

Application Evaluation and Analysis of PDCA Cycle Quality Management in RICU Instrument and Equipment Management

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Abstract: Objective To explore the application value of PDCA cycle quality management in RICU instrument and equipment management. Methods In order to improve the operation quality and efficiency of department management, The PDCA cycle quality management method had been used in the management of RICU instruments and equipment. The effects of PDCA cycle quality management before and after the implementation were compared, and the satisfaction survey was conducted. Results After the implementation of PDCA cycle quality management, the rate of Instruments and equipment with complete accessories was improved ($P<0.05$), and the rate of equipment with stained surface was significantly reduced ($P<0.01$). In the analysis of satisfaction survey results, after the implementation of PDCA cycle quality management, the satisfaction of medical staff on instruments and equipment and the satisfaction of patients on inpatient services were significantly improved ($P<0.01$). Conclusion PDCA cycle quality management method can improve the management efficiency of RICU instrument and equipment, and has high application value in medical equipment management.

Keywords: PDCA Cycle; RICU; Operation Quality and Efficiency; Medical Equipment Management.

1. Introduction

RICU is an intensive treatment management unit in large hospital for centralized monitoring in patients with severe respiratory problems. It can provide patients with respiratory function and multiple organ dysfunction respiratory support for a long time [1]. A lot of technologies are used here, including mechanical ventilation, airway management, and gas metabolism analysis. It provides continuous and dynamic monitoring and treatment for patients with severe respiratory diseases. As a management unit highly dependent on medical equipment for monitoring and treatment, there are various types of high-end medical equipment in the ward. In modern department management, heavy use of medical equipment but neglect of equipment management often leads to frequent instrument failures, high department operation and management costs. It results in a large amount of time and resource waste, high incidence of adverse events of medical equipment, affecting medical safety. Therefore, how to effectively manage RICU's medical equipment and improve the operation quality and efficiency of department management is an urgent problem to be solved in modern hospital management.

PDCA cycle is an important part of quality management theory. It was proposed by Walter A. Shewhart, an American quality management expert. This theory was supported and promoted by W. Edwards. Deming, so it is also called Deming cycle[2,3]. PDCA cycle is the basic idea of total quality management, which is divided into four cycle stages of Plan, Do, Check and Act [4]. In this process, in the face of a management task, the Plan is first made, and then Do stage is implemented effectively according to the Plan content, and the Do stage is checked and supervised in Check stage. Finally, the cycle is summarized, the successful part of this cycle is retained, the reasons for the unsuccessful part is found out and

rectification ideas are put forward, and then the next cycle is transferred to continue execution [5] The RICU management team of a large grade 3 hospital in Xi'an, Shaanxi Province, China adopted the PDCA cycle quality management method in the medical equipment management of the department. In this study, the data of the department management method was statistically analyzed to verify the effectiveness of the PDCA cycle management method in the instrument and equipment management of the RICU department.

2. Materials and Methods

2.1. Research Materials

RICU of this hospital has a total of 8 doctors, 33 nurses and 20 beds. The instruments and equipment included in statistics include invasive ventilator, non-invasive ventilator, sputum extractor, monitor, micropump, infusion pump, CPR, bedside B-ultrasound, mobile DR, blood gas analyzer, atomizer and other kinds of equipment, a total of 128 sets. The data of this study were collected from February 2024 to May 2024.

2.2. Research Methods

Before the start of the cycle, PDCA working quality management research conference was hosted by the department director and the head nurse. The quality management work leading group had been set up, and the essence of PDCA quality management method had been learned, the instrument and equipment quality management methods, in line with the actual situation of the department, had been studied and developed. The relevant management responsibilities should be implemented to the personnel, and the corresponding reward and punishment system should be formulated to prepare for the PDCA quality cycle work.

2.2.1. Plan

(1) In each cycle of the planning stage, based on the

characteristics of the ward management, the management of the operation details that should be paid attention to in the management process had been proposed, including the use of instruments and equipment, cleaning, disinfection, maintenance, decorating, use, scrap and other such various aspects. Then the specific implementation guidelines for each stage was put forward, which had been strictly implemented in the Do stage.

(2) Propose The rectification methods for problems found after the last cycle, rectify and implement them in this cycle, and record the rectification methods and process.

2.2.2. Do

In the Do stage, all PDCA management systems and management details proposed in this cycle plan stage should be strictly implemented, including the following aspects:

(1) Taking and use of instruments and equipment

The equipment that can be used normally should be placed in different areas according to the function type, and the normal use sign should be hung. The equipment with high frequency of use should be placed in the most accessible position, while the equipment with low frequency of use should be placed in a relatively distant position. Taking and repair of the equipment should be registered in the equipment management book. Equipment waiting for repair after failure should be hung with a fault sign to prevent the operator from using it incorrectly, and should be sent to the equipment maintenance department for repair in time.

(2) Tidying, cleaning and disinfection of the instruments and equipment

After each use, it is necessary to summarize and arrange the instruments and equipment in time. It includes placing accessories neatly in time, such as the lead wire, blood pressure cuff, blood oxygen probes, breathing pipes and power cord, and it also includes putting the used disposable consumables into the designated medical waste bins in time, cleaning and disinfecting the surface of equipment, removing blood stains and various other stains. At the same time, the ward should be cleaning clearly to create a comfortable and clean environment for medical staff and patients. It can be easy for doctors and nurses in a good environment to play the highest professional level to give patients treatment decisions, but also can make patients feel comfortable, which is beneficial for patients to actively cooperate with treatment, speeding up the rehabilitation process.

(3) Equipment maintenance

Keep doing daily maintenance well for equipment. It includes checking whether equipment accessories are complete and available, checking whether the power of rechargeable equipment is sufficient, checking whether the air filter of equipment with air filter needs to be cleaned or replaced, checking whether the air oxygen joint of ventilator is leaky, checking whether the machine start-up self-test passes, etc. The monthly and quarterly maintenance of instruments and equipment is completed by the hospital medical equipment management department, and the semi-annual maintenance of instruments and equipment is completed by the hospital medical equipment management department and the manufacturer.

(4) Electrical safety and use safety of instruments and equipment

Attention should be paid to electrical safety during the use

of instruments and equipment to prevent short circuit, flash explosion, fire and other situations, and at the same time, attention should be paid to the standard operation of instruments and equipment to prevent accidental injuries caused by dumping, line pulling and misoperation during the use and movement of equipment, and to prevent the occurrence of adverse medical device events.

2.2.3. Check

Set up quality supervision group, supervise and evaluate each cycle process quantitatively, and record the supervision and evaluation results truthfully.

2.2.4. Action

At the end of each check, quality improvement meeting needs to be hold. At the meeting, the quality supervision group put forward the problems found in the process of this cycle. All participants would discuss and determine the rectification ideas of the problems, and the rectification plan would be implemented in the next cycle, and evaluate the implementation of rectification of the problems found during the last cycle in the process of this cycle.

2.3. Observation Indicators

2.3.1. Comparison of the Effects of Instrument Management Usage

The 20 days before and after the implementation of PDCA cycle quality management were compared and analyzed, including the total number of instruments and equipment used, the number of instruments and equipment with complete accessories, and the number of instruments and equipment with stains on the surface.

2.3.2. Satisfaction Survey

One month before and after the implementation of PDCA cycle quality management, 40 medical staff and 40 patients were surveyed with satisfaction questionnaire, including the satisfaction survey of medical staff on the use of instruments and equipment and the satisfaction survey of patients on inpatient services.

2.4. Statistical Analysis

SPSS20.0 software was used for statistical analysis of the above 1.3 index data. The management usage of 1.3.1 was enumerative data, represented by n%, and chi-square test was used for comparative analysis. The questionnaire scores of 1.3.2 were measured data, represented by $\bar{x} \pm s$, and compared by t test. $P < 0.05$ indicated statistically significant differences, and $P < 0.01$ indicated statistically significant differences.

3. Results

3.1. Comparative Results of Instrument Management Usage

SPSS20.0 software was used for statistical analysis of the recorded instrument and equipment management data, as shown in Table 1 below. It can be seen from the table that the total number of instrument and equipment use did not change significantly before and after the implementation of PDCA cycle management, and the rate of Instruments and equipment with complete accessories was improved after the implementation of PDCA cycle management ($P < 0.05$). The rate of equipment with stained surface was significantly reduced ($P < 0.01$).

Table 1. Comparison table of instrument management usage effect [num, n (%)]

| Group | The total number of instrument and equipment use | Number of instruments and equipment with complete accessories | Number of instruments and equipment with stained surface |
|----------|--|---|--|
| Before | 1845 | 1776(96.26) | 247(13.39) |
| After | 1867 | 1858(99.52) | 13(0.70) |
| χ^2 | - | 4.082 | 11.060 |
| <i>P</i> | - | 0.043 | 0.001 |

3.2. Satisfaction Survey Results

SPSS20.0 software was used for statistical analysis of the satisfaction survey data of medical staff and patients, and the results are shown in Table 2 below. It can be seen from the

table that after the implementation of PDCA cycle management, the satisfaction of medical staff on the use of instruments and equipment and the satisfaction of patients on inpatient services have significantly improved ($P < 0.01$).

Table 2. Analysis table of satisfaction survey (Score, $\bar{x} \pm s$)

| Group | The satisfaction of medical staff on the use of instruments and equipment | The satisfaction of patients on inpatient services |
|----------|---|--|
| Before | 89.23±3.54 | 82.54±4.63 |
| After | 92.17±2.26 | 90.33±3.35 |
| <i>t</i> | -3.331 | -13.715 |
| <i>P</i> | 0.001 | 0.000 |

4. Discussion

PDCA quality management is an effective mode of modern enterprise management, which has been fully used and proved to be a reliable and effective management method. With the progress of modern medical technology, more and more medical equipment has been purchased into hospitals for auxiliary monitoring treatment, which has greatly enriched the means of treatment, improved the accuracy of treatment, and reduced the work intensity of medical staff. It is a research topic in modern hospital management to manage and use these medical equipment well so as to bring them into full play and serve medical staff and patients.

RICU is the centralized treatment management unit for patients with severe respiratory diseases. The patients of RICU often is in critical condition, medical staff need to focus on patient status at any time[6].It requires a variety of medium and high-end medical equipment to continuously provide patients with respiratory and other life support, as well as continuous vital signs monitoring. In this case, the operation status of medical equipment is very important. If a sudden failure occurs in the operation process, it will have serious consequences and even endanger life. Therefore, in the management of RICU departments, the management of medical equipment is an important part. In some large hospital now, as clinical department managers have the pressure of target responsibility assessment, medical staff often overuse part of the medical equipment. Part of the medical equipment have been running continuously for long periods of time without stopping at the beside, but have not been maintained efficiently in time, making it easier for the equipment overload and mechanical fatigue, resulting in failure of equipment suddenly occurred in the process of operation[7].In this case, medical device adverse events are easy to occur, affecting medical safety. At the same time, due to the lack of preventive maintenance for the equipment, it is necessary to contact the manufacturer to replace important parts when the equipment is down, which increases the cost of the department. In the process of waiting for maintenance,

the machine needs to be idle for a long time, which increases the time cost [8,9]. A good state of instruments and equipment can effectively improve the operating efficiency of the department, avoid the occurrence of medical device adverse events to the greatest extent, improve the efficiency of doctors' diagnosis and treatment, and improve the satisfaction of patients' inpatient service.

In this study, as PDCA cycle quality management had been adopted, medical staff insisted on daily maintenance of instruments and equipment according to PDCA cycle management requirements. They put the instrument and equipment in order, cleaned and disinfected every day, which improved the rate of Instruments and equipment with complete accessories($P < 0.05$).and significantly reduced the rate of equipment with stained surface ($P < 0.01$). The management usage effect of medical instruments and equipment had been effectively improved. At the same time, because medical staff checked the status of the equipment every day in the daily maintenance process, the faulty equipment would be dealt with in time, so that the equipment to be used had been in good condition at all times. And because the instruments and equipment had been neatly placed, they could be easily taken, so doctors' satisfaction with the use of instruments and equipment had been significantly improved ($P < 0.01$). Due to the implementation of PDCA cycle management, the environment of the ward had been clean and orderly, and the instrument and equipment had been in good condition. Patients had received relatively good acceptance of the instrument and equipment inspection, and their satisfaction with the inpatient service had been significantly improved ($P < 0.01$). In this study, PDCA cycle quality management played an important role in instrument and equipment management.

5. Conclusion

To sum up, PDCA cycle quality management significantly had improved the use effect of equipment. And it had improved the operation efficiency and service quality of the department in the instrument and equipment management of

RICU department. This management method has high application value in the instrument and equipment management of RICU department.

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