Personalized Psychiatry and Neurology

Review

Personalized Methodological Approaches to the Issues of Monitoring the Effectiveness and Safety of Pharmacotherapy with Antiepileptic Drugs Based on Mobile Medicine Technologies

Vladimir V. Arkhipov, Konstantin M. Mantserov*

Scientific Centre for Expert Evaluation of Medicinal Products, Moscow, Russian Federation;
* Correspondence: mantserovkm@expmed.ru (K.M.M.)

Citation: Arkhipov, V.V., Mantserov, K.M. Personalized Methodological Approaches to the Issues of Monitoring the Effectiveness and Safety of Pharmacotherapy with Antiepileptic Drugs Based on Mobile Medicine Technologies. *Personalized Psychiatry and Neurology* **2023**, *3 (1)*: 22-27. https://doi.org/10.52667/2712-9179-2023-3-1-22-27

Chief Editor: Nikolaj G. Neznanov, D Med Sci, Professor

Received: 16 April 2023
Accepted: 29 April 2023
Published: 15 May 2023

Publisher's Note: V.M. Bekhterev NMRC PN stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2023 by the authors.

Abstract: Increasing the pace of informatization progress, the emergence of modern gadgets and their functionality and accessibility contribute to a significant and rapid growth in the number of users of health applications, which broadens opportunities for the promotion of mobile healthcare technologies. Recent achievements in computer science led to its accessibility and higher user interest, serving as an incentive for the development of mobile healthcare and the rapid expansion of its capabilities to provide medical services, including neurological patients. Global trends that are aimed at the creation of mobile medicine, indicate the relevance of the software products designed to assist patients with epilepsy. The authors have developed a unique algorithm and created a program for conducting post-marketing studies of antiepileptic drugs.

Keywords: *epilepsy; support of patients with epilepsy; IT technologies; artificial intelligence; mobile healthcare; mHealth; effectiveness and safety of anticonvulsants; mobile health programs; antiepileptic drugs; medical healthcare technologies.*

Introduction

The leading trend in the development of modern healthcare is the establishment of a value-oriented model of medical care. According to this model, the evaluation of the effectiveness of the healthcare system and its financing is based on the success obtained by enhancing patients' standard of living and by leveling up the satisfaction of their needs [1].

The transition to a personalized value-oriented model of medical care could become achievable solely based on the new information technology's introduction, corresponding to the new technological order.

There are currently core premises for the development of e-health in Russia. A Unified Medical Information and Analytical System (EMIAS) has been developed and is being implemented to improve the quality and accessibility of medical care in public health institutions. [2,3].

Along with personal computers, a variety of mobile gadgets is widely used daily: recorders, smartphones, tablets, smartwatches, and smart bands. Applications for these devices are wide in range and are actively used for blood pressure, blood glucose, eating behavior, physical activity, heart rate measurement, audiometry, tracking sleep rhythms, pulse oximetry checkups. [4,5].

The most crucial application of mobile medicine achievements is to control the effectiveness and safety of pharmacotherapy and constant monitoring of the patients 'with chronic disease quality of life, epilepsy in particular [6].

Numerous medical and social studies among patients and medical professionals conducted in the USA, Australia, China prove that the use of applications has the greatest potential in the development of mobile medicine. In terms of providing a system for monitoring the condition and accompanying treatment for patients with epilepsy, their use is efficient [7,8,9].

Several articles note the great medical and social significance of mobile medicine tools usage for people suffering from seizures and their equivalents [10]. The utilization of special programs for gadgets is recommended for monitoring the condition of patients, clarifying the nature and frequency of seizures, accompanying pharmacotherapy with antiepileptic drugs, compliance, and daily routine [11,12,13].

Epilepsy is a widespread, socially significant disease, therefore the development and implementation of new mobile devices, information systems and software to accompany patients suffering from epilepsy is a promising direction for the development of digital medicine [14,15].

Objective

Based on the reports from available sources, to conduct comprehensive data analysis on disposable technologies, devices, and mobile applications to accompany patients with epilepsy, to improve methodological approaches to the selection of pharmacotherapy, clinical trials, control of efficacy, and safety.

Research objectives:

1. Based on data from available information sources, conduct a critical analysis of existing mobile applications located on popular smartphone platforms to assist patients with epilepsy;

2. To assess the prospects for the development of domestic software products for evaluating the effectiveness and safety of pharmacotherapy of PEP and the possibilities of their implementation in domestic healthcare.

3. Based on the work carried out, propose up-to-date software for improving methodological approaches to the issues of conducting clinical trials, and monitoring the effectiveness and safety of antiepileptic pharmacotherapy.

Materials and Methods

Search for information in available electronic resources on the research of international experience using methods for evaluating the effectiveness and safety of anticonvulsants and information systems to accompany patients with epilepsy by keywords: epilepsy, antiepileptic drugs, information systems, neural networks, electronic (mobile) medicine, programs, and mobile healthcare applications.

A targeted survey of respondents using the capabilities of the survey services of YANDEX LLC, Viber, and WhatsApp programs to identify their interest in introducing mobile applications to accompany patients.

Research materials:

It should be noted that by entering a keyword query, more than 37.5 thousand articles and messages are issued in 2023. This is a sure indicator of global interest in neural networks and problems of electronic (mobile) healthcare (mHealth). Most of the found publications devoted to this problem are foreign, while the number of domestic publications on the issue is quite limited.

The concept of electronic (mobile) medicine (mHealth) opens up modern healthcare as the opportunity to use the Internet, stationary and mobile devices, sensors fixed directly

on the patient, combined with specialized medical applications for obtaining, analyzing and storing information.

We have not found any specialized domestic information systems, gadgets, or software for monitoring the effectiveness, safety, and conducting clinical trials in anticonvulsant therapy and accompanying patients with epilepsy.

Results

Analysis of Existing Mobile Applications for Smartphones

Since the most popular smartphone platforms are iOS and Android, the analysis of existing applications for patients with epilepsy was carried out in parallel on two smartphones with support for different operating systems.

When entering a query in English on two platforms, we found four applications for accompanying patients with epilepsy: Epilepsy Journal, Seizure Tracker, Helpilepsy, Seizure First Aide.

We conducted a comparative analysis of the applications presented on two different platforms, the presence of advertising, according to the following criteria: the presence of the Russian language, the ability to quickly report the development of an attack, the ability to send a report to a doctor, accessibility (paid or free for users), additional features.

The «Epilepsy Journal» application: when a patient has an attack and presses the button, the timer automatically turns on and the date and time of its start are set. There is a button for emergency medical care, the application will automatically give recommendations on taking medications and record the time of their intake.

The application provides a graphical analysis of the frequency of seizures for a certain period of time, it is possible to record the names of medications taken, their dosages, setting reminders about their use and the need to visit a doctor.

The use of this application for conducting clinical trials is possible as an additional method to illustrate the material obtained since it is not able to give an objective idea of the clinical and clinical-economic evaluation of the drug during the examination.

«Seizure Tracker» is an application with rather limited functionality. A distinctive feature of this application is the ability to record an attack and synchronize it with the user's account in social networks and messengers.

The main focus is on recording video and marking the time of the beginning and the end of the attack. The video can be attached to the app's website account and promptly sent to the doctor. It is possible to supplement the message with personal comments. Only English-language versions are presented. Due to the limited capabilities of this application, its use in clinical trials is impractical.

The «Helpilepsy» application is distinguished by a variety of functionality. There is no button for emergency during an attack in the interface, but there is a possibility of audio and video recording of the attack. Adding information about an attack, the time of the seizure occurrence is recorded manually. The interface provides the choice of the seizure types, the time of their habitual duration, gives an idea of the triggers that contribute to the occurrence of seizures and the reactions that took place after the attack. Indicates the place of the patient's present stay.

The application positions itself as a diary, where you can add data on state changes and features the course of seizures, the state after their completion. A certain block is provided for recording the names of medications taken, recording information on changes in their dosage, adverse reactions, and reminders of a medical appointment. It is possible to record meetings with the attending doctor and subsequently listen to them, set a reminder of scheduled visits. The user can make daily notes about the mood and quality of sleep. It is possible to automatically forward data from the application to the doctor and view them remotely (when access is provided). Only English-language versions are presented, the possibilities of Russification of the program are limited. It is possible to use this

application conducting research on real clinical practice as an additional tool in assessing the risks of antiepileptic pharmacotherapy.

The «Seize First Aide» application consists of an informational unit and a quick message one about the development of an attack. The informational unit describes the principles of first aid in case of a seizure; videos, which cover the topic of the five most common types of seizures, are presented. The second unit is a virtual ambulance call button in case of a seizure and a hotline call button for emergency consultation. The application is not Russified. The use of this application in clinical trials does not make sense, since it is informative, auxiliary in nature [16].

Targeted Survey of Respondents

The analysis of domestic and foreign literature on the problems of evaluating the effectiveness and safety of medicinal antiepileptic drugs was carried out on such resources as: Scopus, Springer.

The authors have developed a questionnaire addressing topical issues of the use of antiepileptic drugs, as well as the methods used for prescribing medications. The questionnaire consists of 24 questions, among them questions with the possibility of choosing one answer option, as well as a question with the possibility of choosing several answer options. The purpose of the questionnaire was to obtain information from neurologists on various aspects of pharmacotherapy with antiepileptic drugs. The survey was conducted using the GOOGLE Forms electronic resource. This service is widely used for conducting surveys of specialists of various professions, (has established itself as a high-quality platform for conducting surveys). An accessible interface and the ability to send a link to complete the survey on any portable or stationary device, such as computers, laptops, smartphones, and tablets, at any convenient time. The link to the Questionnaire was sent out electronically by mail. The letter contained an explanation of the procedure for filling out the questionnaire, the purpose and objectives of the study.

The respondents were neurologists from several Russian cities, such as Moscow, Kazan, St. Petersburg, Tver. Foreign colleagues from Belarus took part in the survey. We received and analyzed 387 questionnaires with answers to the questions, while 12% of the questionnaires were eliminated due to minimal filling or contradictory answers requiring additional explanations.

An electronic survey of 345 neurologists and clinical pharmacologists was conducted to identify the urge to improve mobile applications and to assess the effectiveness and safety of antiepileptic pharmacotherapy.

Preliminary results of the survey imply a lack of awareness and accessibility of mobile healthcare technologies to accompany patients with epilepsy, a shortage of available information resources and tools to assess the effectiveness and safety of antiepileptic drugs and the interest of practitioners in their usage.

Based on the results of the search, the data about existing informational resources that have been used to accompany patients with epilepsy was systematized.

An original algorithm for creating a computer program has been developed.

An algorithm-based "Program for conducting post-marketing studies of antiepileptic drugs" was developed.

Registration of intellectual property rights was carried out (state registration number 2021664964 dated 09/16/2021).

Discussion

Pharmacotherapy is the main method of treating epilepsy, which provides a daily intake of antiepileptic drugs for a long time, frequently throughout life. Long-term treatment with the use of one or more drug significantly increases the risks of adverse reactions and requires control of dosages, adherence, and continuity of treatment.

Global trends aimed at the development of electronic medicine suggest that a significant role in ensuring dynamic monitoring of the pharmacotherapy risks in epilepsy may be the use of the achievements of modern IT technologies, hence the necessary technological base in Russia is available.

The introduction of the achievements of mobile medicine to the domestic healthcare practice should contribute to drug safety improvement, reliability of clinical trials and support in decision-making on the selection of pharmacotherapy.

The authors conducted extended research and systematization of information on international experience in the use of information systems, devices and mobile applications to accompany patients with epilepsy.

Special attention was paid to the critical analysis of applications for mobile devices. Among the disadvantages of existing mobile applications for smartphones, the following should be pointed out: the lack of Russification options and advertising; incomplete usage of gadgets capabilities for video registration and interaction with location systems; limited functionality during clinical trials.

Users of the «Epilepsy Journal», «Seizure Tracker», «Helpilepsy», «Seizure First Aide» note in their reviews that these applications promote compliance, reduce the risks of pharmacotherapy, allow monitoring seizures and quality of life with epilepsy, increase the competence of patients and participants in the treatment process.

The information presented in the article indicates the relevance of the domestic software products development for the support of patients with epilepsy and the risk management of pharmacotherapy.

Conclusions

Risk-oriented selection of pharmacotherapy for patients with convulsive syndromes, based on mobile healthcare technologies, is a promising direction for improving the quality, efficiency, and accessibility of medical care for patients with epilepsy.

The introduction of mHealth technologies into practical healthcare will improve methodological approaches to the issues of conducting clinical (RWD/RWE) antiepileptic pharmacological studies and contribute to making them rather evident.

The authors have developed an original algorithm and created a program for conducting post-marketing studies of antiepileptic drugs. The program functionality allows you to carry out operational accounting and analysis of changes in the condition of patients amid ongoing treatment, as well as conduct clinical studies on the effectiveness and safety of anticonvulsants. Registration of intellectual property rights to this software has been carried out (state registration number 2021664964 dated 09/16/2021).

Author Contributions: V.V.A. - Search, collection and analysis of literature data analysis and critical revision of the content and results of work, solving issues related to the integrity of all parts of the article; K.M.M. - The concept and design of the work, search, collection and analysis of literature data, interpretation of results, solving issues related to the integrity of all parts of the article.

Acknowledgements. The study was performed without external funding

Conflict of interest. Authors declare no conflict of interest requiring disclosure in this article.

References

1. Porter, M.E., Heppelmann, J.E. How Smart, connected products are transforming competition. *Harvard business rev*. **2014**; 92 (11). http://hbr. Org/2014/11/how-smart-connected-products-are-transforming-competition/Ar/

2. Menshikov, S.M., Klimenko, L.A. *Long waves in the economy: When society changes its skin*. **2014**; 288. ISBN 978-5-9710-0728-9. (In Russ.)

3. Zhuravleva, M.V., Kukes, V.G., Prokofiev, A.B., Arkhipov, V.V., Olefir, Yu.V., Serebrova, S.Yu., Sokolov, A.V., Sychev, D.A. Efficacy and safety of medicinal products: the significance and possibilities of clinical pharmacology. *Bulletin of the Scientific Center for the Examination of Medical Products*. **2015**; (2): 20-24. (In Russ.)

4. Hilliard, M.E., Hahn, A., Ridge, A.K., Eakin, M.N., Riekert, K.A. *User preferences and design recommendations for an mHealth app to promote cystic fibrosis self-management JMIR mHealth uHealth*. **2014**; 44.

5. Liu, X., Wang, R., Zhou, D., Hong, Z. Feasibility and acceptability of smartphone applications for seizure self-management in China: Questionnaire study among people with epilepsy. *Epilepsy & Behavior*. **2016**; 55: 57-61.

6. Goh, G., Tan, N.C., Malhotra, R., Padmanabhan, U., Barbier, S., Allen, J.C. et al. Short-term trajectories of use of a caloric-monitoring mobile phone app among patients with type 2 diabetes mellitus in a primary care setting. *J Med Internet Res*. **2015**; 17: 33.

7. Lorig, K.R., Holman, H. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med*. **2003**; 26(1): 1-7. doi: 10.1207/S15324796ABM2601_01. PMID: 12867348.

8. M. Arnhold, M. Quade, W. Kirch. Mobile applications for diabetics: a systematic review and expert-based usability evaluation considering the special requirements of diabetes patients age 50 years or older J Med Internet Res, 16 (2014), p. e104

9. Kumar, M. Khunger, A. Gupta, N. Garg. *A content analysis of smartphone-based applications for hypertension management JASH*. **2015**; 9: 130-136.

10. Leenen, L.A.M., Wijnen, B.F.M., de Kinderen, R.J.A., van Heugten, C.M., Evers, S.M.A.A., Majoie, M.H.J.M. Are people with epilepsy using eHealth-tools? *Epilepsy Behav*. **2016**; 64(A): 268-272. doi: 10.1016/j.yebeh.2016.08.007.

11. Ouwens, S. van der Burg, M. Faber, T. van der Weijden. *Shared decision making & self management Scientific Institute for Quality of Healthcare.* **2012**.

12. Groenewegen, A., Tofighy, A., Ryvlin, P., Steinhoff, B.J., Dedeken, P. Measures for improving treatment outcomes for patients with epilepsy--results from a large multinational patient-physician survey. *Epilepsy Behav*. **2014**; 34: 58-67. doi: 10.1016/j.yebeh.2014.02.033

13. Barlow, J., Wright, C., Sheasby, J., Turner, A., Hainsworth, J. Self-management approaches for people with chronic conditions: a review. *Patient Educ Couns*. **2002**; 48(2): 177-87. doi: 10.1016/s0738-3991(02)00032-0

14. Elger, C.E., Hoppe, C. Diagnostic challenges in epilepsy: seizure under-reporting and seizure detection. *Lancet Neurol*. **2018**; 17(3): 279–288. https://doi.org/10.1016/S1474-4422(18)30038-3

15. Kusmakar, S., Karmakar, C., Yan, B., Obrien, T., Muthuganapathy, R., Palaniswami, M. Automated Detection of Convulsive Seizures Using a Wearable Accelerometer Device. *IEEE Trans Biomed Eng*. **2019**; 66(2): 421-432. doi: 10.1109/TBME.2018.2845865

16. Arkhipov, V.V., Burmistrova, N.I. Automated information systems as a new approach to risk management of pharmacotherapy in the treatment of epilepsy. *Safety and risk of pharmacotherapy*. **2022**; 10(2): 151-160. https://doi.org/10.30895/2312-7821-2022-10-2-247 (in Russ.)