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Glaucoma Medication Adherence One Year After the Support, Educate, Empower (SEE) Personalized Glaucoma Coaching Program

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Abstract

Purpose: To assess the efficacy of the Support, Educate, Empower (SEE) glaucoma coaching program on medication adherence among poorly adherent glaucoma patients for 12 months following cessation of the intervention.

Design: Uncontrolled intervention study with a pre-post design

Participants: The SEE cohort was recruited from the University of Michigan and included glaucoma patients age 40, taking 1 medication, who self-reported poor adherence. Electronic medication monitoring of those who completed the program continued for up to 1-year post-coaching intervention.

Methods: Adherence was monitored electronically (AdhereTech, New York, NY) during the 7-month program and 12-month follow up period. Adherence was the percentage of doses taken on time. Participants were censored for surgery, change in glaucoma medications or adherence

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monitor disuse. The SEE program included automated medication reminders, three in-person motivational interviewing-based counseling sessions with a glaucoma coach, and five phone calls with the coach for between-session support. There was no contact between the study team and participants during the 12-month post-program cessation follow-up. Baseline participant characteristics were summarized with descriptive statistics. Paired t-tests and Wilcoxon signed rank tests were used to investigate significant changes in monthly adherence during follow-up.

Main Outcome Measures: Change in electronically monitored medication adherence over the 12 months following the conclusion of the SEE program.

Results: Out of 48 participants, 39 (81%) completed the SEE program and continued electronic medication monitoring for up to 1-year after program cessation. Participants were on average 64 years old (SD=10), 56% were male, 49% were Black, and 44% were White. The average length of follow-up was 284 days (SD=110, range= 41 to 365 days). Censoring occurred in 18 participants (56%). Average adherence during the follow-up period was 67% (SD=22%). This was significantly lower than adherence during the SEE program (mean=81%, SD=18%, p<0.0001), but significantly higher than baseline preprogram adherence (mean=60%, SD=18%, p=0.0393). The largest monthly losses occurred at months 1 (mean=7%, p=0.0001) and 4 (mean=6%, p=0.0077).

Conclusions: Glaucoma medication adherence decreased significantly in the year after cessation of the SEE coaching program but remained significantly higher than baseline. To maintain excellent long-term medication adherence, intermittent reinforcement sessions may be necessary.

Précis:

A cohort of non-adherent glaucoma patients underwent a motivational interviewing-based personalized glaucoma coaching intervention. Medication adherence decreased in the year following conclusion of the intervention but remained significantly higher than baseline.

Keywords

glaucoma; medication adherence; long-term follow up

Introduction

Despite the existence of effective treatments, glaucoma is the leading cause of irreversible blindness globally.[1] One important modifiable driver of this is poor medication adherence. Approximately 80% of adults with glaucoma do not take their medications appropriately,[2–4] and poor medication adherence is associated with visual field loss.[5,6] Thus, designing effective disease self-management programs to improve glaucoma medication adherence is critical to decrease vision loss from glaucoma.

Successful medication adherence interventions across many chronic diseases have been built on theory, utilized tailored education and reminder systems, and employed motivational interviewing (MI)-based counseling.[7,8] The Support, Educate, Empower (SEE) program, one of the first interventions to incorporate all of these features to support glaucoma self-management, is a personalized glaucoma coaching program based on principles of Self-Determination Theory and uses MI techniques, personally tailored education and reminder

systems to help patients find autonomous motivation to improve their glaucoma medication adherence. As previously described in the SEE program pilot study,[9] glaucoma medication adherence following the 7-month SEE program increased from 60% at baseline to 81% after the seven-month program that included three in-person coaching sessions with five between-session check-in phone calls (P<0.0001). At the end of the program, 59% of participants had adherence greater than 80%.

While the SEE coaching program improved glaucoma medication adherence during the intervention, a strong body of literature shows that the effects of behavior change interventions generally wane over time.[10–12] Furthermore, given the chronic, progressive nature of glaucoma, successful interventions must ultimately show an effect over many years.[13] Accordingly, we aimed to assess glaucoma medication adherence among SEE program participants in the 12 months following cessation of the seven-month intervention and to understand patterns of continued adherence. We hypothesized that adherence would decrease significantly from program completion levels in the year after the intervention without the continuous support and reminders from the SEE program.

Methods

The SEE program is a seven-month intervention consisting of automated medication reminders, three in-person counseling sessions with an ophthalmic technician or health educator trained as a glaucoma coach, and five phone calls with the same coach for between-session support.[9] The glaucoma coach was trained in MI techniques and utilized a web-based tool to create an educational plan tailored to the participant's glaucoma diagnosis, test results, doctor's recommendations and barriers to medication adherence. This tool supported the coach with prompts that guided an MI-based conversation with the participant to identify and overcome barriers to optimal glaucoma medication adherence. Participants could elect to receive no medication reminders versus some combination of audible or lighted reminders on the electronic medication bottle and/or a text message or automated phone call reminding them to take their medication when it was time to instill eyedrops.

Participants provided informed consent for electronic monitoring of their glaucoma medication use during the study period, including the 12 months following the conclusion of the SEE coaching program intervention. The study coordinator sent messages to treating physicians to report on patient adherence data following each in-person study visit. Following the cessation of the 7-month SEE coaching program, there was no contact between study personnel or glaucoma coaches and participants during the 12-month follow up period, although participants continued to see their treating physician for usual care.

Descriptive statistics of participant demographics were computed, including means, standard deviations (SD), frequencies, and percentages. Medication adherence in the 1-year follow-up after the SEE coaching program was calculated as the number of glaucoma medication doses taken on time by the number of doses prescribed, multiplied by 100 to convert to the percentage scale. "On time" was defined as within a specified time window of the dose on the previous day, specifically 24+/−4 hours for medications dosed once daily, 24+/−2 hours for medications dosed twice daily, and 24+/−1.3 hours for medications dosed thrice daily.

When calculating adherence for medications dosed more than once daily, we compared the current day's doses with the previous day's doses instead of the previous dose because lifestyle and sleeping patterns can result in unevenly spaced medication administration times.[9] Percent adherence was calculated over all available post-SEE follow-up and at 1-month intervals. Follow-up was censored at the time of glaucoma laser or incisional surgery, any change in glaucoma medication, or if the adherence monitor became inactive (at the last recorded dose taken). Follow up was censored if there was a change in the glaucoma medication regimen, because the new medication could not be electronically monitored as the study team purposefully stopped all contact with participants and could not set up a new adherence monitor.

Adherence over follow-up was summarized with descriptive statistics and compared to baseline adherence (pre-counseling) and adherence during the SEE coaching program with paired t-tests. As this was a pilot study, there was no control group that did not receive the SEE coaching program. A scatterplot was used to visualize follow-up adherence in relation to adherence during the SEE program. Side-by-side boxplots were used to show the distribution of adherence monthly over follow-up and to observe temporal trends. Paired t-tests and Wilcoxon signed rank tests were used to test for significant changes in monthly adherence during follow-up. SAS version 9.4 was used for all statistical analysis (SAS Institute, Cary, NC). This study was approved by the University of Michigan Institutional Review Board and adhered to the tenets of the Declaration of Helsinki.

Results

All 39 participants who completed the SEE coaching program continued electronic medication monitoring for up to 1-year after program cessation. These participants were on average 64 years old (SD=10), 56% were male, 49% were Black and 44% were White. The average amount of follow-up was 284 days (SD=110, range= 41 days to 365 days). Over half (21 participants, 54%) completed one full year of follow-up. Censoring of follow-up occurred in 18 participants (56%), including 3 censored for having glaucoma laser or incisional surgery, 3 censored for changes in glaucoma medication that could not be electronically monitored, and 12 censored for adherence monitor inactivity. Of those censored, 4 (10%) completed 10-11 months of follow-up, 3 (8%) completed 7-9 months of follow-up, 8 (21%) completed 4-6 months of follow-up, and 3 (8%) completed up to 3 months of follow-up adherence monitoring.

Adherence during the entire follow-up period was on average 67% (SD=22%). This was a statistically significant decrease from adherence during the SEE coaching program (mean=81%, SD=18%, p<0.0001; Table 1), but statistically significantly better than baseline pre-SEE program adherence (mean=60%, SD=18%, p=0.0393; Table 1). Compared to adherence during the SEE program, 2 participants (5%) improved their adherence between 10-15% during follow-up and 9 participants (23%) had follow-up adherence within +/−5% of adherence during the SEE program (Figure 1). The remaining 28 participants (72%) had decreases in medication adherence during follow-up of 5-10% (n=7), 10-20% (n=7), 20-30% (n=9), 30-40% (n=3), and 50-60% (n=2).

Descriptive statistics of monthly medication adherence and change in adherence after completing the SEE program are presented in Table 2. Medication adherence showed an average initial decrease of 7% (SD=11%) during the first month after completing the SEE program (mean adherence during SEE = 81%; 1-month follow-up adherence = 74%; p=0.0001). In the subset of participants who completed the entire year of follow-up (n=21), their adherence at month 12 showed an average decrease of 14% from adherence at the completion of the SEE Program (SD=17%, p=0.0003). Monthly trends in follow-up medication adherence revealed that most loss in adherence occurred within the first 4 months after completing the SEE program and leveled off thereafter (Figure 2). The 2 largest monthly losses occurred at month 1 (mean=7%, p=0.0001) and month 4 (mean=6%, p=0.0077).

As a sensitivity analysis, we re-calculated adherence during censored time periods assuming either 0% adherence or 100% adherence for the medication regimen observed at the end of the intervention. During the 1-year follow-up period, average adherence excluding censored time periods was 67% (SD=22%; median=70%). Adherence decreased to an average of 54% (SD=29%; median=58%) when assuming 0% adherence during censored time periods and increased to an average of 76% (SD=16%; median=78%) when assuming 100% adherence during censored time periods.

Discussion

In this study of glaucoma medication adherence after the SEE personalized coaching program intervention, we found that while glaucoma medication adherence decreased in the year after the intervention, it remained significantly higher than pre-intervention levels. Adherence decreased the most in the first four months after completing the SEE program, with the largest decreases at month one and month four. Analyzing long term follow up is critical when evaluating glaucoma self-management interventions because glaucoma slowly progresses over years, and medication adherence in chronic disease generally decreases over time.[13–17] Thus, to impact the disease course, interventions need to be effective over many years.

The minimal clinically important difference (MCID) for glaucoma medication adherence varies depending on the intervention cost and the burden to the practice and the physician.[18] The SEE intervention falls into the category of "less costly or physician time-intensive interventions," for which experts believe the MCID is 5-15%.[18] By this standard, the improvement from 60% adherence at baseline to 67% adherence 1 year after cessation of the SEE program is clinically significant. However, the decrease in adherence from 81% during the SEE program to 67% one year later is more clinically relevant. Prior studies have showed significantly worse visual field progression at adherence rates less than 80%.[19] Thus, it is critical to develop strategies to maintain glaucoma medication adherence at SEE program intervention levels.

Currently there is limited long-term follow-up data on successful glaucoma medication adherence interventions. A study of newly diagnosed glaucoma patients randomized to receive two 60-90 minute small group glaucoma education sessions led by an

ophthalmologist versus normal care found that the intervention group had higher medication persistence at one year compared to controls (89% versus 77%, p=0.049) based on pharmacy claims data.[20] The Medication Adherence in Glaucoma Improvement Study (MAGIC) was a randomized controlled trial which employed a one time, 45-minute conversation between a non-adherent glaucoma patient, the patient's companion and a trained technician addressing individual barriers to glaucoma medication adherence.[21] The mean proportion of doses taken on schedule in the six months after randomization was statistically and clinically significantly higher in the intervention group compared to the control group (0.85 versus 0.62, P<0.0001). However, similar to our study, adherence in the MAGIC study decreased over six months. The decrease in adherence occurred in both the control and intervention groups but remained significantly higher in the intervention group compared to the control group throughout the six-month time period (P=0.003).

We built on prior work by analyzing glaucoma medication adherence monthly for 12 months following the cessation of the SEE personalized glaucoma coaching program intervention. The significant short-term improvements in adherence following the SEE program indicate that the initial dose of intervention—consisting of automated medication reminders, three in-person counseling sessions with a glaucoma coach, and five between-session phone calls with the same coach—improved glaucoma medication adherence. However, research suggests that no matter how effective short-term gains are with behavior change, ongoing support helps with behavior change maintenance. The impact of diabetes self-management interventions has been found to diminish over time,[11,22] but reinforcement following the conclusion of the intervention may improve long term glycemic control.[11] For example, a randomized controlled trial in which the intervention group received three diabetes group education classes within three weeks followed by three additional education sessions every four months over the 12-month follow-up period found a statistically significant improvement in glycemic control at the end of the follow-up period.[23] One study of weight loss in women with type 2 diabetes compared the efficacy of individual motivational interviewing sessions (every three months for one year) combined with group based behavioral therapy for obesity (for 18 months) to a control consisting of the same group based therapy for obesity plus an attention control consisting of individual education sessions about women's health.[24] The authors found that the group randomized to individual motivational interviewing sessions had significantly greater weight loss at 18 months compared to the control arm.[24] Weight loss was significantly greater in the motivational interviewing group than the control group during the first six months of the intervention, and weight remained stable in the motivational interviewing group through months 6-12 while the control group had weight regain. However, weight regain occurred in the motivational interviewing group between 12 and 18 months once motivational interviewing sessions had ceased, even though the group-based behavioral therapy continued.[24] Thus, to achieve long term glaucoma medication adherence, we will likely need to adopt scalable, ongoing individualized approaches to support maintenance of behavior change.

The greatest declines in glaucoma medication adherence following the SEE program took place at 1 month and 4 months after the intervention. We cannot attribute these declines to the Hawthorne effect, as we saw that the Hawthorne effect waned after 2 months of electronic monitoring in the pre-SEE program intervention phase of the study.[9] The timing

of the largest declines in medication adherence after the SEE program suggest that quarterly coaching booster sessions after the initial program may help to promote continued excellent glaucoma medication adherence. If medication adherence for large patient populations could be easily monitored in real time, it would be ideal to tailor the booster sessions to times when people's adherence levels fell below the 80% threshold, which is associated with more severe visual field defects.[19] Diabetes self-management program reimbursement could serve as a model for glaucoma self-management reimbursement, as Medicare currently reimburses for group or individual diabetes counseling in 30 minute sessions ten times in the first year after diagnosis of diabetes or a diabetic complication.[25] In subsequent years, Medicare reimburses four thirty-minute sessions for maintenance.[25] Reimbursing for glaucoma self-management programs similar to diabetes self-management support reimbursement would enable the uptake of such programs into clinical practice.

It is likely that, as with most therapies, the optimal dose and frequency of counseling from the glaucoma coach in the SEE intervention will vary by patient. Patient-level factors associated with greater improvements in medication adherence during the intervention phase included fewer glaucoma medications, greater glaucoma-related distress and lower income. Other patient-level factors, including visual field loss, glaucoma severity, visual acuity and systemic comorbidities, were not associated with degree of improvement in medication adherence during the intervention phase.[26] Most participants had a decrease in adherence the year after the SEE intervention, and they may benefit from booster counseling sessions. However, two participants had an increase in adherence the year following the intervention, and they would not need booster sessions. This highlights the importance of tailoring the dose of counseling to individual patient needs. Being able to monitor daily glaucoma medication adherence for all people with glaucoma would enable highly tailored interventions, where coaching sessions and phone calls could be triggered by individual adherence levels falling below 80%.

This study has notable strengths. It is one of the few studies to measure glaucoma medication adherence for a full year after an intervention. Medication adherence in the year following the intervention was monitored using electronic medication monitoring, which is the gold standard. This study also has limitations. As this was a pilot study, there was no control group comparator. We do not have qualitative data to explain participants' behavior, for example why two participants had increased adherence 12 months after the intervention. Although several glaucoma medication adherence studies have used similar technology,[19,21,27] the AdhereTech electronic medication adherence monitor used in this study has not been previously validated. We were not able to measure glaucoma medication adherence after a medication change or surgery, and if a participant discontinued using their medication adherence monitors it was unknown if the participant stopped the medication entirely or simply stopped using the medication adherence monitor. Given the small sample size in this pilot study, we did not have the power to analyze post-intervention adherence by factors such as race, income, or baseline attitudes. This study was conducted at one academic medical center and only included nonadherent glaucoma patients, so the results may not be generalizable.

In conclusion, participants who underwent the SEE personalized glaucoma coaching program had improved glaucoma medication adherence one year after the intervention compared to baseline. However, adherence decreased sharply over the course of the year from adherence levels during the SEE program intervention. Additional doses of personalized coaching are likely necessary to maximize the impact on long-term glaucoma self-management. Future work should focus on determining the optimal dose and frequency of such longer-term interventions.

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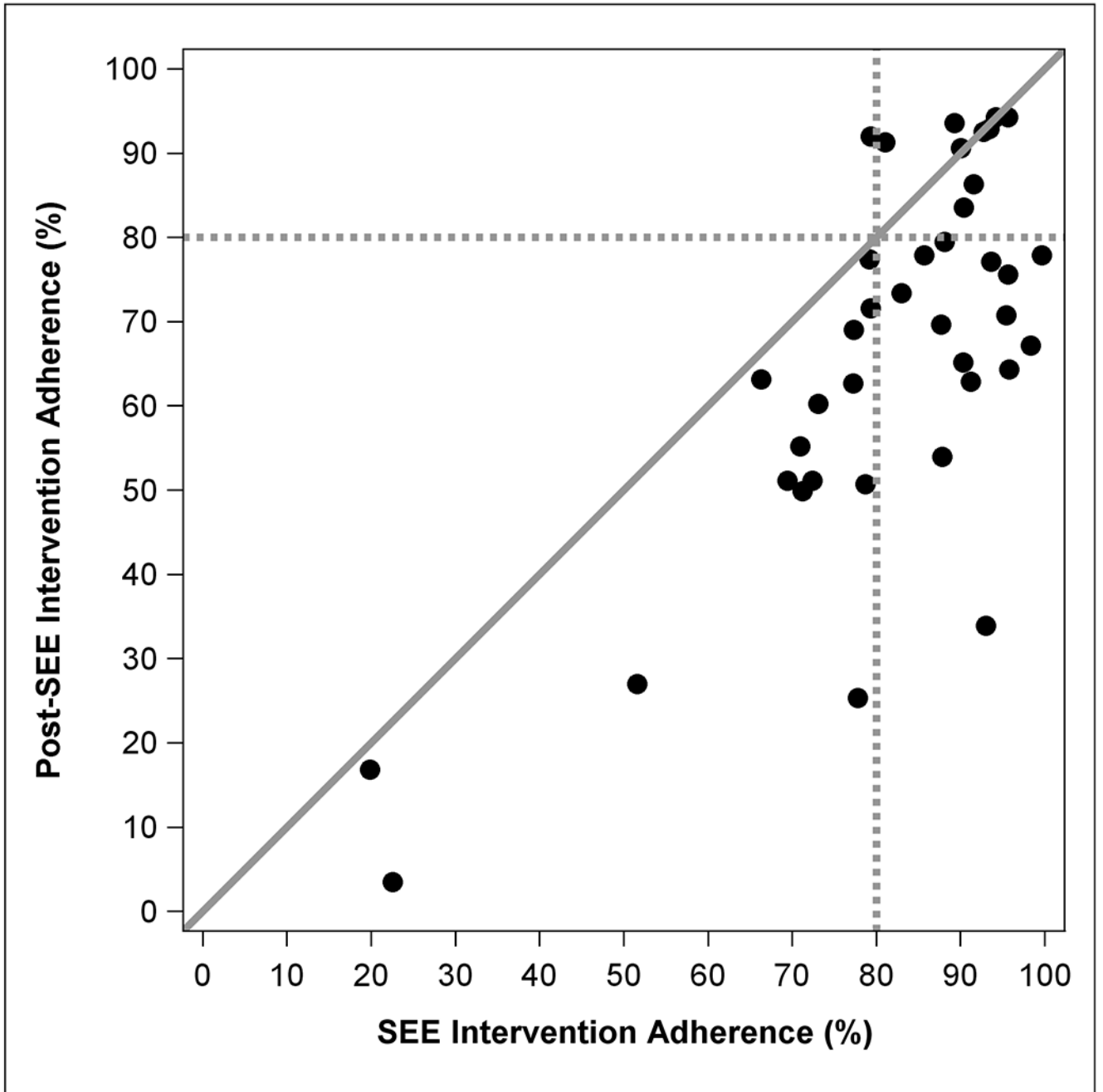
Figure 1:
Scatterplot of adherence during versus after SEE counseling
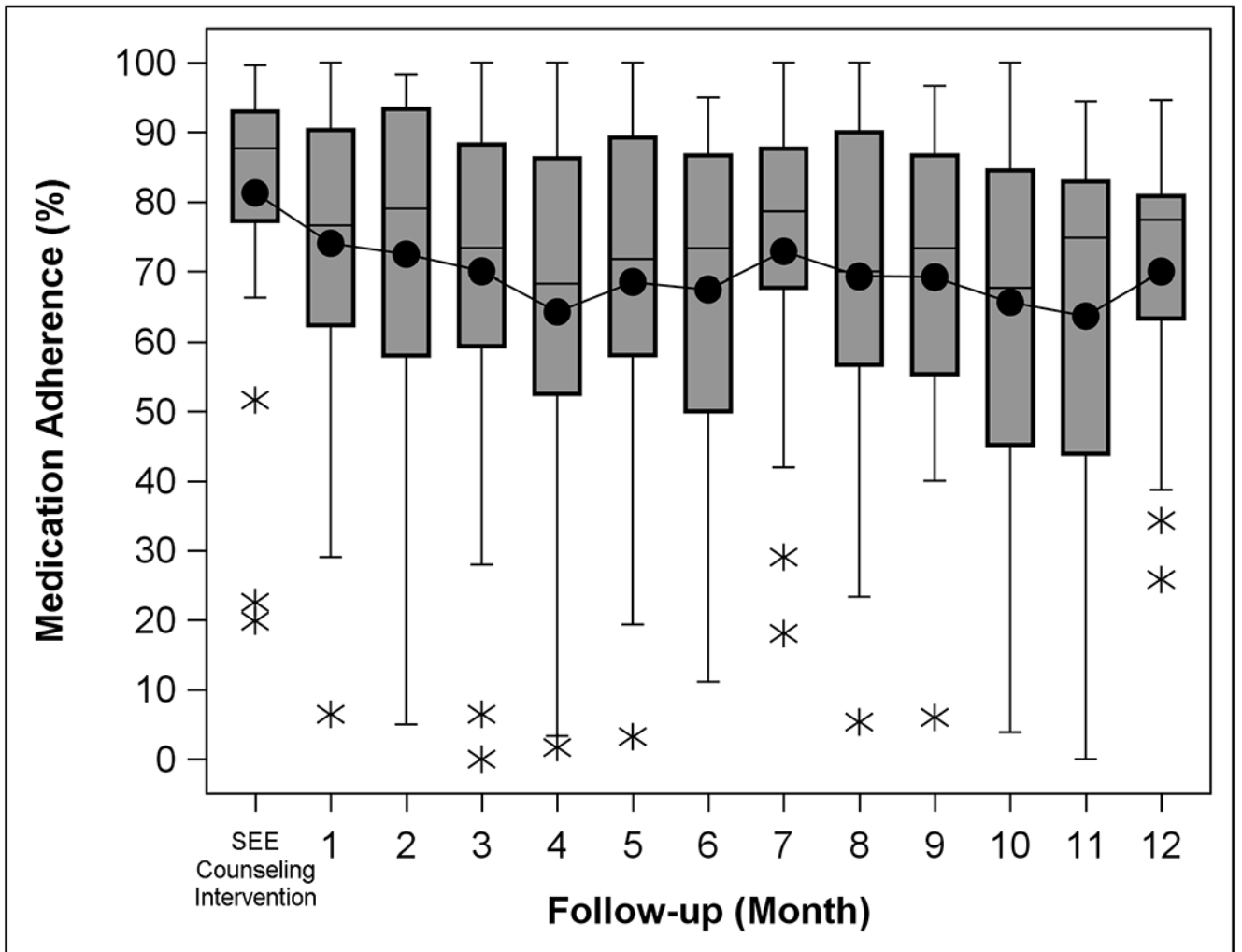
Figure 2:
Side by side boxplots for adherence over time

Table 1.

Comparison of medication adherence before, during, and after the SEE counseling intervention (n=39). Note: pre-SEE adherence is calculated as the median monthly adherence over 3 months of pre-treatment monitoring; adherence during the SEE intervention is calculated over the 6-month period of intervention; post-SEE adherence is calculated over all available follow-up, up to 12 months post-intervention.

Time	Mean (SD)	Min, Max	Median	P-value[*]
Pre-SEE	59.9 (18.5)	13.3, 80.0	67.5	0.0393
During SEE	81.3 (17.6)	19.8, 99.6	87.7	<0.0001
Post-SEE	66.5 (22.5)	3.4, 94.3	69.7	

[*] paired t-test comparing medication adherence post-SEE intervention to that during or pre-intervention

Table 2.

Change in medication adherence from during SEE intervention to follow-up after completion of the SEE intervention

Follow-up	N	Percent Adherence		Change from adherence during SEE				Change from Previous Month			
		Mean (SD)	Median	Mean (SD)	Median	P-value[*]	P-value[**]	Mean (SD)	Median	P-value[*]	P-value[**]
Month 1	39	74.0 (20.4)	76.6	−7.3 (10.7)	−7.6	0.0001	<0.0001	−7.3 (10.7)	−7.6	0.0001	<0.0001
Month 2	38	72.5 (23.5)	79.0	−8.8 (13.9)	−4.9	0.0004	0.0004	−1.1 (10.8)	−2.2	0.5343	0.4625
Month 3	37	70.1 (23.1)	73.4	−11.5 (13.0)	−11.4	<0.0001	<0.0001	−2.5 (10.4)	−2.0	0.1539	0.1855
Month 4	36	64.3 (27.1)	68.3	−17.4 (19.5)	−12.7	<0.0001	<0.0001	−5.6 (11.8)	−4.2	0.0077	0.0081
Month 5	31	68.5 (23.5)	71.8	−17.2 (21.8)	−11.4	0.0001	<0.0001	0.3 (11.8)	0.5	0.8857	0.6297
Month 6	31	67.5 (23.9)	73.3	−18.3 (22.5)	−9.9	<0.0001	<0.0001	−1.1 (12.0)	0.8	0.6185	0.8259
Month 7	28	72.9 (20.2)	78.6	−13.5 (18.8)	−8.7	0.0007	0.0001	0.8 (13.2)	−0.5	0.7557	0.9294
Month 8	27	69.3 (23.5)	70.0	−16.9 (22.7)	−8.4	0.0007	0.0005	−3.0 (16.2)	−1.0	0.3394	0.2772
Month 9	26	69.2 (21.8)	73.3	−16.9 (17.9)	−13.0	<0.0001	<0.0001	−0.8 (17.7)	−1.2	0.8100	0.7202
Month 10	25	65.7 (24.1)	67.7	−20.0 (21.7)	−20.4	0.0001	<0.0001	−4.2 (15.6)	−0.5	0.1949	0.2848
Month 11	24	63.7 (25.5)	74.8	−21.6 (24.8)	−15.1	0.0003	<0.0001	−2.3 (15.5)	−0.6	0.4838	0.7606
Month 12	21	70.0 (19.2)	77.4	−14.5 (17.1)	−11.6	0.0009	0.0003	2.1 (13.1)	0.2	0.4699	0.7120

SEE, Support Educate Empower; SD, Standard Deviation;

[*]
paired t-test,

[**]
Wilcoxon signed-rank test