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Application Effect Analysis of PDCA Cycle in Reducing the Missing Scan Rate of Consumables in CICU

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Abstract: Objective: To explore the application effect of PDCA cycle in reducing the missed scanning rate of consumables in Cardiac Intensive Care Unit (CICU), so as to improve the management efficiency of consumables and ensure the supply of rescue materials. **Methods**: The fish bone diagram was used to analyze the cause of the problem. The PDCA cycle management method was used to analyze the missing code scan of CICU consumables before the rectification (January to June 2024), formulate and implement the code scan rate improvement strategy, and compare the missing code scan rate after the rectification (July to December 2024). **Results**: After rectification, the missing scan rate of consumables decreased from 14.02% to 1.96% ($P<0.05$). The timely replenishment rate of consumables was improved, and the incidence of rescue consumables shortage was reduced. **Conclusion**: PDCA cycle strategy can effectively optimize the management of CICU consumables, reduce the phenomenon of missing code scanning, and improve the ability of rescue materials support.

Keywords: CICU; Consumables Management; Missing Scan Rate; PDCA.

1. Introduction

As a special unit for treating critically ill cardiac patients, the quality of consumables management in Cardiac Intensive Care Unit (CICU) directly affects medical safety and treatment efficiency. CICU consumables are characterized by high value, variety, and urgent usage, making traditional manual management models difficult to meet the needs of precise management[1]. With the development of medical informatization, the Supply Processing and Distribution (SPD) management model has been widely applied in clinical consumables management[2]. Through real-time monitoring of inventory information via SPD, the whole-process tracking of consumables is realized. The consumption of consumables in the department was recorded timely by the mobile Personal Digital Assistant (PDA) terminals. When the total amount of low-value consumables is lower than the set inventory lower limit, procurement personnel are reminded to place orders for replenishment in a timely manner[3]. However, in clinical practice, the low scanning rate of consumables in PDA scanning management leads to an imaginary high inventory, which covers the actual shortage of consumables. Finally, the lack of timely supply of consumables affects the normal development of medical services[4-5]. Currently, there is limited research on systematically improving the PDA scan rate of consumables, especially in specialized units like CICU. Dr. Deming, an American quality management expert, put forward the concept of plan, do, check, and act (PDCA) cycle in the 1950s. The PDCA cycle can promote quality improvement and form a closed-loop quality management model, which has been widely applied in medical quality management and nursing management, achieving favorable results[6-9]. This study analyzed the causes of missing scans of CICU consumables using PDCA cycle, formulated targeted improvement measures, and explored the application effect of scan rate improvement strategies to provide reference for optimizing CICU consumables management.

2. Materials and Methods

2.1. General Information

The study was conducted in the CICU of The Seventh Affiliated Hospital of Sun Yat-sen University. Data on the missing scan rate of consumables in CICU were collected for statistical comparison. The missing scan rate before PDCA management implementation (January-June 2024) served as the control group, and the rate after implementation (July-December 2024) served as the observation group.

2.2. Methods

2.2.1. The Quality Improvement Group Was Established and the PDCA Cycle Management Steps Were Formulated

The head nurse served as the group leader to provide help and guidance for the whole group activities. One deputy group leader shall be appointed as consumables manager, responsible for daily consumables management, organization of activities, supervision and data collation and analysis. Four executive commissioners were set up, all of whom were leaders of the clinical nursing working group and were responsible for the supervision of daily activities of consumables scanning code. This activity is strictly carried out according to the four steps of PDCA.

2.2.2. Analyze the Current Situation and Make a Plan (Plan).

To clarify the consumables scan rate, the consumables manager conducted monthly inventory checks from January 2024 to June 2024 to analyze the current status of PDA-based consumables scanning. The CICU quality improvement team used fishbone diagram analysis to identify causes of low PDA scan rates from five dimensions: man, machine, material, method, and environment. **(Figure 1)**

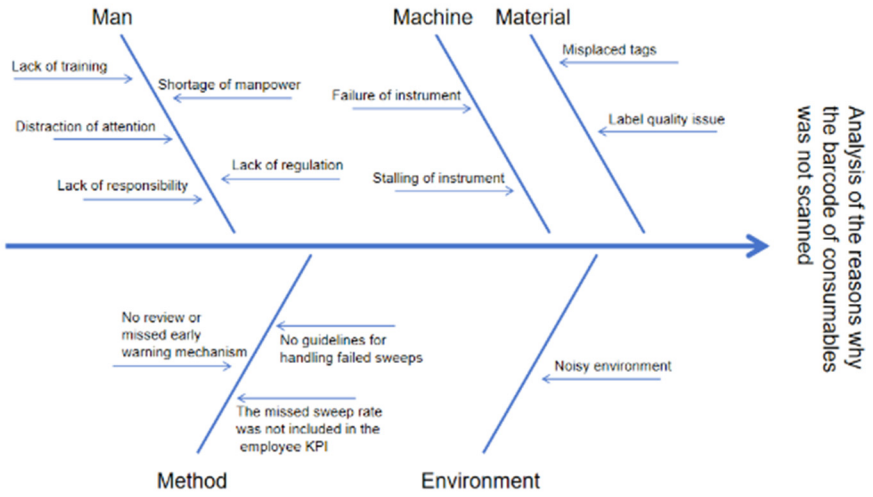


Figure 1. Fishbone diagram for the analysis of the reasons why the barcode of consumables was not scanned

(1)Man: Insufficient sense of responsibility among some nurses, who subjectively believed that low-value consumables did not require scanning, failed to understand the importance of standardized operations, and did not remediate missing scans promptly. Inadequate training for new employees leading to unskilled scanning procedures or PDA operations. Distraction during emergencies. High workload reducing efficiency and inadequate supervision.

(2)Machine (PDA Equipment): PDA instrument failure, resulting in the inability to scan the code. Instrument stalling: affect the efficiency of scanning code.

(3)Material: Label quality problems, bar code printing blurred, fading, resulting in the inability to scan the code, improper label position pasting, pasting on the curved or depressed surface is difficult to scan.

(4)Method (Processes and Methods): Process design flaws (lack of secondary verification or missing scan warning mechanisms). Unclear standards for handling scan failures such as manual entry procedures. Absence of assessment mechanisms (missing scan rate not included in employee KPIs).

(5)Environment: Noise interference, noisy environment distracting the operator's attention.

Using Pareto's 80/20 principle, the primary causes of low scan rates were identified, including insufficient nurse responsibility, distraction, and PDA malfunctions (**Figure 2**). Corresponding strategies were developed, focusing on enhancing nurse awareness, optimizing processes, strengthening supervision, and improving training and assessment.

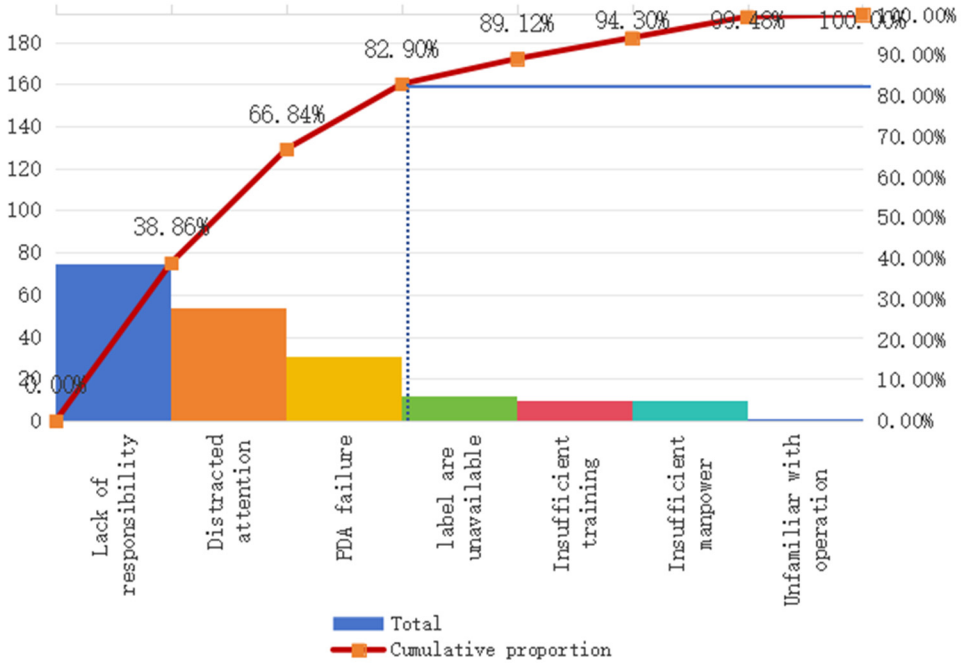


Figure 2. Pareto Diagram of the Failure to Scan the Barcode of Consumables

2.2.3. Improvement Measures (Do)

(1) Enhancing Nurse Awareness and Normative Consciousness

Nurses' insufficient responsibility accounted for 38.86% of total missing scans. Misconceptions included viewing consumables management as logistics responsibility, underestimating risks of missing scans during rescues, and perceiving scanning as cumbersome. In this regard, we have

adopted the following measures: Regular special meetings on consumables management importance were organized, with real-case demonstrations of potential medical safety risks. Senior nurses shared experiences on efficient scanning and error prevention. Team-based supervisors conducted daily scan checks, recorded frequent offenders, and arranged interviews with those with ≥3 missing scans for root cause analysis and rectification.

(2)Optimizing Processes

A "dual-verification scanning" system was implemented to ensure timely scanning after use [5]. Consumables management specialists conducted weekly spot checks and monthly comprehensive inventory. Missing scans were recorded and linked to performance assessments to boost compliance. A dedicated storage area for unscanable codes was established for unified post-processing (e.g., during PDA failures). Consumables storage was optimized by categorizing items by type and frequency, placing commonly used items in accessible locations to reduce rush-induced omissions.

(3)Information System Improvement

Daily PDA maintenance protocols were established, including timely charging, memory cleanup to reduce lag, and shift handover checks for quantity, battery, and performance. A "1+1" equipment configuration was adopted, with backup PDAs activated during malfunctions[3]. For multiple PDA failures, The codes of used consumables are uniformly placed and scanned collectively after the PDA is repaired, and the IT department was notified for repairs/replacements. Regular equipment maintenance was scheduled with IT support.

(4)Training and Assessment

Nurse training covered correct PDA operation, consumables information verification, and handling of special scanning scenarios (theoretical and practical sessions)[1-5]. New employees, standardized training nurses, and interns received focused orientation on scanning importance and one-on-one operational guidance, with experienced mentors providing daily supervision.

2.2.4. Effect Evaluation (Check)

Monthly inventory data were collected to compare missing scan rates before (January-June 2024) and after (July-December 2024) PDCA implementation. Statistical analysis was performed using SPSS 19.0, with chi-square tests for inter-group comparisons and $P<0.05$ indicating statistical significance.

After PDCA implementation, the missing scan rate significantly decreased from 14.02% to 1.96% ($P<0.05$), as shown in the table below. (**Table 1**)

Table 1. Comparison of the results of missed scanning rates of consumables before and after the implementation of the PDCA cycle method

Group	Number of successful scans	Number of times the code was missed	Total number of scans	Missed scan rate
Control group	1214	198	1412	14.02%
Experimental Group	1701	34	1735	1.96%
χ^2 value				165.89
P value				<0.001

2.2.5. Act Stage

After in-depth analysis and confirmation of the effect of this round of PDCA cycle, a series of interventions we have taken have achieved remarkable results. Nurses' awareness of the importance of consumables scanning code has made a qualitative leap. During the implementation of the project, through continuous publicity and training, nurses have changed from the initial passive scanning code to active scanning code, and they can consciously abide by the operating standards in the process of active scanning code. This change of consciousness is not only reflected in the code scanning behavior, but also extends to other aspects of consumable management, including quality, expiration date and other issues, and actively participates in the whole process of consumables management, forming a good management atmosphere. The consumables management process becomes smoother due to the improvement of code scanning rate. In the past, problems such as inventory data confusion and consumables traceability difficulties caused by the lack of timely or inaccurate code scanning have been significantly improved. Now, inventory data can reflect the use of consumables in real time and accurately, which provides a strong basis for the formulation of procurement plans, reduces the occurrence of inventory backlogs and backouts, and increases the safety and reliability of consumables management.

Through the inspection results and analysis, this study solidified the form of effective measures and successful experience formed in the process of code scanning rate improvement. For example, the "code Scanning operation Specification of consumables" was formulated to clarify the code scanning process, the use requirements of equipment, the handling methods of special cases, and to ensure that rules can be followed in daily work. Regularly carry out training activities for consumables scanning code, establish training assessment system, link the scanning code rate with individual performance, etc., so that the results of scanning code rate improvement can be maintained for a long time[5].

After the implementation of the project, we will continue to monitor and analyze the code sweep rate of CICU consumables, collect data regularly, and evaluate the change trend of the code sweep rate. When the scan rate fluctuates abnormally, the problem is found in time and measures are taken to intervene. At the same time, according to the monitoring results, the scan process and operation standards are continuously optimized to ensure the stable improvement of the scan rate. At the same time, strengthen the cooperation and communication between CICU and the warehouse management department, information department and other relevant departments. In the process of consumables management, closely cooperate with the warehouse management department to deal with the problems in the process of scanning the code of consumables in time; Cooperate with the information department to continuously optimize the function of the information system and provide technical support for the scanning code of consumables [3].

3. Discussion and Conclusion

Through the application of PDCA cycle, the code scanning rate of CICU consumables has been significantly improved. The complete closed-loop process from problem discovery to improvement implementation, and then verification and continuous optimization shows its strong systematic advantages. In the Plan stage, we clarified the root cause of low scan rate; In the Do stage, through the process optimization, information system improvement and personnel training and other measures, the difficulties in the code

scanning work were gradually overcome. In the Check stage, the scanning rate is significantly improved, and the management process is more standardized. In the Act stage, the improvement results were solidified and the direction was provided for further optimization of consumables management in the future. The application of PDCA cycle not only solved the current problem, but also laid the foundation for the long-term fine management of CICU consumables.

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