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Barriers to telemedicine among physicians in epilepsy care during the COVID-19 pandemic: A national-level cross-sectional survey in Japan

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Abstract

Objective: This study aimed to investigate the factors affecting the unwillingness of physicians involved in epilepsy care to continue telemedicine during the coronavirus disease 2019 (COVID-19) pandemic in Japan.

Method: This was a national-level cross-sectional survey initiated by Japan Young Epilepsy Section (YES-Japan) which is a national chapter of The Young Epilepsy Section of the International League Against Epilepsy (ILAE-YES). We asked physicians who conducted telemedicine in patients with epilepsy (PWE) during the COVID-19 pandemic at four clinics and 21 hospitals specializing in epilepsy care in Japan from March 1 to April 30, 2021. The following data were collected: (1) participant profile, (2) characteristics of PWE treated by telemedicine, and (3) contents and environmental factors of telemedicine. Statistically significant variables (p < 0.05) in the univariate analysis were analyzed in a multivariate binary logistic regression model to detect the independently associated factors with the unwillingness to continue telemedicine.

Result: Among the 115 respondents (response rate: 64%), 89 were included in the final analysis. Of them, 60 (67.4%) were willing to continue telemedicine, and 29 (32.6%) were unwilling. In the univariate binary logistic regression analysis, age (Odds ratio [OR] = 1.84, 95% confidence interval [CI] 1.10–3.09, p = 0.02), psychiatrist (OR = 5.88; 95% CI 2.15–16.08, p = 0.001), hospital (OR = 0.10, 95% CI 0.01–0.94, p = 0.04), the number of COVID-19 risk factors in the participant (OR = 2.88, 95% CI 1.46–5.09, p = 0.002), the number of COVID-19 risk factors in the cohabitants (OR = 2.52, 95% CI 1.05–6.01, p = 0.04), COVID-19 epidemic area (OR = 4.37, 95% CI 1.18–16.20, p = 0.03), consultation time during telemedicine (OR = 2.51, 95% CI 1.32–4.76, p = 0.005), workload due to telemedicine (OR = 4.17, 95% CI 2.11–8.24, p < 0.001) were statistically significant. In the multivariate binary logistic regression analysis, workload due to telemedicine &n...
1. Introduction

Telemedicine involves the delivery of healthcare services using information and communication technologies to improve patient outcomes [1]. It has many advantages [2]. For example, patients with epilepsy (PWE) who cannot drive and/or are afraid to go out due to fear of seizures can receive medical treatment using telemedicine [3]. It also reduces the costs of care and hospital visits [4,5], and the efficacy and safety of seizure control in telemedicine have been demonstrated [6,7].

Telemedicine has rapidly become available for PWE to prevent COVID-19 infection since 2020 [5,8-11]. The Japanese government also urgently approved the use of telemedicine in 2019 to take full advantage of contactless medicine [12]. Most PWE, caregivers, and physicians were highly satisfied with telemedicine during the COVID-19 pandemic [5,8,10].

A previous systematic review has shown that the barriers causing failures of eHealth intervention among healthcare professionals prior to the COVID-19 pandemic were workload, changes in work practice, costs of telemedicine, lack of information and communication technology training, concerns about privacy and security, lack of interoperability, low adaptability to telemedicine, and decreased quality of care [13]. Specifically, the lack of physical examination was associated with lower satisfaction with telemedicine among physicians in epilepsy care during the COVID-19 pandemic [10]. However, it is not clear whether the lack of physical examination is a barrier for physicians in continuing telemedicine. In addition, the study did not investigate the previously known barriers. Hence, barriers to telemedicine among physicians in epilepsy care before and during the COVID-19 pandemic have not been investigated.

Due to the rapid spread of telemedicine, physicians in epilepsy care may have faced various barriers to performing telemedicine during the COVID-19 pandemic, causing them to be unwilling to continue telemedicine. Therefore, we aimed to investigate the factors affecting the unwillingness of physicians involved in epilepsy care to continue telemedicine during the COVID-19 pandemic using a nationwide cross-sectional survey in Japan.

2. Methods

2.1. Study design and participants

The authors (TK and NK) initially created a survey questionnaire, which was then shared and validated with 13 co-authors in the pilot study. After the initial screening of applications from epilepsy centers and clinics throughout Japan by the official email list of the Japanese Epilepsy Society, 21 hospitals accredited as epilepsy centers or epilepsy training facilities and four epilepsy clinics were nominated. Our survey was conducted using Google Forms and was sent via email to 181 physicians who treated PWE in the nominated facilities. The valid period for a response was from March 1 to April 30, 2021. Details of the participating facilities are provided in Online Supplemental File 1. Physicians who conducted telemedicine for PWE during the COVID-19 pandemic were eligible to answer the survey. We followed the Japanese government’s definition of telemedicine under the COVID-19 pandemic; accordingly, telemedicine was defined as medical care delivered by physicians to patients via (1) telephones or (2) auditory and visual communication devices such as videotelephony [12,14].

Telemedicine does not include text or image message-based medical care without auditory and visual communications [12,14]. Consent for participation in the study was obtained through the questionnaire. The study was approved by the ethical committee (#A201200010) of Yokohama City University, the initiating facility, and by the Japan Epilepsy Society. This study adhered to the principles of the Declaration of Helsinki.

2.2. Questions included in the survey

The questionnaire consisted of the following sections: (1) participant profile, (2) characteristics of PWE treated with telemedicine, and (3) contents and environmental factors of telemedicine.

2.2.1. Participant profile

In the first part of this survey, we asked about the participants' profiles: (a) age category (25–34, 35–44, 45–54, 55–64, 65–74, and 75–84 years), (b) sex, (c) type of facility (hospital or clinic), (d) whether the facility is located within a COVID-19 epidemic area, (e) risk factors in the respondent for severe COVID-19 infection, (f) risk factors in the respondent's cohabitants for severe COVID-19 infection or stress related to the COVID-19 pandemic [15], (g) presence of cohabitants who had to be separated from the respondent due to the pandemic [16], and (h) vaccination against COVID-19. (i) participants’ impression of the regulations for telemedicine [13]. To incorporate the variable of (d) whether an area has a COVID-19 epidemic into the analysis, we categorized the location of the facility as either an epidemic or non-epidemic area according to the infection rate in each prefecture compared to the national average as of February 28, 2021, the day prior to the start of the survey (Online Supplemental File 1). We included the following risk factors for severe COVID-19 infection or stress related to the COVID-19 pandemic in (e): pregnant [15], breastfeeding [15], living alone [16], over 65 years old [15], medically-dependent state [15], smoking [15], obesity (body mass index ≥30) [15], medical history of diabetes mellitus [15], hypertension [15], chronic heart disease [15], chronic pulmonary disease [15], chronic kidney disease [15], neoplasm [15], or immunocompromised state [15]. Regarding the risk factors in (f), we deleted living alone and added the factor cohabitants under 0–4 or 5–17 years old [17–19] into the same cohabitant's risk factors as in (e).

2.2.2. Characteristics of PWE treated by telemedicine

To investigate the baseline characteristics of the patients treated with telemedicine, we asked whether the participants had seen PWE with the following characteristics prior to telemedicine: seizure more than once a month [20,21], two or more antiepileptic drugs [22], history of side effects due to antiepileptic drugs, and in-person consultation time of 31 min or more.

For healthcare professionals, the quality of health care is one of the most important factors related to the promotion and barriers of eHealth interventions [13]. We compared the following factors in
PWE between telemedicine and in-person visits: frequency of change in antiepileptic drugs, side effects of antiepileptic drugs, worsening seizure control, and improving seizure control.

2.2.3. Contents and environmental factors of telemedicine

We asked about the methods, contents, and environmental factors of telemedicine. Because environmental factors are associated with the barriers to eHealth intervention [13], we asked about the following: problems and safety in telemedicine [13], telemedicine consultation time per patient, support of hospitals and clinics for telemedicine [13], workload due to telemedicine [13], and financial cost to the hospital/clinic due to telemedicine [13].

2.3. Statistical analysis

We divided the participants into two groups: those who were willing to continue telemedicine and those who were not. We compared the questionnaire variables with the Mann–Whitney U test based on the Shapiro–Wilk test, chi-squared test, or Fisher's exact test. We used Fisher's exact test for five or fewer applicable participants in a categorical question. Bonferroni correction was used for multiple comparisons. The age at every 10 years and the number of risk factors were treated as ordinal variables. Similarly, the decrease, no change, and increase in a single question were treated as ordinal variables. Univariate binary logistic regression was conducted to determine the association between the variables in the two groups and the unwillingness to continue telemedicine. Crude and adjusted odds ratio (OR) estimates and 95% confidence intervals (CIs) are presented. Goodness-of-fit for the regression models was assessed using the Hosmer–Lemeshow test, with p > 0.05 considered a good fit of the model. The collinearity of the predictors was examined using the variation inflation factor (VIF), with VIF > 10 considered significant collinearity. Statistical analyses were conducted using the free software environment R version 4.0.5 (R Development Core Team 2021) and SPSS v25 (IBM, Armonk, NY).

3. Results

Fig. 1 shows the sampling process used in the survey. A total of 25 facilities (21 hospitals and four epilepsy clinics) participated in this survey. The link to the questionnaire was sent to 181 physicians, and 115 (63.5%) responded. A total of 103 physicians met the inclusion criteria; however, seven physicians were excluded for double responses and seven for missing data. Ultimately, 89 physicians were included in the analysis.

Table 1 shows the distribution of responses for all the questionnaire variables. The common profiles of participants were as follows: 35–44 years old (41/89 [46.1%]), male (72/89 [80.9%]), pediatricians (29/89 [32.6%]), and working in hospitals (84/89 [94.4%]). Telephone (77/89 [86.5%]) was used more frequently than videotelephony (12/89 [13.5%]). Of the 89 respondents, 60 (67.4%) were willing to continue telemedicine, and 29 (32.6%) were unwilling. Table 2 shows the results of the univariate and multivariate binary logistic regression analyses. In the univariate binary logistic regression analysis, age (OR = 1.84, 95% CI 1.10–3.09, p = 0.02), psychiatrist (OR = 5.88, 95% CI 2.15–16.08, p = 0.001), hospital (OR = 0.10, 95% CI 0.01–0.94, p = 0.04), the number of COVID-19 risk factors in the participant (OR = 2.88, 95% CI 1.46–5.69, p = 0.002), the number of COVID-19 risk factors in the cohabitants (OR = 2.52, 95% CI 1.05–6.01, p = 0.04), COVID-19 epidemic area (OR = 4.37, 95% CI 1.18–16.20, p = 0.03), consultation time during telemedicine (OR = 2.51, 95% CI 1.32–4.76, p = 0.005), workload due to telemedicine (OR = 4.17, 95% CI 2.11–8.24, p < 0.001) were statistically significant. In the multivariate binary logistic regression analysis, only the workload due to telemedicine (OR = 4.93, 95% CI 1.96–12.35, p = 0.001) was independently associated with an unwillingness to continue telemedicine. There was no collinearity between the factors, and all VIF values were <10. The Hosmer–Lemeshow test showed p = 0.57, indicating a good fit for this regression model.

4. Discussion

In this national-level cross-sectional survey, we demonstrated that workload due to telemedicine among physicians in epilepsy care was independently associated with their unwillingness to continue telemedicine. To our knowledge, this was the first study...
Table 1: Questionnaire variables.

| <Participant profile> | Total Willing to continue telemedicine | Unwilling to continue telemedicine | p value |
|----------------------|----------------------------------------|----------------------------------|---------|
| **n** = 89 (%)       | n = 61 (%)                              | n = 28 (%)                       |         |
| **Age**              |                                        |                                  |         |
| 25–34                | 9 (10.1)                               | 6 (9.8)                          | 3 (10.7) |
| 35–44                | 41 (46.1)                              | 32 (52.5)                        | 9 (32.1) |
| 45–54                | 26 (29.2)                              | 19 (31.1)                        | 7 (25.0) |
| 55–64                | 12 (13.5)                              | 4 (6.6)                          | 8 (28.6) |
| 65–74                | 0 (0.0)                                | 0 (0.0)                          | 0 (0.0)  |
| 75–84                | 1 (1.1)                                | 0 (0.0)                          | 1 (3.6)  |
| **Sex**              |                                        |                                  |         |
| Male                 | 72 (80.9)                              | 47 (77.0)                        | 25 (89.3) |
| Female               | 17 (19.1)                              | 14 (23.0)                        |          |
| **Specialty**        |                                        |                                  |         |
| Pediatric            | 29 (32.6)                              | 23 (37.7)                        | 6 (21.4) |
| Neurologist          | 16 (18.0)                              | 13 (21.3)                        | 3 (10.7) |
| Neurosurgeon         | 19 (21.3)                              | 15 (24.6)                        | 4 (14.3) |
| Psychiatrist         | 25 (28.1)                              | 10 (16.4)                        | 15 (53.6) |
| **Number of risk factors of COVID-19 infection in the participant** | 0/1/2/3 or more | 43 (70.5)/16 (26.2)/2 (3.3)/0 (1.1) | 12 (42.9)/9 (32.1)/6 (21.4)/1 (3.6) | 0.004 * |
| **Number of risk factors of COVID-19 infection in the cohabitants** | 0/1/2/3/4 or more | 58 (95.1)/2 (3.3)/0 (0.0)/0 (0.0)/1 (1.6) | 19 (67.9)/6 (21.4)/2 (7.1)/1 (3.6)/0 (0.0) | 0.001 * |
| **COVID-19 vaccination:** At least one dose of a COVID-19 vaccine | 23 (25.8) | 14 (23.0) | 9 (32.1) | 0.51 |
| **Facility**         |                                        |                                  |         |
| Hospital             | 84 (94.4)                              | 60 (98.4)                        | 24 (85.7) |
| **MHLW regulations for telemedicine** | Participants considered the regulations inappropriate | 69 (77.5) | 49 (80.3) | 20 (71.4) |
| **Changes in antiepileptic drugs** | 69 (77.5) | 49 (80.3) | 20 (71.4) | 0.51 |
| Decrease/No change/Increase | 55 (61.8)/33 (37.1)/1 (1.1) | 35 (57.4)/25 (41.0)/1 (1.6) | 20 (71.4)/8 (28.6)/0 (0.0) | 0.20 * |
| **Side effects of antiepileptic drugs** | 17 (19.1)/71 (79.8)/1 (1.1) | 14 (23.0)/46 (75.4)/1 (1.6) | 3 (10.7)/25 (89.3)/0 (0.0) | 0.25 * |
| Decrease/No change/Increase | 5 (5.6)/81 (91.0)/3 (3.4) | 4 (6.6)/54 (88.5)/3 (4.9) | 1 (3.6)/27 (96.4)/0 (0.0) | 0.80 * |
| **Worsening of seizure control** | 5 (5.6)/82 (92.1)/2 (2.2) | 4 (6.6)/55 (90.2)/2 (3.3) | 1 (3.6)/27 (96.4)/0 (0.0) | 0.99 * |
| Decrease/No change/Increase | 5 (5.6)/82 (92.1)/2 (2.2) | 4 (6.6)/55 (90.2)/2 (3.3) | 1 (3.6)/27 (96.4)/0 (0.0) | 0.99 * |
| **Contents and environmental factors of telemedicine** | **Methods and contents of telemedicine** | **Problems and safety in telemedicine** | **Support of hospitals and clinics for telemedicine** | **Seizures at least once a month** | 63 (70.8) | 47 (77.0) | 16 (57.1) | 0.10 |
| Videotelephony        | 12 (13.5)                              | 8 (13.1)                         | 4 (14.3) |
| Only follow-up or prescription visits without physical examination | 20 (22.5) | 12 (19.7) | 8 (28.6) | 0.51 |
| **Telemedicine consultation time per a patient** | 59 (66.3)/19 (21.3)/11 (12.4) | 46 (75.4)/11 (18.0)/4 (6.6) | 13 (46.4)/8 (28.6)/7 (25.0) | 0.004 * |
| | **Problems and safety in telemedicine** | **Creation of a flow chart for telemedicine** | **Provision of applications and equipment for telemedicine** | **Evaluation of telemedicine** | 72 (80.9) | 52 (85.2) | 20 (71.4) | 0.21 |
| Telemedicine failure due to technical problems | 28 (31.5) | 20 (32.8) | 8 (28.6) | 0.88 |
| Telemedicine problems due to lack of IT literacy among patients | 27 (30.3) | 18 (29.5) | 9 (32.1) | >0.99 |
| Concerns about privacy protection and safety in telemedicine | 69 (77.5) | 49 (80.3) | 20 (71.4) | 0.51 |
| | **Support of hospitals and clinics for telemedicine** | **Training opportunities for telemedicine** | **Support department for telemedicine** | **Seizures at least once a month** | 63 (70.8) | 47 (77.0) | 16 (57.1) | 0.10 |
| Creation of a flow chart for telemedicine | 72 (80.9) | 52 (85.2) | 20 (71.4) | 0.21 |
| Provision of applications and equipment for telemedicine | 28 (31.5) | 19 (31.1) | 9 (32.1) | >0.99 |
| Training opportunities for telemedicine | 13 (14.6) | 10 (16.4) | 3 (10.7) | 0.75 |
| Support department for telemedicine | 19 (21.3) | 14 (23.0) | 5 (17.9) | 0.78 |

* p < 0.05, ** p < 0.01, *** p < 0.001
to determine the barriers to telemedicine among physicians in epilepsy care.

Consistent with previous studies in other medical fields prior to the COVID-19 pandemic, the workload due to telemedicine was also a barrier to telemedicine in epilepsy care. A systematic review showed that the workload of healthcare professionals was the biggest factor contributing to the failure of eHealth interventions [13]. Healthcare professionals observed an increased workload after the implementation of eHealth interventions [13]. General practitioners in the United Kingdom experienced an increased work burden due to telehealth [23], while healthcare professionals in rural Australia required extra hours to receive training on the basic technology and usage of related applications. This burden is a barrier to telemedicine [24]. Similar to previous studies conducted before the COVID-19 pandemic, some physicians in our study might be reluctant to continue telemedicine because of the increased workload. However, in contrast to previous studies, training and support for telemedicine [13,25,26], safety [13], usability [13,26,27], financial costs [13,28], regulation [13,25], and quality of health care [13] were not associated with an unwillingness to continue telemedicine in our study, possibly due to the rapid spread of telemedicine during the pandemic. Although previous studies conducted during the COVID-19 pandemic showed that physical examination was associated with satisfaction with telemedicine among physicians in epilepsy care [10], the contents of telemedicine was not associated with an unwillingness to continue telemedicine in our study. This may be explained by the differences in the outcomes studied (satisfaction with telemedicine vs. unwillingness to continue telemedicine). Furthermore, previous studies did not include workload as a factor.

It should be noted that telemedicine may occasionally increase the workload as discussed below. Evidence has shown that the workload of physicians should be given the proper attention. The workload of physicians was originally high, with physicians in the United States working for an average of 51 h per week [29]. Twenty-three percent of physicians work more than 60 h per week [30]. In particular, physicians in Japan also work very long hours as over 40% of physicians in hospitals work more than 60 h per week [31]. Moreover, aside from the physical stress, the COVID-19 pandemic has increased mental stress and burnout among physicians [32–34]. Under these circumstances, telemedicine increased the workload for 32.6% of the participants in our study, although it reduced the workload for 38.2% of the participants and consultation time during telemedicine, possibly due to the rapid spread of telemedicine.

### Table 1

| Variable                                      | Total (n = 89) | Willing to continue telemedicine (n = 61) | Unwilling to continue telemedicine (n = 28) | p value |
|-----------------------------------------------|---------------|----------------------------------------|-----------------------------------------------|---------|
| Workload due to telemedicine                  |               |                                        |                                               |         |
| Decrease/No change/Increase                   | 34 (38.2)/26 (29.2)/29 (32.6) | 32 (52.5)/17 (27.9)/12 (19.7) | 2 (7.1)/9 (32.1)/17 (60.7) | <0.001* |
| Financial cost to the hospital/clinic due to telemedicine |               |                                        |                                               |         |
| Decrease/No change/Increase                   | 17 (19.1)/38 (42.6)/58 (69.1) | 15 (24.6)/14 (15.7)/8 (13.1) | 2 (7.1)/20 (71.4)/6 (21.4) | 0.06*   |

COVID-19: Coronavirus disease 2019. MHLW: Ministry of Health, Labour and Welfare. PWE: Patients with epilepsy. IT: Information technology.

*Telemedicine compared to in-person visits.

Mann-Whitney U test.

Fisher exact test.

Chi-squared test.

Bonferroni correction.

| Variable                                      | Univariate | Multivariate |
|-----------------------------------------------|------------|--------------|
|                  | Crude OR (95%CI) | p value | Adjusted OR (95%CI) | p value |
| Age              | 1.84 (1.10–3.09)     | 0.02 | 1.83 (0.84–3.97)     | 0.13 |
| Psychiatrist     | 5.88 (2.15–16.08)    | 0.001 | 2.45 (0.63–9.51)     | 0.19 |
| Hospital         | 0.10 (0.01–0.94)     | 0.04 | 0.88 (0.04–19.23)    | 0.94 |
| The number of COVID-19 risk factors in the participant | 2.88 (1.46–5.69)     | 0.002 | 2.22 (0.97–5.08)     | 0.06 |
| The number of COVID-19 risk factors in the cohabitants | 2.52 (1.05–6.01)    | 0.04 | 2.23 (0.93–5.36)     | 0.07 |
| COVID-19 epidemic area                           | 4.37 (1.18–16.20)   | 0.03 | 1.95 (0.36–10.69)    | 0.44 |
| Consultation time during telemedicine            | 2.51 (1.32–4.76)    | 0.005 | 1.00 (0.40–2.55)     | 0.99 |
| Workload due to telemedicine                     | 4.17 (2.11–8.24)    | <0.001 | 4.93 (1.96–12.35)    | 0.001 |

OR: Odds ratio. CI: Confidence interval.
Besides telemedicine. Thus, while establishing an ideal support system for telemedicine is essential, paying attention to the usual workload and characteristics of physicians who can be affected by telemedicine is also critical. For instance, the working environment, including working hours and stress level, and physicians’ characteristics, such as difficulty with adaptation of new technology, should be considered.

This study had several limitations. First, the situation of COVID-19 infection, infrastructure, and regulations are different in each country, making it difficult to apply our findings to different situations. Second, since this study was a cross-sectional questionnaire survey, some variables might have been affected by recall bias. Although unlikely, the causal relationship between workload due to telemedicine and unwillingness to continue telemedicine may be reversed. In short, unwillingness to continue telemedicine might have caused the feeling of increased workload. Third, this study did not investigate whether videotelephony was performed via home videoconferencing, such as Zoom, or high-end video with a trained assistant with the patient. Although home videoconferencing might be the main method, the difference between the two methods might affect the workload.

5. Conclusion

This national-level cross-sectional survey found that two-thirds of physicians in epilepsy care were willing to continue telemedicine, while the rest were unwilling. Workload due to telemedicine among physicians in epilepsy care was independently associated with the unwillingness to continue telemedicine during the COVID-19 pandemic. As such, the identification and reduction of the causes of increased workload due to telemedicine will further promote its use in epilepsy care.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.yebeh.2021.108487.

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