ORIGINAL ARTICLE

The Application of Telemedicine Among Self-administered Eye Drop Users: the Accuracy and Patient Satisfaction

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ABSTRACT

Introduction: Telemedicine has comparable benefits to face-to-face consultation in certain healthcare settings. The purposes of this study were to determine the accuracy and patient satisfaction levels following telemedicine and in-house clinic teaching sessions on self-administered eye drop techniques. **Methods:** A case-control study was conducted on eye drop users who received instruction in the self-administered eye drop technique teaching via telemedicine and face-to-face sessions. The respondents' self-administration of eye drops was video-recorded and graded independently by two qualified optometrists on a scale of 1 to 10. Patient satisfaction levels with both platforms were determined using a 5-point Likert scale questionnaire. **Results:** This study enrolled 50 eye drop users (N = 25 face-to-face, N = 25 telemedicine) with a mean age of 33.84 ± 15.85 years old. Nearly half of them (48%) had been using the eye drops for more than a year, and 52% had not been instructed on how to administer the eye drops. The accuracy of self-administered eye drops was high (M = 9.5, IQR = 1.5) and did not differ significantly between groups ($p > 0.05$). While both groups reported high levels of satisfaction (90%), listening difficulties were found to be significantly associated with patient satisfaction ($p = 0.02$). **Conclusion:** Both the in-house clinic and telemedicine sessions are significantly comparable to the face-to-face approach for clinical education purposes. The potential for telemedicine delivery is somewhat promising, but additional areas must be explored in the future to demonstrate the effectiveness of the practice.
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INTRODUCTION

Delivering comprehensive eye care services is challenging amidst the COVID-19 pandemic. This health crisis has reduced the number of patients presented to the eye clinic (1), prompted the ophthalmologist to postpone non-urgent cases (2), and contributed to a decline in patient follow-up visits to the eye clinic (3) due to fear of infection. Telemedicine has rapidly gained traction throughout the world as a viable alternative that replaces conventional clinic visits with virtual visits. This practice entails the use of a variety of digital technologies, classified according to their transmission time, synchronous or asynchronous, for the exchange of valid information in the delivery of healthcare services that are geographically limited (4).

Telemedicine has been demonstrated in eye care services by screening and diagnosing diabetic retinopathy, glaucoma, macular degeneration, and retinopathy of prematurity (5), triaging patients for referral appointments using a cloud-based platform (6), and providing real-time consultation between physicians and patients, consent taking, and visual rehabilitation (6). Nonetheless, non-compliance with prescribed medications was amplified during the pandemic crisis (7), emphasizing the importance of continuous real-time physician-patient communication to monitor patients' adherence and accuracy with prescribed medications. Even prior to the pandemic, due to overburdened clinical settings, many patients had been prescribed ocular drugs with little or no instruction on how to accurately self-administer the eye drops.

Previous research has established that a significant proportion of patients do not apply the eye drops properly (8-10), which may result in a variety of negative consequences, including ineffective outcomes, excessive eye drop waste, increased cost, decreased patient satisfaction, and risk of ocular surface injuries (11). Hence, the application of telemedicine to facilitate

continuous physician-patient communication should be investigated to improve post-healthcare delivery despite the pandemic. While telemedicine has demonstrated comparable outcomes to face-to-face clinic visits, it may not be appropriate for certain patient groups or clinical conditions (12). There is limited data on the effectiveness of teleconsultation in the optometric field in terms of patient adherence to ocular medications during follow-up care. To address this knowledge gap, the current study implemented a module for self-administered eye drop education via video conference and in-house clinic in order to assess eye drop administration accuracy and patient satisfaction in both media. This may enable the recognition that telemedicine has the potential to expand access to eye care services.

MATERTIALS AND METHODS

This case-control study was performed with the approval of the Research Ethics Committee of Universiti Teknologi MARA (600-TNCPI (5/1/6)). Based on a G* Power Analysis (version 3.1.9.7), 50 subjects were recruited for this study, with 25 subjects receiving education face-to-face at an in-house clinic and another 25 receiving education via telemedicine via Google Meet (tele-optometry). The following inclusion criteria were applied in this study: the subject must be over the age of 18; the subject must use eye drops as a medical treatment; and the subject must be able to comprehend and respond to the questionnaire independently. Subjects who had never used eye drops, those with muscle or nerve problems such as Parkinson's Disease or tremors, those who were paralyzed or had movement disabilities, and those with low vision with best-corrected visual acuity of 6/18 or worst were excluded from this study. Potential participants for this study were identified using purposive sampling; by which eye drop users that went for an eye examination at selected optometry practices were invited to participate in this study.

On these two platforms, the participants were educated about eye drop instillation techniques via a slide presentation by two optometry trainees. To ensure consistency and comparability of the teaching session across the two distinct platforms, the same optometry trainees delivered all instructions and education. The participants were then instructed to self-administer the eye drops themselves, and the entire procedure was video-recorded for scoring purposes. Each participant was permitted only one attempt. The recorded videos were independently graded by two qualified optometrists who were unaware of the subjects' demographic data. A grading system adapted from a previously published report was used to assess the accuracy of the eye drop self-administration technique (8). One point was awarded for each technique on the checklist, for a total possible score of 10 points for each participant (Table I).

Table I: Grading system on assessing eye drop application technique

Criteria	Point
Tilting head backward	1 point
Directing bottle to eye using one hand	1 point
Pulling down the lower eyelid to expose the inferior forniceal space with the fellow hand	1 point
Able to squeeze the bottle to produce at least one drop	1 point
Eye drop being successfully applied on the first attempt	1 point
Less than 3 unsuccessful/missed instillation	1 point
Only a single drop instilled	1 point
2 drops or less used in total	1 point
Nasolacrimal occlusion after unsuccessful instillation	1 point
Bottle tip remains untouched throughout the recording	1 point
Total	**10 points**

A self-administered questionnaire was adapted from Schwartz et al. (13) to describe the subjects' demographics and responses regarding eye drop usage and technique. To ensure that the questions were easily understood, the bilingual modified questionnaire was pre-tested on a group of eye drop users who were not included as study participants. The questionnaires were validated by modifying the terms used in response to feedback. Patient satisfaction levels with teaching sessions on both platforms were assessed using 5-point Likert scales for communication, comfort, and difficulty, adapted from a previous study by Gustke et al. (14). There were also additional questions inserted to elicit information about factors affecting patient satisfaction levels during the teaching sessions. The reliability test of the validated questionnaires was determined by using the Cronbach Alpha and showed acceptable reliability with $\alpha=0.70$.

This study used the same type of eye drop for both platforms, namely Systane Lubricant Eye Drop, in order to eliminate any variation in the medication type. The eye drop was provided by the researcher prior to data collection, but those who have similar eye drops were allowed to use their own. All subjects were required to sign a consent form prior to data collection indicating their agreement to participate in this study.

The Statistical Package for Social Science (SPSS) software Version 26.0 (SPSS Inc., Chicago, IL, USA) was used for data entry and statistical analysis. Descriptive analysis was used to define the demographic characteristics, background, and responses concerning eye drop usage, types of platform used, the influencing factors, and the scoring of the eye drop self-administration technique among users. Due to the fact that the data was not normally distributed using the Shapiro-Wilk Test ($p < 0.001$), the Mann-Whitney test was used instead to compare the scoring accuracy of the eye drop self-administration as well as patient satisfaction levels between tele-optometry and in-house clinic teaching, whereas the Fisher's Exact test was used to ascertain the association between patient satisfaction levels in both

groups.

RESULTS

The subjects' demographic profile is summarised in Table II. A total of 50 subjects were recruited to participate in this study, the majority of whom are female (74%, n = 37), with an average age of 33.84 ± 15.85 years. Around half of the subjects were degree holders (52%), followed by those with a secondary school education (30%), those with a diploma (10%), those with a primary school education (6%), and master holders (2%). The majority of subjects used eye drops to alleviate dry eye symptoms (70%). About 52% of the respondents had used the eye drops for less than a year and 52% had not received any instruction on how to administer the eye drops. Table III summarises the characteristics of eye drop users.

Table II: Demographic profile, N=50

Demographic profile	**Frequency (N)**	**Percentage (%)**
Gender		
Male	13	26.0
Female	37	74.0
Educational level		
Primary school	3	6.0
Secondary school	15	30.0
Diploma	5	10.0
Degree	26	52.0
Master	1	2.0
Home area		
Rural	14	28.0
City	36	72.0
Marital status		
Married	21	42.0
Single	29	58.0
Platform		
Face-to-face	25	50.0
Tele-optometry	25	50.0
	Mean	**Standard Deviation**
Age	33.84	15.85

Between examiners 1 and 2, there was a significant and moderate positive relationship in the accuracy of eye drop self-administration (r = 0.50, p-value = < 0.001), and the value of Cronbach's Alpha for the scoring was α=0.66. Hence, the average score was used as the basis for further analysis. Among the observed items, "P7—only a single drop instilled" and "P9—nasolacrimal occlusion after unsuccessful instillation" received the lowest ratings from subjects. The average score of all items is presented in Table IV. Overall, self-administration accuracy was scored at a median of 9.50 in this study, with an IQR of 1.50, ranging from 6.50 to 10.0. The Mann-Whitney test was used to compare the median accuracy of self-administration of eye drops between tele-optometry and the in-house clinic (Table V). Table V also shows no statistically significant difference in the median score (p = 0.380) of teaching sessions between tele-optometry (M = 9.50, IQR = 1.00) and the in-house clinic (M = 9.50, IQR = 1.25).

Table III. Characteristic of eye drop user

Characteristic	Frequency (N)	Percentage (%)
Types of eye drop used		
Drops for dry eyes	35	70.0
Rewetting drop (CL wearer)	5	10.0
Antibiotic eye drop	5	10.0
Glaucoma eye drop	2	4.0
Post-operation cataract eye drop	3	6.0
How long have you been using eye drop?		
Less than 1 year	26	52.0
1 year- 4years	15	30.0
More than 5 years	9	18.0
Do you administer your own eye drops?		
Never	1	2.0
Sometimes	18	36.0
Always	31	62.0
Do you have difficulty administering your eye drops?		
Yes	17	34.0
No	33	66.0
If question No 4 is Yes, how often do you have difficulty administering your eye drops?		
Never	34	68.0
Sometimes	10	20.0
Always	6	12.0
Do you receive instruction on how to administer your eye drop?		
Yes	24	48.0
No	26	52.0
Who gives the instruction? (Multiple choice)		
Doctor	10	20.0
Pharmacist	6	12.0
Optometrist	17	34.0
Family members	5	10.0
None	24	48.0

Figure I illustrate the difference in patient satisfaction levels between the two groups of platforms. The Mann-Whitney test revealed no significant difference in patient satisfaction levels following education via either platform (p > 0.05). Both groups reported a high level of satisfaction (90%) and the only factor significantly associated with patient satisfaction was difficulties in listening (p = 0.02) (Table VI).

DISCUSSION

It has been noted that it is critical to educate patients on proper eye drop administration techniques, either verbally or in writing, in order to improve their skills

Table IV. Scoring for each item of the accuracy of eye drop's self-administration evaluation

Item	Criteria	Frequency (N)	Percentage (%)
P1	Tilting head backward	50	100
P2	Directing bottle to eye using 1 hand	50	100
P3	Pulling down eyelid to expose the inferior fornical space with the fellow hand	47	94
P4	Able to squeeze the bottle to produce at least 1 drop	49	98
P5	Eye drop being successfully applied on the first attempt	40	80
P6	Less than 3 unsuccessful/missed instillation	49	98
P7	Only a single drop instilled	28	56
P8	2 drops or less used in total	39	78
P9	Nasolacrimal occlusion after unsuccessful instillation	36	72
P10	Bottle tip remains untouched throughout the recording	44	88

Table V: Median scoring for eye drops self-administration's accuracy between tele-optometry and in-house clinic

Variable	Median (IQR)		Z-statistic	P-value
	Face-to-face	Tele-optometry		
Scoring of eye drop self-administration (N=50)	9.50 (1.25)	9.50 (1.50)	-0.877	0.380

(16; 15). This study demonstrated a high score (M: 9.5, IQR: 1.5) in self-administration of eye drops using both in-house and telemedicine education platforms. Most of the subjects scored well in demonstrating "P1—tilting the head backward" (100%) and "P2—directing the bottle to the eye using one hand" (100%). This showed similar attributes that other studies have noted to be important with regard to proper technique when administering eye drops (9, 11, 16, 17). The least scored items were recorded in "P7—only a single drop instilled" (56%), "P9—nasolacrimal occlusion after unsuccessful instillation" (72%), and "P8—two drops or less used in total" (78%); all of these findings were consistent with previous research conducted in a real-world population of eye drop users and in tertiary care clinics (17, 18).

In the current study, there was no significant difference regarding the accurate technique for self-administering eye drops between both platforms. Two optometrist trainees taught both groups using a standard module, which resulted in similar high scores in both groups. This finding is consistent with a previous study in which participants demonstrated an immediate and significant improvement following exposure to an instructional video on proper eye drop self-administration technique and an illustrated educational handout (19). The majority of the participants from the study reported that the tutoring materials had aided them in self-administering the eye drops properly. We found no significant correlation between age, education level, previous education on eye drop administration, or characteristics of eye drop use and scores on either platform. This is

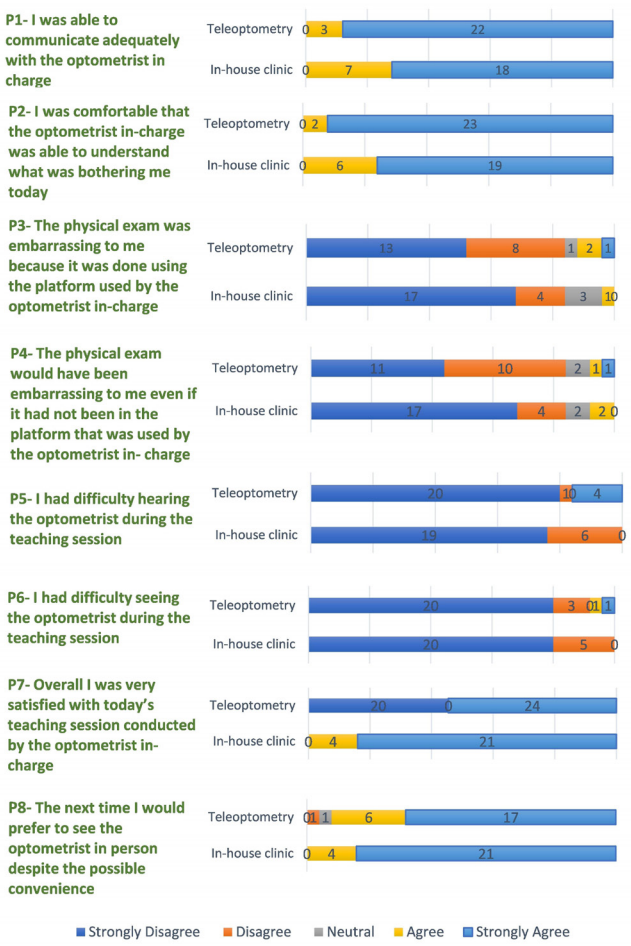

Figure 1: Patient's satisfaction level following self-administration eye drops teaching session on in-house clinic and tele-optometry platform

Table VI. The association of patient satisfaction levels in both tele-optometry and in-house clinic by the Fisher's Exact Test analysis

Questions item	Fisher's Exact Test Exact Sig. (2-sided)
I was able to communicate adequately with the optometrist in-charge	0.157
I was comfortable that the optometrist in-charge was able to understand what was bothering me today	0.274
The physical exam was embarrassing to me because it was done using the platform used by the optometrist in-charge	0.400
The physical exam would have been embarrassing to me even if it had not been on the platform that was used by the optometrist in-charge	0.261
I had difficulty hearing the optometrist during the teaching session	0.020
I had difficulty seeing the optometrist during the teaching session	0.702
Overall, I was very satisfied with today's teaching session conducted by the optometrist in-charge	0.110
The next time I would prefer to see the optometrist in person despite the possible convenience	0.385

in contrast with another study, which concluded that ineffective eye drop application is associated with advanced age, poor vision, and a low education level. Nonetheless, this was not the primary concern, as the

technique could be improved if patients were provided with clear instructions on how to accurately self-instill the eye drops (20).

There was no significant difference in patient satisfaction levels in the aspects mentioned between the in-house clinic and telemedicine ($p > 0.05$) in this study. This finding is consistent with several previous studies, which found high levels of satisfaction among in-house clinic and telemedicine respondents, regardless of demographic characteristics. Difficulties in listening to the physician became the only factor significantly associated with patient satisfaction levels on both platforms. A higher level of audio clarity and synchronization is required to ensure that patients receive precise information from the physician during video conferences; this can be very distracting to patients who are not accustomed to lengthy audio delays (21). Inadequate internet connectivity can result in substandard video quality and a lack of audio synchronization. However, the internet remains an inadequate medium for viewing large-sized images and documents (22).

This study had some limitations. For example, there were some challenges in ensuring that the recorded video for the participants who were educated via telemedicine was clear and easy to evaluate for each item required high resolution. In addition, a stable internet connection, whether for the researchers or the participants who received education through telemedicine, was a major concern in this study, as it was a technical issue that was difficult to avoid. Therefore, it would be biased if the examiners gave lower scores to participants in this group than to participants who received face-to-face education. Thus, a specific angle must be adjusted, and similar studies in the future should exclude participants who do not have a stable internet connection. In addition, the vision of respondents educated via telemedicine was not clinically examined in this study. An assumption was made based on the gross history obtained at the start of the procedure. Next, as all the participants were allowed to instill the eye drop only on the first attempt, they might have made more errors than they would have at home due to nervousness or discomfort with the surroundings during the study's conduct. This might have a beneficial or detrimental effect on their performance. A pre-and post-assessment of eye drop self-administered technique will be beneficial to investigate the effect of clinical consultation or education on various platforms in the future. While this study reflected the use of telemedicine, it did not encompass all telemedicine practices. Patient satisfaction was determined by the quality of the delivery systems and the attitude shown by the physician-in-charge. Therefore, their satisfaction levels may vary in other studies.

CONCLUSION

Telemedicine is widely used in eye care services in a variety of ways; this study demonstrated the consultation and education of eye drop instillation during patients' follow-up visits to eye care services. Telemedicine is just as effective as face-to-face clinic visits for teaching the eye drop instillation technique, with high and comparable patient satisfaction levels on both platforms. Future research is required to expand the scope of the practice and demonstrate its effectiveness, thereby expanding eye care services.

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