommended devices were received during the course of this study, with only 20% of devices at 3 months and 16% of devices at 1 year having never been received. Electronic magnifiers were the most likely device not to be received, despite the rarity of abandonment and the common report of daily use by participants who had received their device. In the U.K., research has found portable electronic magnifiers to be the device of choice for leisure reading in experienced optical magnifier users, and a cost-effective supplement to optical devices.^{10,11} Together, these findings support the importance of electronic magnifier provision, even in a setting with limited financing.

Devices such as filters and telescopes, which were more often abandoned, may have been less successful due to certain limitations. Filters, while frequently used, were also frequently abandoned. Abandonment may be related to limited ability to evaluate filters in patients' natural environments. Often, local rehabilitation therapists or case workers from the commission for the blind adjusted filter recommendations as needed while providing care in patients' homes. This led to abandonment of the mobile clinic device despite replacing that device with one better suited to the patient's specific needs.

Telescopes were most often abandoned in this sample. However, telescopes were less commonly recommended than many other devices, with the majority of recommendations being for a full-field spectacle Galilean telescope that provides approximately 2x magnification and is designed for television viewing. While all subjects reported subjective improvement with this approach during the clinical session, based on a mean visual acuity of 0.93 log MAR (Snellen equivalent: 20/170), this would only be expected to improve patients' visual acuity to 0.63 log MAR (Snellen equivalent: 20/85)¹². Thus there was perhaps inadequate reserve to achieve television viewing goals. Other telescope types (e.g. bioptic, monocular) were recommended too infrequently to enable sub-analysis in this sample. Further exploration of abandonment of devices which provide distance magnification would be informative.

In addition to low vision devices, spectacle prescriptions were issued on the mobile clinic. Improvement with refractive correction was common, with 45% of participants found to benefit from some form of distance and/or near correction. In this study, spectacles were considered beneficial if participants reported a subjective improvement, with or without a measurable improvement in visual acuity. Previous studies have used change in visual acuity to determine benefit from spectacle correction. However, the percent of participants experiencing a benefit from spectacle correction in this study was substantially larger than what has previously been reported¹³, likely in part due to limited accessibility of low vision

rehabilitation. Since the mobile clinic serves patients in areas with a scarcity of low vision rehabilitation providers, many participants may have not had a thorough refraction in the recent past.

While this study's strengths include its prospective design, use of a questionnaire previously found to give repeatable results,⁵ and good 3 month post-rehabilitation retention, it does have several limitations. There was a sizable decrease in the number of devices reported about at 1 year as some participants were lost to follow up. Additionally, the questionnaire used in this study does not provide information about intensity and duration of use. The self-report data collected in this study is not objective, and is thus subject to recall bias. The small proportion of devices that were abandoned limits our ability to determine patient characteristics predictive of abandonment.

Another qualification that must be made regarding results involves financing of recommended devices. In the United States, low vision devices are not covered by major medical insurances, including Medicare. Participants in this study received devices through a grant administered by the state commission for the blind. Abandonment, therefore, may differ in populations which must pay out of pocket. However, our results' agreement with Dougherty et al⁵, in which participants likely purchased their own devices, suggest that this may not be the case.

This study shows that device abandonment in a mobile clinic population is similar to that previously assessed for outpatient low vision rehabilitation. Findings of this study contribute to our understanding of device recommendation effectiveness, which may be an important consideration for policy decisions regarding resource allocation in providing devices to low vision rehabilitation patients. In general, there was strong acceptance and utilization of devices, particularly those recommended for near tasks.

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Figure 1.

Frequency of Device Use: The number of devices used to achieve reading (gray bar), glare control (white bar), and distance magnification (black bar) goals are shown based on frequency of use at 3 months (**A**) and 1 year (**B**). At both time points, reading devices were used most frequently, most on a daily basis. Glare control and distance magnification devices were most frequently abandoned.

Table 1.

Number and Type of Devices Utilized at 3 Months and 1 Year.

	3 Months				1 Year			
	Recommended	Abandoned	In Use	Never Received	Recommended	Abandoned	In Use	Never Received
Digital magnification	32	0	15	17	25	3	17	5
Filters	36	7	27	2	18	3	13	2
Hand magnifier	39	1	37	0	28	1	26	1
Optical Character Recognition technology	3	0	0	3	1	0	0	1
Smartphone app	2	1	1	0	1	1	0	0
Spectacle-based magnification	11	3	6	2	6	0	4	2
Stand magnifier	4	0	2	2	4	1	2	1
Telemicroscope/loupe	5	2	2	1	5	1	2	2
Telescope	19	7	9	3	11	6	2	3
Spectacle Prescriptions	29	4	13	12	16	3	7	6

Table 2.

Device Recommendations per Participant at 3 Months and 1 Year.

	Three Months				One Year		
	Recommended	Abandoned	In Use	Not Received	Recommended	Abandoned	In Use
1 device	20	1	17	2	12	2	7
2 devices	44	7	28	9	32	3	22
3 devices	51	8	32	11	34	6	20
4 devices	35	5	22	8	25	5	17
							3