

The Application of PDCA Circulation Method in Improving the Application of Internet + Smart First Aid in the Treatment of Preoperative Patients with Severe Neurological Diseases

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Abstract

Objective: To investigate the application and feasibility of PDCA circulation method in the treatment of patients with severe neurological diseases in Internet + smart first aid, with a view to promoting the sustainable construction of smart first aid. **Methods:** A total of 105 patients with severe neurological diseases in Zhuji people's Hospital and cooperative units were selected, and 52 cases in the research group and 53 cases in the control group were divided according to the single and double number visiting time: In this paper, through reading the literature, the development of Internet + wisdom first aid treatment of patients with severe neurological diseases was investigated, and the common problems were analyzed and summarized, and the research group used the PDCA circulation method to sort out the existing problems, analyze the causes of the problems and improve them. The difference in treatment time between the two groups was compared, and the patient's satisfaction was evaluated for the time of being transferred to the hospital emergency room by 120 ambulances, the time from emergency admission to surgery (Cath lab), and the satisfaction of the patient. **Results:** The time from emergency treatment to the operation room (catheter room) in the study group was significantly shortened, and patient satisfaction was significantly improved compared with that in the control group, with a statistically significant difference ($P < 0.001$). **Conclusion:** Through the application of PDCA circulation method in the Internet + smart emergency treatment of neurologically severe preoperative patients, the Internet + smart emergency mode

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can be continuously improved, the treatment process can be significantly optimized, the first aid time can be shortened, and the treatment efficiency of neurocritical ill patients can be improved. Therefore, it has been expected to improve the success rate of treatment and improve the success rate of neurological patients.

Keywords

PDCA, First Aid Mode, Quality Management, Internet + Smart First Aid

1. Introduction

Internet + intelligent first aid system is a new first aid system developed in recent years. It has been widely used in medical institutions at all levels because of its significant advantages compared with the traditional first aid system [1]. The system is mainly composed of three parts: pre-hospital first aid platform, in-hospital care platform and specialized center, which fully connect all aspects of first aid, reasonably allocate medical resources, shorten the time cost of first aid and improve the quality of first aid [2] [3] [4]. Neurocritical patients have complex and changeable conditions and severe symptoms, early intervention can effectively prevent complications and improve the prognosis of patients [5] [6] with severe neurological conditions. In order to further explore and improve the practice and first aid quality of Internet + intelligent first aid system, PDCA circulation method is applied to improve it. The report results are as follows.

2. Materials and Methods

2.1. General Information

A total of 105 neurocritical patients admitted to our hospital from October 2020 to October 2021 were selected as research objects and randomly divided into a study group (n = 52) and a control group (n = 53). There were 33 males and 19 females in the study group, aged from 34 to 72 years, with an average age of (51.52 ± 6.40) years. There were 35 males and 18 females in the control group, aged from 35 to 71 years, with an average age of (52.00 ± 6.34) years. Inclusive criteria: 1) Preoperative Glasgow Coma Index (GCS) score < 8; 2) aged between 25 and 75 years old; 3) Family members were informed of the study and signed the consent form. Exclusion criteria: 1) The patient has a history of severe cardiovascular and cerebrovascular diseases; 2) Patients with multiple organ failure and parenchymal organ disease; 3) Poor patient compliance. There was no significant difference in baseline data (gender, age, etc.) between the two groups (P > 0.05, **Table 1**), indicating comparability. The study was approved by the hospital ethics committee. (Ethical batch No. ZJYY-LL-WT-2020382175)

2.2. Method

The control group received the Internet + intelligent first aid, and the whole

Table 1. Comparison of preoperative basic information between study group and control group.

Group	Number of cases	Man	Age	120 Time from reception to emergency room (min)	Preoperative GCS score
The study group	52	33 (63.5%)	51.52 ± 6.40	31.10 ± 4.21	6.35 ± 1.73
The control group	53	35 (66.0%)	52.00 ± 6.34	31.38 ± 3.85	6.13 ± 1.98
Statistical value		0.076	0.387	0.373	0.820
P value		0.782	0.700	0.710	0.412

process of first aid was supervised and guided through the network platform. The emergency vehicle is equipped with corresponding monitoring instruments. After obtaining the patient's condition information in the first time, it is transmitted to the hospital emergency department of the hospital in real time through the 4G/5G network system, and the situation in the emergency vehicle is broadcast live, and the rescues will be carried out jointly inside and outside the hospital. After collecting patient information to the maximum extent, discussion and analyzes of the patient's condition were carried out in the hospital, corresponding diagnosis and treatment plans were formulated to reduce the time between each link of preoperative preparation for patients and ensure the continuity of the first aid process.

In the study group, PDCA circulation management was performed on the basis of intelligent first aid in the control group, and the specific measures were as follows.

2.2.1. Plan

Establish Management Team

First of all, set up the Internet + wisdom first aid quality management team. The team members included: 1 head nurse of neurosurgery, 1 chief physician, 2 attending physicians of neurosurgery and emergency department, 2 neurosurgical nurses, and 2 nurses in the operating room, a total of 8 people. The chief physician, as the team leader, is responsible for determining the specific operation process, evaluation standards, inspection system, etc. All team members should point out and report the corresponding irregular operation in time, cooperate with each other and complete each part of the PDCA.

Problem Analysis

Through the analysis of the influencing factors that lead to the flow of patients from entering the emergency vehicle to the completion of preoperative preparation, it is concluded that the adverse factors affecting the continuity of all links of preoperative preparation mainly included the following five aspects: insufficient medical staff, insufficient hardware conditions, insufficient patients, insufficient procedures, and insufficient system, and the corresponding fishbone diagram (**Figure 1**) was drawn to point out the specific causes of the adverse factors in detail. Meanwhile, by analyzing the percentage of the corresponding specific

causes in the whole PDCA, seven important reasons affecting the preoperative preparation of patients were summarized, including medical staff were not familiar with intelligent first aid, patients' lack of understanding of intelligent first aid, samples are submitted for a long time, ambulance travel time is long, intelligent first aid quality management is insufficient, in-hospital scheduling is not timely, and first aid personnel training is not performed. (Figure 2)

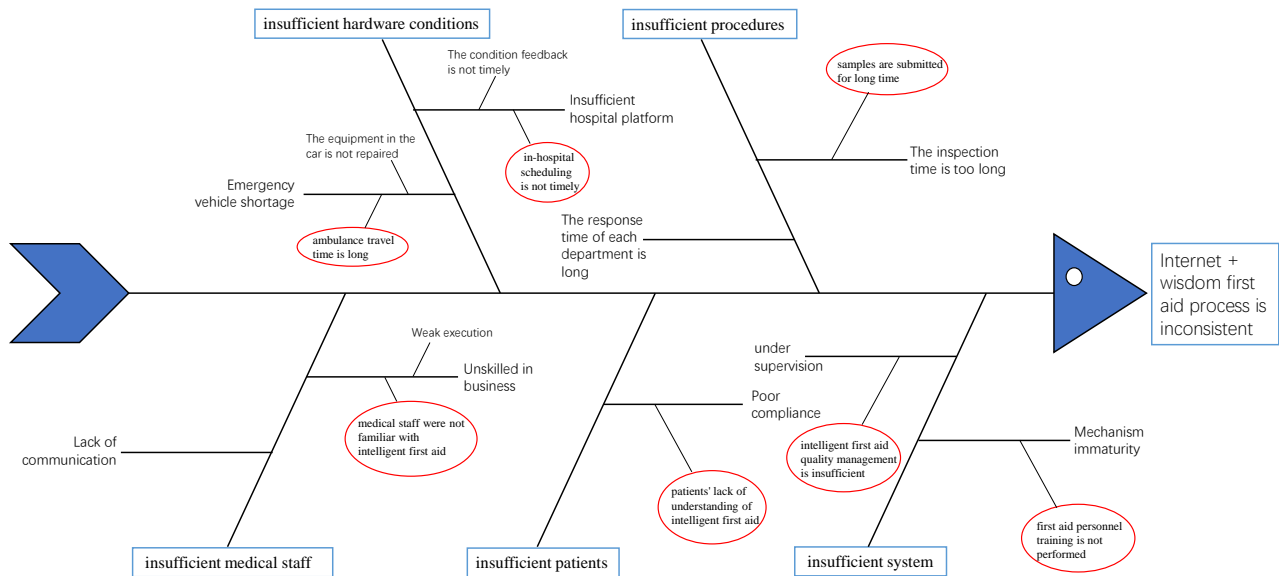


Figure 1. Fishbone diagram of adverse factors in first aid process.

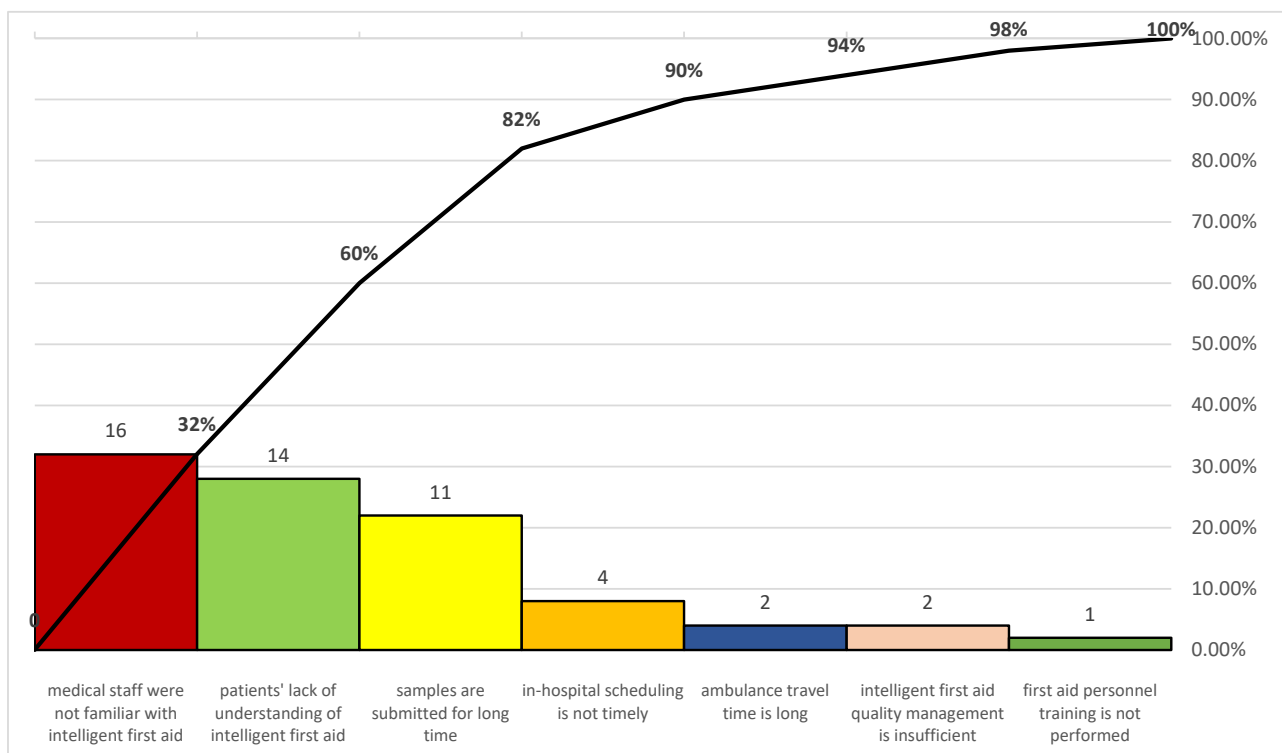


Figure 2. Frequency and proportion of adverse factors in emergency treatment process.

Optimization strategy

The quality management team analyzed and summarized the prominent problems by consulting to literature, conducting group discussion brainstorming, and formulated the corresponding optimization strategies: 1) Medical staff are not familiar with smart first aid: Medical staff's understanding of the new Internet + smart first aid mode can be enhanced by holding in-hospital lectures, learning exchange meetings, public account tweets, so as to encourage medical staff to summarize problems encountered in practice and make continuous improvement. 2) Patients have insufficient knowledge of intelligent first aid: Outside the hospital through network publicity, radio publicity and other ways to increase the public's awareness of intelligent first aid; the hospital popularized the Internet plus smart first aid model to patients through education, small cards and other means. 3) Excessive sample submission time: Through the application of a medical UAV system, the collected samples shall be sent to the hospital for examination in the first place. According to the condition of the patient arriving, samples from emergency patients are tested first, thus reducing the waiting time for test results. 4) Untimely dispatching in the hospital: A special first aid command team is established to collect first aid information, dispatch first aid personnel and dispatch emergency vehicles, and supervises the progress of each link in real time to ensure the coherence of emergency activities. 5) Long travel time of crash cart: avoid traffic congestion on road segments by applying new GPS and intelligent transportation systems to reduce the travel time of ambulance. 6) Insufficient quality management of intelligent first aid: Through the establishment of a quality management team, the process of intelligent first aid each time shall be recorded, analyzed and summarized, the existing problems in the process of first aid shall be corrected, and high-quality first aid activities shall be ensured. 7) Insufficient training of emergency personnel: Through regular training of emergency medical staff, assessment after training, timely feedback on the business ability of emergency personnel, enhance adaptability to Internet + intelligent first aid, and improve the quality of first aid.

2.2.2. Performed (Do)

The optimization measures implemented by the Internet + Intelligent First Aid Quality Management Team specifically include the following points. The implementation time is 2 months after the status quo analysis, and circular improvement is performed within the next 12 months.

Increasing the familiarity of medical staff with intelligent first aid

First of all, establish Internet + intelligent first aid expert group to regularly preach and publicize the personnel of each department, and irregularly conduct sampling inspection on each department to examine the understanding of intelligent first aid by each medical staff. Use media software such as hospital public account and microblog to write introductions about Internet + intelligent first aid and popularize relevant knowledge. Departments closely related to first aid, such as emergency department, specialty and anesthesiology department, will be

listed as key departments to deepen and increase the depth and intensity of propaganda, organize the personnel of key departments to conduct learning and exchange meetings every week, to publish their deep understanding and learning experience of Internet + wisdom first aid, and to share the problems encountered in the practice process and discuss them in a unified way. The members of expert group shall record and summarize each exchange meeting and give guidance. Every month, relevant lectures on Internet + intelligent first aid shall be held throughout the hospital, relevant experts and professors shall be invited to guide the work. The expert group of the hospital will conduct in-depth analysis on the relevant issues on the practice of Internet + intelligent first aid in the hospital, so as to further increase the cognition of medical staff on intelligent first aid.

Increased patient awareness of intelligent first aid

Through popularization and publicity, improve people's awareness of intelligent first aid. Standard operation: When emergency personnel arrive at the scene for first aid activities, they should standardize the first aid operation, explain the necessary situations to the patients and their families, and give certain humanistic care. Network publicity: Through the public number, microblog, hospital publicity website, etc., write the relevant introduction to introduce the specific process of intelligent first aid, the instruments and equipment involved and their advantages compared with traditional first aid, and make animation short films to help readers better understand. Radio publicity: Set up special lectures on intelligent first aid, further explain intelligent first aid, and interact with the listeners, answer the questions concerned and worried by the masses, eliminate the doubts and misunderstandings of the public. In-hospital education: Introduce the relevant knowledge of intelligent first aid to inpatients, and post the flow chart of intelligent first aid in ward, nurse station and other places. Through the above ways to help the masses understand and understand the Internet + intelligent first aid, so that they can better cooperate with the work of medical staff in the process of first aid development.

Reduce sample submission time

Through cooperation with telecom, mobile and other companies, the medical UAV system is introduced, which is connected with the hospital command platform and simultaneously subject to the dispatching and supervision of the emergency command team. The UAV system can automatically locate the location where the first aid occurs and start at the same time as the crash cart after receiving the first aid order. After the relevant first aid personnel take samples of the patient, the samples can be sent to the hospital for inspection the first time, so as to improve the efficiency of first aid. A special UAV team shall be established under the first aid command team, which is mainly responsible for the normal operation of UAV after the occurrence of first aid, sampling and inspection after delivery of samples, and the possible technical problems. Due to its unique air transportation advantages, UAV can transport patient samples in a

straight-line distance, obtain test results before the patient arrives at the hospital, facilitate emergency personnel to make decisions and save the cost of emergency time.

Expedite in-hospital scheduling

Through the establishment of emergency command team, coordinate and arrange various emergency activities. Upon receipt of the first aid information, the command team should immediately respond, contact the relevant emergency personnel through telephone, WeChat, nail group and other means, and notify the corresponding departments to make preparations; synchronize the emergency information to the crash cart and UAV system, dispatch the appropriate vehicle type to the emergency scene and notify the UAV team to make preparations; contact the corresponding expert departments for remote consultation after receiving the basic information and disease evaluation of the patients; notify the relevant personnel to take samples and contact the clinical laboratory and the operating room to open the green channel for emergency preparation after the samples arrive in the hospital with the UAV. Through the intervention and supervision of each link of intelligent first aid, each step is connected smoothly and the efficiency of the operation of the first aid process is improved.

Reducing Crash Cart Travel Time

By upgrading the in-vehicle GPS system and equipped with intelligent transportation system, driving efficiency can be improved. After the emergency vehicle receives the dispatch, the GPS system in the cart automatically locates, automatically calculates the shortest driving distance, and combines with the intelligent traffic system to avoid the road congestion section and automatically plans the driving route. The intelligent traffic systems can also carry out real-time monitoring of road conditions along the road and reflect the road conditions in the cab, helping emergency vehicles reach the emergency scene faster. At the same time, the emergency command team should be on standby at any time and be responsible for the technical support for the smooth itinerary of the crash cart and the equipment failure in the cart.

Insufficient quality management of intelligent first aid

Through the establishment of Internet + intelligent emergency quality management team, record and supervise the process of each emergency activity, including the supervision on the response and dispatching of emergency command team, the supervision on the travel planning of crash cart team, the supervision on the quality of emergency treatment on the spot of emergency team, the supervision on the control of drone in UAV team, the analysis and supervision on the guidance of emergency treatment process and the formulation of diagnosis and treatment plan by hospital emergency expert group, and the evaluation on the preoperative preparation of patients before going to the hospital. After summarizing and analyzing, the quality management report meeting of intelligent first aid was held every week, and the problems and shortcomings occurred in the process of first aid at present stage were pointed out and continuously

improved.

Intensify the training of emergency personnel

By setting up the first aid system assessment criteria for medical staff, standardize the first aid operation of medical staff, and reflect the familiarity and practice of each person with intelligent first aid operation and process. For those who have insufficient mastery, they shall regularly participate in intelligent first aid training and participate in quantitative assessment after training, and the compliance can continue the first aid activities.

2.2.3. Check

The patient was transported to the hospital emergency room by 120 ambulances and admitted to the emergency room (catheter).

Room time and patient satisfaction were evaluated as indicators. Statistical analysis was performed for neurocritical patients from October 2020 to October 2021. After analysis, it was concluded that the time to transfer patients to the hospital before and after PDCA circulation was 20.15 ± 3.68 points in the control group and 19.60 ± 3.47 points in the study group, and the difference was not statistically significant, which may be related to more nearby medical care after 120 admission, relatively short transport distance, and small number of cases. The time from emergency admission to admission to the operating room (catheterization laboratory) was 24.83 ± 5.34 points in the control group, 15.67 ± 3.50 points in the study group after application, and 9.16 points in the study group, and the difference was statistically significant ($P < 0.01$, **Table 2**). In addition, patient satisfaction increased from 87.75 ± 4.56 to 94.60 ± 4.65 . The difference was statistically significant ($P < 0.01$, **Table 2**). On the basis of PDCA cycle, we continue to analyze the possible influencing factors, such as low coherence in each link, there are still problems in communication between emergency personnel, and each intelligent device leads to delayed information transmission due to external factors such as the network, and further improves the PDCA cycle.

2.2.4. Continuous Improvement (Action)

In view of the problems in the cycle process at the problems occurred in the circulation process, the corresponding improvement plan is formulated: Regular intelligent first aid simulation training, quantitative analysis of training results,

Table 2. Comparison of relevant conditions between the two groups after PDCA circulation.

Group	Number of cases	Emergency room to operating room time (min)	Length of stay	GOS score	Patient satisfaction (%)	Total hospitalization expenses (Yuan)
The study group	52cases	29.10 ± 5.30	18.32 ± 3.99	3.12 ± 0.76	94.60 ± 4.65	6.06 ± 1.25
The control group	53cases	44.51 ± 10.50	19.56 ± 5.76	2.77 ± 0.80	87.75 ± 4.56	7.58 ± 1.33
Statistical value		9.525	0.750	2.248	7.615	6.050
P value		<0.001	0.454	0.025	<0.001	<0.001

constantly strengthen the coordination ability and response ability among departments; upgrading the first aid communication environment, including emergency personnel equipped with special communication equipment, crash cart network environment upgrading, regular maintenance of first aid equipment and so on. PDCA circulation was applied to optimize the management of the improved process plan, and was extended to the pre-emergency management of critical patients in other departments of the hospital after maturity.

3. Results

The results showed that after improving Internet + intelligent first aid by PDCA circulation method, the study group took 24.83 ± 5.34 points compared with the control group: the time from emergency admission to admission to the operating room (catheterization laboratory).

After application, the study group took 15.67 ± 3.50 points, shortened 9.16 points, and the emergency efficiency was significantly improved. The patient satisfaction increased from 87.75 ± 4.56 to 94.60 ± 4.65 , and the emergency process was significantly optimized.

4. Discussion

In recent years, with the development of high and new technologies such as the Internet, the Internet of Things and artificial intelligence, the modern Internet medical system is gradually integrated with traditional first aid, which has improved the quality of first aid [7] [8] [9]. Patients with severe neurological conditions are critical, rapidly changing, complex and diverse. Glasgow Outcome Scale is often used to assess the patient's condition before surgery, and the score level is positively correlated with the severity of the disease [10]. For critically ill patients, emergency measures should be taken immediately and preparation time before rescue should be minimized [11] [12]. In the traditional first aid mode, after dialing the first aid telephone number, the local hospital immediately dispatched the nearby ambulance to the scene for rescue, and evaluates the patient's condition. After the crash cart arrived at the hospital, the patient's condition will be assessed again, and sampling and submission, disease analysis, and diagnosis and treatment plan discussion were started. After contacting relevant personnel such as the operating room and anesthesiology department, a series of preoperative preparation are completed before surgical treatment is performed on the patient [13] [14]. For prehospital critically ill patients, rapid rescue and timely surgical treatment are effective ways to prevent complications and improve the prognosis of patients. The Internet plus + intelligent emergency system can effectively solve the shortcomings of traditional first aid, crash cart rush is timely, more objective for first-aid personnel to conduct on-site emergency treatment, more smooth handover before the hospital and in the hospital, and shorter rescue time.

With the wide application of Internet + intelligent first aid system in primary

hospitals, compared with traditional first aid, the treatment cost increases moderately, the consistency of emergency treatment process increases, and the quality and efficiency of emergency treatment improves [15]. After receiving the emergency telephone number of the patient, the Internet + intelligent emergency system starts to dispatch the crash cart and notify the expert team to arrive at the emergency command center for remote guidance through the camera connected with the crash cart and screen shot [16]. The real-time synchronous traffic information of the collision vehicle is used to optimize its driving route to avoid the time cost caused by road problems. After the emergency vehicle arrives at the scene, the patient's condition information can be input, such as detecting the patient's heartbeat, blood oxygen, respiration and other indicators. The emergency personnel can also fill in the electronic medical record in the crash cart and make a preliminary diagnosis, which can be simultaneously uploaded to the hospital platform for the expert group's reference. The discussion and development of the rescue plan can be completed during the operation of the emergency vehicle [17] [18]. The ambulance is equipped with small operating tables and corresponding emergency equipment in order to cope with emergencies in critically ill patients' status [19]. Through real-time information exchange, before the patient arrives at the hospital, the relevant surgical preparation can be completed, including surgical staff preparation, anesthesia staff preparation, CT and other auxiliary examination. After the patient arrives at the hospital, the green channel for rescue is opened, and the patient is given surgical treatment at the first time, so that the connection between the hospital and the out-of-hospital rescue is smooth. Through real-time information exchange, the in-hospital resources can be reasonably allocated, the first aid time can be shortened, and the first aid efficiency can be improved.

In the practice and application of the Internet + intelligent first aid system, its own advantages have been proved and reflected, but its own problems also appear [20]. PDCA circulation method is a commonly used quality management mode at present, which mainly includes four parts: plan, execution, check and continuous improvement [21]. It also keeps circulating to continuously improve the quality and achieve the expected goals. The results showed that after the application of PD CA cycle method to improve Internet + intelligent first aid, compared with the control group, the study group spent 44.51 ± 10.50 minutes in the first aid process, while the study group spent 29.10 ± 5.30 minutes after the application, which was shortened by 15.41, and the first aid cost was significantly reduced. The GOS score of the control group was 2.77 ± 0.80 and that of the study group was 3.12 ± 0.76 . The prognosis of the patients was significantly improved. Patient satisfaction increased from 87.75 ± 4.56 to 94.60 ± 4.65 . In conclusion, the application of PDCA circulation method in the quality management of Internet + intelligent first aid for the treatment of critically ill neurological patients can constantly improve the Internet + intelligent first aid model, optimize the treatment process, shorten the preparation time, effectively im-

prove the treatment efficiency of patients and improve patient satisfaction. In the practice and application of Internet + intelligent emergency system, its own advantages have been continuously confirmed and reflected.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Watson, H.A., Tribe, R.M. and Shennan, A.H. (2019) The Role of Medical Smartphone Apps in Clinical Decision-Support: A Literature Review. *Artificial Intelligence in Medicine*, **100**, Article ID: 101707. <https://doi.org/10.1016/j.artmed.2019.101707>
- [2] Ahad, A., Tahir, M., Aman Sheikh, M., Ahmed, K.I., Mughees, A. and Numani, A. (2020) Technologies Trend towards 5G Network for Smart Health-Care Using IoT: A Review. *Sensors (Basel)*, **20**, 4047. <https://doi.org/10.3390/s20144047>
- [3] Fakhruddin, S.S., Gharghan, S.K., Al-Naji, A. and Chahl, J. (2019) An Advanced First Aid System Based on an Unmanned Aerial Vehicles and a Wireless Body Area Sensor Network for Elderly Persons in Outdoor Environments. *Sensors (Basel)*, **19**, 2955. <https://doi.org/10.3390/s19132955>
- [4] Huang, L.B., Liu, J., Hong, J.F., Hu, Y.-Y. and Xu, Y.-L. (2021) Application of Intelligent First Aid System in Pre-Hospital First Aid Nursing Quality Control. *Fujian Journal of Medicine*, **43**, 177-178.
- [5] Qiu, H. and Du, W. (2021) Evaluation of the Effect of PDCA in Hospital Health Management. *Journal of Healthcare Engineering*, **2021**, Article ID: 6778045. <https://doi.org/10.1155/2021/6778045>
- [6] Chen, Y., Zheng, J., Wu, D., Zhang, Y. and Lin, Y. (2020) Application of the PDCA Cycle for Standardized Nursing Management in a COVID-19 Intensive Care Unit. *Annals of Palliative Medicine*, **9**, 1198-1205. <https://doi.org/10.21037/apm-20-1084>
- [7] Bai, L., Yang, L., Shi, X. and Huang, W. (2022) Effect of PDCA Circulation Nursing Intervention on Prognosis of Patients with Severe Pneumonia. *American Journal of Translational Research*, **14**, 252-263.
- [8] Cook, A.M., Morgan, J.G., Hawryluk, G.W.J., Mailloux, P., McLaughlin, D., Papanagelou, A., Samuel, S., Tokumaru, S., *et al.* (2020) Guidelines for the Acute Treatment of Cerebral Edema in Neurocritical Care Patients. *Neurocritical Care*, **32**, 647-666. <https://doi.org/10.1007/s12028-020-00959-7>
- [9] Lai, Y.L., Chou, Y.H. and Chang, L.C. (2018) An Intelligent IoT Emergency Vehicle Warning System Using RFID and Wi-Fi Technologies for Emergency Medical Services. *Technology and Health Care*, **26**, 43-55. <https://doi.org/10.3233/THC-171405>
- [10] Raina, K.D., Morse, J.Q., Chisholm, D., Whyte, E.M. and Terhorst, L. (2022) An Internet-Based Self-Management Intervention to Reduce Fatigue among People with Traumatic Brain Injury: A Pilot Randomized Controlled Trial. *The American Journal of Occupational Therapy*, **76**. <https://doi.org/10.5014/ajot.2022.048587>

- [11] Huang, L., Lu, C., Pang, M., Li, L., Zhang, Y., Su, A. and Ding, L. (2021) Effect of PDCA-Based Nursing Intervention on Activities of Daily Living, Neurological Function and Self-Management in Acute Cerebral Stroke. *American Journal of Translational Research*, **13**, 5315-5321.
- [12] Gardašević, G., Katzis, K., Bajić, D. and Berbakov, L. (2020) Emerging Wireless Sensor Networks and Internet of Things Technologies-Foundations of Smart Healthcare. *Sensors (Basel)*, **20**, Article 3619. <https://doi.org/10.3390/s20133619>
- [13] Guo, C. and Li, H. (2022) Application of 5G Network Combined with AI Robots in Personalized Nursing in China: A Literature Review. *Frontiers in Public Health*, **10**, Article ID: 948303. <https://doi.org/10.3389/fpubh.2022.948303>
- [14] Feng, F.J., Xu, L.B., Wen, G.-F., Wang, C.-B. and Du, W.-W. (2021) Effect of Intelligent First Aid on Prognosis of Patients Undergoing Craniocerebral Trauma Surgery. *Chinese Modern Doctors*, **59**, 5-8.
- [15] Tsao, Y.C., Cheng, F.J., Li, Y.H. and Liao, L.D. (2022) An IoT-Based Smart System with an MQTT Broker for Individual Patient Vital Sign Monitoring in Potential Emergency or Prehospital Applications. *Emergency Medicine International*, **2022**, Article ID: 7245650. <https://doi.org/10.1155/2022/7245650>
- [16] Hong, J.-F., Hu, Y.-Y., Cai, D. and Li, Q.-Y. (2021) Application of Intelligent First Aid Information System in the Transport of Novel Coronavirus Pneumonia and Related Patients. *Journal of Trauma and Emergency Medicine*, **9**, 40-43.
- [17] Guo, C., Yu, Y., Xie, R.G. and Gu, S. (2021) Discussion on Pre-Hospital Emergency Mode of 5G Smart Medical Treatment. *Chinese Journal of Health Quality Control*, **28**, 61-63.
- [18] Alkinani, M.H., Almazroi, A.A., Jhanjhi, N.Z. and Khan, N.A. (2021) 5G and IoT Based Reporting and Accident Detection (RAD) System to Deliver First Aid Box Using Unmanned Aerial Vehicle. *Sensors (Basel)*, **21**, 6905. <https://doi.org/10.3390/s21206905>
- [19] Huabangyang, T., Klaiaunghong, R., Jansanga, D., Aintharasongkho, A., Hanlakorn, T., Sakcharoen, R., Kamsom, A. and Soion, T. (2021) Survival Rates and Factors Related to the Survival of Traffic Accident Patients Transported by Emergency Medical Services. *Open Access Emergency Medicine*, **13**, 575-586. <https://doi.org/10.2147/OAEM.S344705>
- [20] Kim, D., You, S., So, S., Lee, J., *et al.* (2018) A Data-Driven Artificial Intelligence Model for Remote Triage in the Prehospital Environment. *PLOS ONE*, **13**, e0206006. <https://doi.org/10.1371/journal.pone.0206006>
- [21] Shi, Y.P., Li, X., Cui, X.Y., *et al.* (2022) Application of PDCA Circulation to Improve the Use of Intravenous Fluids in Hospitalized Patients. *Chinese Pharmacy*, **33**, 2797-2800.