Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Objective: This study aimed to investigate whether the proposed model could manage patients with epilepsy (PWEs) during the coronavirus disease 2019 (COVID-19) outbreak.

Methods: We used a model to manage the PWEs during the outbreak. Questionnaire survey and hospital data were used to explore whether PWEs under our management were affected by the virus.

Results: A total of 118 (78.7%) PWEs completed the survey. During the “model period,” 22.9% (27/118) of the respondents reported antiepileptic drug (AEDs) discontinuity, including six (22.2%) PWEs who failed to purchase AEDs. Of the patients, 40.7% (22/54) failed to attend ordinary clinic, which was higher than that during the “period before model” (7.9%, 5/63). The common causes were movement limits (77.3%) and appointment failure (54.5%). A shift from ordinary clinic toward remote consultation was observed. Of the PWEs, 15.7% (13/83) referred to online pharmacy. 87.5% (14/16) of emergencies related to epilepsy were timely treated. 48.3% of PWEs thought that the epidemic had an impact on accessing medical services. Hospital data indicated that a decline in ordinary clinic visit, inpatient, surgery, and emergency attendance was observed in January and February 2020 and an increase in March 2020, as the epidemic mitigated. By contrast, online clinic visit soared in February, when the outbreak hit hard. In addition, we found no cross-infection of COVID-19 in our hospital and respondents.

Conclusion: We demonstrated a much-needed model to manage the PWEs during the outbreak. We believed that the core architecture of this model was suitable for the management of other chronic diseases.

1. Introduction

Coronavirus disease 2019 (COVID-19), a highly contagious pneumonia, has become a pandemic [1,2]. During the outbreak, people in China were ordered to stay and maintain social distancing, but a number of patients with chronic diseases, for example, epilepsy, had difficulty accessing medical aids. Moreover, valuable resources in hospitals were freed up against COVID-19. Consequently, diagnosis and treatment were delayed for these patients, and some of them might suffer from the severe threat of life. Under these circumstances, we developed a management framework for patients with epilepsy (PWEs) and conducted a survey afterward to assess the efficacy and safety of the management during the outbreak.

2. Methods

This preliminary study aimed to investigate the feasibility of the proposed model in managing PWEs during epidemic. We hypothesized that our model could optimize medical resources and help PWEs fight against COVID-19.

2.1. Model introduction

The model was introduced on the blog of the COVID-19 section in the homepage of the journal “Neurology” [3]. In brief, the model was proposed to manage PWEs’ decentralization and hierarchiza-
tion during the pandemic (Appendix Fig.). For the registered PWEs, a follow-up system was set up to provide medical support. The system included three main solutions: telephone follow-up, smartphone application [App] [4], and online clinic. Online clinics hosted by neurologists provided consultation, diagnosing, and prescription. In the model, PWEs will be counseled on the basis of the assessments. First, a patient will be referred to a “Fever Clinic” [5]. If the patient was suspected of COVID-19 infection, then self-isolation at home for 14 days will be recommended. Second, if the PWE experienced increased seizure frequency or severe seizure- or antiepileptic drug (AED)-related adverse events, then online or outpatient clinic will be recommended. In addition, emergency assistance was another option. Third, the methods for purchasing AEDs, for example, local drugstore, online hospital pharmacy, and internet pharmacy, will be introduced considering the importance of medication adherence. Finally, PWEs with psychological issues will be referred to a mental health hotline. For PWEs in hospitals, in case of emergency, neurologists offered onsite consultation or tele-consultation depending on the risk of COVID-19. Notably, the number of inpatients was strictly controlled. Therefore, epilepsy surgery was postponed.

In practical operation, volunteers were recruited to handle telephone follow-up, and registered PWEs were recommended to use an online or outpatient clinic as necessary. Considering that part of our registered PWEs was in our WeChat address book (WeChat is a Chinese multipurpose messaging and social media App), sending WeChat messages to this group of PWEs to introduce the process of seeking medical assistance during the pandemic was convenient. For the other registered PWEs, text message was sent using the telephone number left in our database. Given the limited resources, we did not offer additional intervention to strengthen the knowledge, relationship, and consultation. However, PWEs would be well informed and educated if they voluntarily participated in the management model under our guidance. By contrast, in the previous management prior to the pandemic, PWEs were routinely recommended to access ordinary clinic for consultation. AED purchase was predominantly completed in the hospital pharmacy. Consultations via hotline, online clinics, and medical Apps were less used.

2.2. Study areas and participants

This study was implemented in an academic, tertiary referral, and epilepsy center, which was affiliated with the Sichuan Provincial People's Hospital in western China. Participants were obtained from our previous registry (1153 cases), who were previously diagnosed with epilepsy and receiving AED treatment. We enrolled PWEs who were 18–60 years old; participants were under AED treatment for more than 6 months; and participants should reside in the study area and provide consent to participate. The exclusion criteria were severe intellectual and developmental impairment, illiteracy or mental incompetence, neurologic disease, psychosis, or other severe medical conditions (e.g., tumors and fractures). One hundred fifty participants, who were selected from our registry, met the criteria.

2.3. Procedures and data collection

The model was developed in late January 2020, launched in the first week of February 2020, and lasted until the end of March 2020. Minor continual revisions were made corresponding to the changes in hospital regulations on medical resources. Once the model was launched, we sent messages to all PWEs who had already registered in our WeChat address book, introducing the basic rules of coping with epilepsy during the COVID-19 epidemic (e.g., online clinic, hotline, self-report of fever symptoms/epidemic history, and ways of drug purchase). On April 1, 2020, we initiated the survey on the challenges and predicaments, which PWEs might encounter during the epidemic, for 7 days. Electronic questionnaire was sent to the selected participants via WeChat. Afterward, we compiled respondents’ feedback for analysis. Given that the epidemic in China started to become evident on January 23 and seemed to be under controlled in March 2020 [6], we set the time interval from February 1 to March 31, 2020, as the “model period.” In addition, we defined a past 2-month period prior to January 23 as the “period before model.” Recent 6-month hospital data were obtained and used as a background to illustrate how medical resource was reallocated. The hospital data covered monthly amount of inpatients, ordinary clinic visits, emergency visits, fever clinic visits, online clinic visits, and surgery.

2.4. Standard protocol approvals, registrations, and patient consents

This study was approved by the Medical Ethics Committee of the Sichuan Provincial People's Hospital. Written informed consent was obtained electronically in the e-questionnaire.

2.5. Data availability

Data can be made available on request from the corresponding author after the approval of the Medical Ethics Committee.

2.6. Statistical analysis

The analyses were conducted in SPSS 22.0. Categorical variables were assessed using $\chi^2$, corrected $\chi^2$, and Fisher exact. $P < 0.05$ was considered statistically significant.

3. Results

Of the 150 PWEs, 118 completed the survey (median age of 27 years, IQR of 21.3–36.8 years, 45.8% men), resulting in a completion rate of 78.7%. Table 1 summarizes the demographics and clinical characteristics. The majority of samples were living in an urban area ($n = 83$, 70.3%), high school level ($n = 82$, 69.5%), and employed ($n = 69$, 58.5%). Fifty-four (45.8%) PWEs were married or partnered. The most common seizure type in our sample was focal seizure (71.2%).

3.1. Survey on the management of epilepsy

Table 2 reports PWEs’ feedback on epilepsy management during the epidemic. Of the 118 PWEs, 34 experienced seizure attack during the “model period,” which was higher than that ($n = 25$) during the “period before model” (28.8% vs. 21.2%, $P > 0.05$). 22.9% reported AED discontinuity during the “model period” and 19.5% during the “period before model.” For PWEs with drug discontinuity, “purchase failure” took up a portion of 22.2% during the “model period” and 8.6% during the “period before model.” During the “model period,” 22 out of 54 (40.7%) PWEs attempting to attend ordinary clinic failed primarily because of movement limits (77.3%) and appointment failure (54.5%). By contrast, ordinary clinics were unavailable for only 7.9% ($n = 63$) during the “period before model.” With regard to consultation, a prominent shift from ordinary clinic to remote consultation (online clinics, hotline, and WeChat/medical App) was notified during the epidemic. Meanwhile, 15.7% of participants referred to online pharmacy as a novel way to purchase AED. In the “model period,” 87.5% of emergencies related to epilepsy (14 of 16 cases) were hospitalized through emergency entry. Moreover, we found no case of COVID-19 infection in our respondents. Of the PWEs, 48.3% thought that the epi-
Epilepsy condition and availability of medical services during the COVID-19 epidemic.

Demographics and clinical characteristics of respondents.

Table 2
Demographics and clinical characteristics of respondents.

| Age, years, median (IQR) | 27 (21.3–36.8) |
|--------------------------|-----------------|
| Male (n, %)              | 54 (45.8)       |
| Educational level (n, %) |                 |
| Middle school or below   | 36 (30.5)       |
| High school              | 23 (19.5)       |
| College or above         | 59 (50.0)       |
| Residency (urban area, n, %) | 83 (70.3) |
| Employed (n, %)          | 69 (58.5)       |
| Currently married or partnered (n, %) | 54 (45.8) |
| Living alone (n, %)      | 11 (9.3)        |
| Disease duration, years, median (IQR) | 5 (3–7) |

Seizure type* (n, %)

| Focal                  | 84 (71.2) |
| Generalized            | 28 (23.7) |
| Unknown                | 21 (17.8) |
| Monotherapy            | 58 (49.2) |

* Both focal and generalized seizures can occur in some individuals.

Table 2
Epilepsy condition and availability of medical services during the COVID-19 epidemic.

| PWEs with seizure attack | Model period 22 (28.8) | Model period before model 25 (21.2) | P value 0.176 |
|--------------------------|------------------------|--------------------------------------|--------------|
| AED discontinuity        | 27 (22.9)              | 23 (19.5)                            | 0.524        |
| Causes of AED discontinuity |                       |                                       | 0.402        |
| Purchase failure         | 6 (22.2)               | 2 (8.6)                              |              |
| Severe side effect       | 2 (7.4)                | 1 (4.3)                              |              |
| Missing doses            | 17 (63.0)              | 19 (82.6)                            |              |
| Others                   | 6 (22.2)               | 4 (17.4)                             |              |
| Number of PWEs who consult | 65 (55.1)          | 60 (50.8)                            | 0.514        |
| Means of consultation    |                        |                                       | <0.001       |
| Ordinary clinic          | 32 (49.2)              | 58 (96.7)                            |              |
| Hotline                  | 13 (20.0)              | 3 (5.0)                              |              |
| Online clinic            | 15 (23.1)              | 2 (3.3)                              |              |
| WeChat/medical Apps      | 17 (26.2)              | 4 (6.7)                              |              |
| Attempt to attend ordinary clinic | 54 (45.8) | 63 (53.4)                            | 0.241        |
| Failure of ordinary clinic | 22 (40.7)             | 5 (7.9)                              | <0.001       |

Causes of attendance failure

| Movement limits          | 17 (77.3)              | 0                                    | 0.106        |
| Appointment failure      | 12 (54.5)              | 4 (80.0)                             |              |
| Fear of getting infected | 6 (27.3)               | 0                                    |              |
| Others                   | 5 (22.7)               | 1 (20.0)                             |              |
| PWEs who purchased AEDs  | 83 (70.3)              | 91 (77.1)                            | 0.237        |
| Ways in purchasing AEDs  |                        |                                       | <0.001       |
| Hospital pharmacy        | 41 (49.4)              | 68 (75.8)                            |              |
| Online hospital/internet pharmacy | 13 (15.7) | 3 (3.3)                              |              |
| Local drugstore          | 36 (43.4)              | 25 (27.5)                            |              |
| Epilepsy-related emergency | 16 (13.6)            | 13 (11.0)                            | 0.552        |
| Emergency type           |                        |                                       | 1.0          |
| Injury                   | 8 (50.0)               | 7 (53.8)                             |              |
| Status epilepticus/frequent seizures | 5 (31.3) | 3 (23.1)                             |              |
| AED side effects         | 4 (25.0)               | 3 (23.1)                             |              |
| Others                   | 2 (12.5)               | 1 (7.7)                              |              |
| Medical aids for emergency | 14 (87.5)             | 12 (92.3)                            | 1.0          |

Opinion on how the epidemic affects seeking medical services

| Affected severely        | 7 (5.9)                | /                                    |              |
| Affected to a certain extent | 50 (42.4)            | /                                    |              |
| Not particularly          | 61 (51.7)              | /                                    |              |

4. Discussion

During the pandemic, medical resources were largely spent on the control of COVID-19. Consequently, reinforcing the balance of the management of chronic diseases became important. Our study introduced a model in accordance with local medical resources, providing medical support and strategic plan against COVID-19 for PWEs.

In our study, the high rate of responders was due to the registered patients who voluntarily participated in our follow-up management. During the epidemic, medical adherence with good medical adherence. Our data demonstrated that outpatient volume decreased sharply during the epidemic because most of the ordinary clinics were shut down, and self-quarantine policy restricted people from going out. The number of patients was also strictly controlled in hospitals to reduce the risk of cross-infection. By contrast, online clinics, as an interim surrogate for ordinary clinics, increased during the epidemic and started to decrease as ordinary clinics gradually reopened at the end of the epidemic. In our study, we found a decrease in emergency attendance during the epidemic probably because emergency patients were delivered to nearby local hospitals, avoiding some mild cases rushing to tertiary hospitals (referred to “decentralization”). In addition, we observed that fever clinic visit fluctuated during the epidemic, which was consistent with the degree of the epidemic. Based on previous data, we hypothesized that the change in distribution because of COVID-19 emerged in February, when hospital started normal operations after the Chinese Spring Festival (January 24–31). Therefore, the change in January was predominantly due to the Festival.

We observed that the risk of seizure seemed to increase during the epidemic, although no statistical difference was revealed possibly because of limited sample size and self-reported manner for seizures. This phenomenon should be studied in a large population to determine whether enhanced measures should be adopted to safeguard the PWEs in this crisis. The epidemic seemed not to significantly affect adherence to AEDs, suggesting that most of the PWEs were capable of purchasing drugs and maintaining regular medication. However, purchasing drugs and maintaining regular medication might be a challenge for some cases, particularly those who were incompetent to purchase online or isolated indoors. As previously mentioned, a shift from ordinary clinics toward remote consultation was observed during the epidemic, indicating that new communication technology proved its role in combating COVID-19. A high percentage (87.5%) of emergency cases in our respondents received prompt treatment via emergency channel, which indicated that the emergency department was running
normally in this extraordinary time. Given the huge medical pressure in emergency departments, running under overload and avoiding collapse remained pivotal. Nevertheless, near half of the participants thought that the epidemic could affect, to a certain extent, their accessibility to medical services.

This study was the first preliminary evaluation on the management of epilepsy during the pandemic. Nevertheless, our study had several limitations. First, we skewed our selection to a small sample with certain conditions (e.g., registered patients only), which failed to represent some minorities (e.g., the elderly, children, and those with severe comorbidities). In addition, the bias effect was due to the PWEs who were not capable of using electronic devices, excluding those who were digital literate. Second, the primary outcomes were based on self-report, which could increase information bias, particularly when participants were asked to recall things several months before. Third, this study was conducted at a tertiary referral epilepsy center in a single hospital. The generalization of the model should be proven by more centers and participants. We believed that the conception and structure of our model could provide referral.

We demonstrated a much-needed model to manage PWEs during the COVID-19 outbreak. Using decentralization and hierarchization, the PWEs, with or without COVID-19 infection, could still be managed. In addition, the cross-infection on COVID-19 could be effectively avoided. The core architecture of this model was also suitable for the management of other chronic diseases during pandemic.

**Declarations**

All patients gave their informed consent prior to their inclusion in this study.

**Funding**

This study was supported by the National Natural Science Foundation of China (NSFC, 81701269).

**Conflicts of interest**

The authors declare that they have no conflict of interest.
Availability of data and material

The data that support the findings of this study are available on request from the corresponding author [Q.M]. The data are not publicly available because of their containing information that could compromise the privacy of research participants.

Code availability

Not applicable.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.yebeh.2020.107528.

References

[1] Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727–33.
[2] WHO. COVID-19 strategy update – 14 April 2020. www.who.int/publications-detail/covid-19-strategy-update—14-april-2020. [accessed 14 April, 2020].
[3] Y Si, L Sun, H Sun, Y Niu, Q Mo Invited Commentary: Epilepsy management during the COVID-19 pandemic. https://blogs.neurology.org/covid-19-coronavirus/invited-commentary-epilepsy-management-during-the-covid-19-pandemic/?from=message&isappinstalled=0. [accessed 18 May, 2020].
[4] Si Y, Xiao X, Xia C, Guo J, Hao Q, Mo Q, et al. Optimising epilepsy management with a smartphone application: a randomised controlled trial. Med J Aust 2020;212:258–62.
[5] Pan L, Wang L, Huang X. How to face the novel coronavirus infection during the 2019–2020 epidemic: the experience of Sichuan Provincial People’s Hospital. Intensive Care Med 2020. Available at: https://doi.org/10.1007/s00134-020-05964-0.
[6] WHO. Coronavirus (COVID-19). https://covid19.who.int/region/wpro/country/cn [accessed 22 April, 2020].