

Research on the effect of FOCUS-PDCA quality management on improving the maintenance and use of monitors in hospitals

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Abstract: Objective To explore the application value of FOCUS-PDCA in improving the maintenance and use management effect of monitors in hospital. Methods A large hospital in Xi'an adopted the FOCUS-PDCA quality improvement measures in the maintenance and management of monitors. Through F(Find), O(Organize), C(Clarify), U(Understand), S(Select), P(Plan), D(Do), C(Check), and A(Action), the management efficiency can be improved. The management effect before and after using FOCUS-PDCA management measures was compared. Results After the implementation of FOCUS-PDCA quality improvement measures, the availability rate of all monitors in the hospital was improved significantly, from 92.96% before implementation to 98.46% after implementation, the ratio of uncharged monitors to be used and the ratio of monitors with stains on the surfaces decreased significantly ($\chi^2=76.900$, $2=174.432$; $P<0.05$), the pass rate of monitors in one inspection increased significantly ($\chi^2=45.133$; $P<0.05$). Conclusions In the maintenance and use management of monitors, the use of FOCUS-PDCA quality improvement can promote the daily maintenance and use management of monitors by medical staff, promote the preventive maintenance of monitors by clinical medical engineers. It can improve the availability rate of all monitors, and improve the management and use effect of monitors. FOCUS-PDCA has great value in the maintenance and use management of monitors in hospitals.

Keywords: FOCUS-PDCA; Management effect; Availability rate; Application value.

1. Introduction

Monitors are the most commonly used medical devices to measure the physiological parameters of patients in hospitals. When the monitoring values are found to be beyond the normal value ranges, monitors will issue sound and light alarms[1]. They can continuously monitor the vital signs of patients, and have the function of storing and printing, so that doctors can analyze and compare historical data, so as to make diagnostic decisions on the abnormal value found, and carry out medical treatment in time to control the development of the patients' conditions[2]. At present, monitors are widely used in hospitals because they can help medical staff monitor the signs of patients, and have the characteristics of small size and easy operation. Almost every clinical department will use them. However, due to various problems in the use and management of monitors, the failure rate of monitors is high, which affects the operation efficiency of clinical departments.

FOCUS-PDCA was proposed by quality management experts in the United States. It is an important management method for continuous quality improvement. It is developed on the basis of PDCA cycle management. While, It can improve the management efficiency through nine aspects of quality improvement measures: F(Find), O(Organize), C(Clarify), U(Understand), S(Select), P(Plan), D(Do), C(Check) and A(Action). In recent years, PDCA management method has been widely used in hospital management, and it has achieved good results[3-5]. This study discusses the effect of using FOCUS-PDCA quality management to improve the

maintenance and use of monitors in hospitals.

2. Research materials and methods

2.1. General materials

Since August 1, 2021, a large hospital in Xi'an has adopted the FOCUS-PDCA quality improvement method in the maintenance and use management of monitors in the whole hospital. There are 1236 monitors, including 23 models of 8 brands. There are 412 Mindray PM9000 monitors, 334 Mindray IPM12 monitors, 137 Philips G40 monitors and 116 Philips G70 monitors, which are the top four models with the largest number of monitors. All the monitors used in the hospital were taken as the research objects.

2.2. Research methods

2.2.1. F(Find)-To find the problems

The clinical medical engineers conducted a statistical analysis of the monitor maintenance records in the hospital and the equipment management and use records of the clinical departments within two years, and communicated with the manufacturer's engineers many times. Finally, they found that the faults in the use of the monitors mainly included the following aspects.

(1) Medical accessories such as ECG lead wires, blood oxygen probes, blood pressure cuffs, etc. were damaged, resulting in inability to measure data, or large waveform interference, which affected the observation of measurement data.

(2) The monitor's rechargeable battery was low in power

or the rechargeable battery was damaged, so that the monitor could not continue to work after a power outage.

(3) The motherboard memory battery was damaged, causing the system recording time to be inconsistent with the actual time.

(4) The blood pressure control module inside the device was damaged, resulting in the failure to measure blood pressure, the failure of blood oxygen control module caused the failure to measure blood oxygen, and the failure of ECG module caused the failure to measure ECG.

(5) The cooling fan was aging, causing the fan to make too much noise.

(6) The monitoring alarm limit was unreasonable, resulting in frequent alarms.

(7) The display screen and display control module were faulty.

(8) The blood pressure, blood oxygen and ECG measurement interfaces were damaged, which led to the failure to insert the lead wire for corresponding inspection.

(9) The device shell was damaged due to accidental fall

2.2.2. O(Organize)-To establish the CQI group

Established the CQI (Continuous Quality Improvement) group, whose members included relevant personnel from the Medical Equipment Management Department and clinical departments. The director of Medical Equipment Management Department was the leader of CQI, who was responsible for the coordination and implementation of the whole quality management process.

2.2.3. C(Clarify)-To clarify the current management process

According to the found problems, the existing management process of equipment maintenance and use was sorted out, and the weak links in the equipment maintenance system process and management process were found, and the root causes of the problem were found [6].

2.2.4. U(Understand)-To understand the reasons

CQI held the quality improvement meeting, during which the members carried out brainstorming and discussion. According to the existing maintenance and use management system process, the root causes of the above problems were analyzed from the five aspects of Man, Machine, Material, Method and Milieu. The root causes included the following aspects :(1) the medical staff were not careful enough in the finishing process of the monitor every day, so that the medical accessories such as blood pressure cuff, ECG lead wires and blood oxygen probes were damaged but not replaced in time, resulting in the monitoring data process reporting errors or inaccurate results; (2) medical staff did not check the battery status of monitors in time, and did not replace or charge batteries of medical devices in time; (3) the preventive maintenance of the monitor was not carried out, which led to the failure of the monitor function modules and the inability to monitor parameters, and it also caused problems such as excessive fan sound; (4) nursing staff were not skilled in the operation of monitors. When inserting the medical accessories into the interfaces of medical devices, they did not pay attention to the insertion direction or exerted too much force, which led to the damage of interfaces of devices or medical accessories;(5)nursing staff did not fully understand the patients' vital sign parameters, and the alarm limit values of monitors were set irrationally; (6)in the process of moving

medical devices to monitor inpatients or transferring patients, the nursing staff did not place monitors properly, resulting in the falling of monitors and damage to devices; (7) too many devices were placed near the beds, resulting in crowding of the devices and easy pulling of the device wires, which may lead to devices tipping and damage;(7) the ward environment was not cleaned in place and timely, resulting in too much dust in the ward environment, which entered devices through the monitors' heat dissipation holes, resulting in device failures;(8) the hospital lacked the quantitative assessment system for medical staff to operate in strict accordance with the operation process, resulting in non-standard operation of medical devices[7].

2.2.5. S(Select)-To select an improved process plan

According to the above reasons for the high failure rate of monitors, the members of the IQC group finally determined the following improvement process plan by reviewing relevant materials and holding meetings and discussions: (1) established a three-level preventive maintenance system for equipment, and the first-level maintenance was carried out by medical staff. Completion, secondary and tertiary maintenance were performed by clinical medical engineers and the maintenance process was recorded; (2) medical staff carried out daily maintenance of monitors, including startup check, accessory check, charging power check, etc., and clean and maintain medical devices every day; (3) medical staff cleaned and dedusted the ward environment every day to ensure that the ward environment was free of dust;(4) Trained medical staff on the principle and operation of medical devices; (5) Trained medical staff on the process of patient transfer; (6) Arranged the bedside devices reasonably and clean up the idle devices in time; (7) established the quantitative assessment system for the management and use of medical devices and associated it with individual year-end assessment of medical staff;(8) strengthened the awareness of safety and saving of medical staff and paid attention to the safety of electricity[8].

2.2.6. P(Plan)-To make the plan

For the above improvement process plan, the implementation plan should be made, mainly including the following aspects :(1) CQI group members should develop training plans for equipment management and use, patient vital signs explanation and patient transfer process; (2) the CQI group formulated the daily management list of medical staff; (3) the CQI group should establish the annual implementation plan of the three-level maintenance of medical devices; (4) the CQI group studied and established the implementation plan of quantitative assessment of medical devices management for medical staff.

2.2.7. D(Do)-To carry out the plan

Strictly implemented the planned measures, including :(1) according to the developed equipment management and use training plan, the clinical medical engineers of the CQI group contacted the engineers of the monitor manufacturers to train the medical staff; (2) the CQI group invited the chief physicians of emergency medicine in the hospital to explain the patient's vital sign parameters; (3) the CQI team invited experts in transport and emergency treatment outside the hospital to train medical staff on the transfer process; (4) medical staff should strictly carry out the management of monitors and other medical devices according to the contents of the daily management list, including cleaning, disinfection, sorting, start-up test, etc.; (5) Carried out the three-level

preventive maintenance of monitors and other medical devices according to the implementation time and implementation items of the three-level maintenance annual implementation plan; (6) Quantitative assessment of medical staff was carried out according to the implementation plan of quantitative assessment of equipment management for medical staff.

2.2.8. C(Check)-To check the implementation

The CQI team conducted regular inspection on the implementation of improvement measures in the clinical departments, and random inspection was carried out, and the inspection results were recorded and summarized.

2.2.9. A(Action)

CQI team held a quality improvement and rectification meeting to discuss the problems found in the inspection, study and formulate rectification measures, and the rectification measures would be implemented in the next round of quality cycle.

2.3. Observation indicators

2.3.1. Availability rate statistics of all monitors in the hospital

After the implementation of FOCUS-PDCA quality improvement for 3 months and before the implementation of quality improvement, the availability rate of all monitors in the hospital was statistically compared.

2.3.2. Comparison of management effects of the monitors to be used

Before and after the implementation of FOCUS-PDCA quality improvement, 300 monitors to be used were randomly selected from clinical departments, and the status of the monitors was compared, including the number of uncharged monitors to be used, the number of monitors with stains on the surfaces, and the pass number of monitors in one inspection.

2.3.3. Statistical analysis

The availability rate of all monitors in 2.3.1 was expressed as a percentage; the monitor management effect data in 2.3.2 is count data, which was analyzed by Chi-square test, $p < 0.05$ indicates that the difference is statistically significant.

3. Results

3.1. Statistical results of the availability rate of the monitors in the hospital

The availability rate of all monitors in the hospital before and after the implementation of FOCUS-PDCA quality improvement is shown in Table 1 below. It can be concluded that after the implementation of FOCUS-PDCA quality improvement measures, the availability rate of all monitors in the hospital was improved significantly, from 92.96% before implementation to 98.46% after implementation.

Table 1. The availability rate of all monitors in the hospital before and after the implementation of FOCUS-PDCA quality improvement [n (%)]

Group	Total number	Availability number of monitors	Availability rate of monitors
Before	1236	1149	92.96%
After	1236	1217	98.46%

3.2. Comparison results of management effects of the monitors to be used

The comparison of the management effects of the monitors to be used before and after the implementation of the FOCUS-PDCA quality improvement is shown in Table 2 below. It can be concluded that after the implementation of the FOCUS-PDCA quality improvement measures, the ratio of uncharged monitors to be used, the ratio of monitors with stains on the surfaces decreased significantly ($\chi^2=76.900$, $2=174.432$; $P < 0.05$), and the pass rate of monitors in one inspection increased significantly ($\chi^2=45.133$; $P < 0.05$).

Table 2. The comparison of the management effects of the monitors to be used before and after the implementation of the FOCUS-PDCA quality improvement [n (%)]

Group	n	Number of uncharged monitors to be used	Number of monitors with stains on the surfaces	Pass number of monitors in one inspection
Before	300	92(30.67)	132(44.00)	246(82.00)
After	300	11(3.67)	29(9.67)	295(98.33)
χ^2	-	76.900	174.432	45.133
P	-	0.000	0.000	0.000

4. Discussion

Monitors are the most commonly used medical devices in hospitals. The availability rate of all monitors in hospital can represent the overall operating status of the hospital. In recent years, with the development of medical technology, the hospital has more and more high-end and large medical devices. The hospital attaches great importance to the management and use of such devices, but ignores the use and management of small and medium-sized medical devices. As a result, small and medium-sized medical devices represented by monitors are heavily used, but lack of standardized management, resulting in high device failure rate and high medical accessories loss rate, affecting the operation efficiency of clinical departments, affecting the hospitalization experience of patients, and even causing adverse events related to medical devices. The effective maintenance and use management of monitors is an important part of medical equipment management [9].

FOCUS-PDCA is an effective management tool for quality improvement. In this study, FOCUS-PDCA was used to manage the monitors in the whole hospital. In this process, firstly, the problems in the use of monitors were summarized by finding problems, then the CQI group was established to organize and coordinate the implementation of the whole quality management process, and the existing equipment maintenance management process was sorted out to find out the weak management links where the problems occurred. Then, through brainstorming discussion, the root causes of monitor management and use problems were analyzed. According to the root causes found, the improved process plan was selected, and the schedule of each process was made. Furthermore, the improved process plan was promoted through PDCA cycle, and the rectification plan was proposed for the problems found in the current cycle inspection and it would be executed in the next cycle. By adopting the FOCUS-PDCA quality improvement measures, the manufacturer's engineers trained the medical staff on the operation of monitors, the medical experts in the hospital explained the patient's vital signs parameters, and the emergency transport

experts outside the hospital trained the patient's transport process. On the other hand, medical staff managed and maintained the monitor according to the contents of the daily management list every day, and clinical medical engineers carried out preventive maintenance of monitors. The above improvement measures significantly improved the availability rate of all monitors in the hospital, from 92.96% before implementation to 98.46% after implementation. As the medical staff cleaned and disinfected the monitor every day, checked the charging status of the devices, and monitors obtained effective preventive maintenance, the ratio of uncharged monitors to be used, the ratio of monitors with stains on the surfaces decreased significantly ($\chi^2=76.900$, $2=174.432$; $P<0.05$), and the pass rate of monitors in one inspection increased significantly ($\chi^2=45.133$; $P<0.05$). FOCUS-PDCA effectively improved the availability rate and management effect of monitors.

5. Conclusions

In the maintenance and use management of monitors, the use of FOCUS-PDCA quality improvement can promote the daily maintenance and use management of monitors by medical staff, promote the preventive maintenance of monitors by clinical medical engineers. It can improve the availability rate of all monitors, and improve the management and use effect of monitors. FOCUS-PDCA has great value in the maintenance and use management of monitors in hospitals.

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