

# Application of the PDCA cycle for standardized nursing management in a COVID-19 intensive care unit

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**Background:** Nursing quality is an integral part of health care quality and one of key performance indicators (KPIs) for health care management. The Plan-Do-Check-Act (PDCA) cycle is a management tool for continuous improvement of a business's products or processes. It can be applied to standardize nursing management and thus improve the nursing quality and increase the survival rate of patients. This study assessed the value of the PDCA cycle in standardizing nursing management in an intensive care unit (ICU) for patients with severe coronavirus disease 2019 (COVID-19).

**Methods:** The status quo of the ICU was analyzed, and the relevant issues and countermeasures were proposed. The PDCA cycle was applied to standardize the nursing management in the ICU.

**Results:** Nine measures were proposed and applied to improve the management of the COVID-19 ICU: defining the clean or contaminated areas, use of self-designed shoe storage cabinets, defining staff roles and responsibilities, establishing the staffing structure, staff training, placing items at fixed locations, improving shift handover, use of bulletin boards for listing key points, and use of reserved drugs cabinets. The virus contamination awareness, professional skills, awareness of duties and responsibilities, and quality and performance of nursing were remarkably improved 2 weeks after the implementation of the above countermeasures.

**Conclusions:** The PDCA cycle helps to standardize nursing management in COVID-19 ICU by developing and applying effective nursing management approaches.

**Keywords:** Plan-Do-Check-Act cycle (PDCA cycle); coronavirus disease 2019 (COVID-19); nursing management; standardization

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#### Introduction

Nursing quality is an integral part of health care quality and one of key performance indicators (KPIs) for health care management (1,2). The Plan-Do-Check-Act (PDCA) cycle is a repetitive four-stage model for continuous improvement in quality management (3,4). It can be applied to standardize nursing management (5,6) and thus improve the nursing quality and increase the survival rate of patients (7,8).

In January 2020, our hospital (Zhongshan Hospital of Fudan University) sent its aid team to Hubei Province to support the prevention and control of coronavirus disease 2019 (COVID-19). The team was designated to treat patients with severe COVID-19 admitted to the intensive care unit (ICU) of the Department of Infectious Diseases of Eastern Campus, Renmin Hospital of Wuhan University (9,10). In order to effectively combat the epidemic and improve the quality of nursing care for critically ill patients, a nursing management team was established, which carefully analyzed the status quo of the ICU and applied the PDCA Cycle to standardize and improve the quality and performance of nursing.

We present the following article in accordance with the SURGE reporting checklist (available at http://dx.doi. org/10.21037/apm-20-1084).

# Methods

Ethical approval for this study was waived as this study was performed during the COVID-19 epidemic. The nursing team approved the use of the nursing sheets and pictures relevant to this study for this article. All the medical staff participating in this study signed the informed consent documents.

# Status quo analysis

No standardized nursing management policies had been applied in the ICU when the aid team took charge in February 2020. A nursing management team including 12 nursing staff members from Zhongshan Hospital was established, and a ward management standardization program was carried out by applying the PDCA cycle.

# Identifying problems and proposing suggestions

Surveys were carried out in February, 2020, and the results were summarized.

# Problems

Problems identified during the surveys included (I) contaminated areas not being clearly defined, (II) the roles and responsibilities of nursing staff being unclear, (III) the disorderly placement of items, (VI) ineffective shift handover, and (V) long wait times for drugs.

# Suggestions

To address these issues, the following countermeasures were suggested: (I) defining the clean and contaminated areas, (II) use of self-designed shoe storage cabinets, (III) defining the staff's roles and responsibilities, (IV) establishing the staffing structure, (V) carrying out staff training, (VI) placing items at fixed locations, (VII) changing the shift handover 1199

modes, (VIII) improving handover communication by using bulletin boards, and (VIIII) using reserved drug cabinets.

# PDCA cycle

# Plan

- (I) The contaminated areas were not clearly defined: although the ICU had been rebuilt as a quarantine ward, there was no clear division of different areas; as a result, the contaminated area was not clearly defined and the patient flow was poorly designed. The countermeasure was to divide the ICU into contaminated areas, semi-contaminated areas, and clean areas, and to use self-designed shoe storage cabinets.
- (II) The roles and responsibilities of nursing staff were unclear: the medical staff came from different places, with varied roles and responsibilities; there was no clearly appointed managing staff, and the professional capabilities and skills also differed among the staff members. The countermeasures adopted were to clarify the roles and responsibilities of each nurse, establish staffing structure, and conduct staff training.
- (III) Placemen of items was disordered: the items were placed casually because there were no designated places for items. The countermeasure was to place items at fixed locations.
- (IV) Shift handover was ineffective: the large amount of patients in the ICU led to information being lost during shift handover. In addition, communication was not efficient because there was too much information. The new team changed the shift handover mode and used bulletin boards to list the key points.
- (V) Drug transport was time-consuming: a lack of personnel led to an inefficient transportation of drugs. Reserved drugs cabinets were used to solve this problem.

# Do

- (I) Regular updates were instituted. With a focus on the nursing problems, regular meetings were held to propose measures for increasing the management awareness of the nursing staff and to define job responsibilities.
- (II) Specialist nursing teams were established. A detailed work plan was developed for each group. Regular training sessions were held to improve the professional skills for the management of critically ill patients.

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**Figure 1** The awareness of medical staff of contaminated areas before and after the implementation of the countermeasures. The awareness rate increased from 91.1% to 100% after the countermeasures were implemented, indicating all staff were aware of these areas and could follow a safe workflow.

# Check

- (I) The head nurse and quality control personnel ensured that the quality inspection and nursing care for each patient could be fully implemented. The head nurse conducted ward rounds at least once a week.
- (II) The performance of nursing staff was evaluated by questionnaire-based survey, on-site survey, and written examinations.

# Act

- (I) Feedback including countermeasures and improvements were offered for the existing problems. The head nurse and quality control staff followed up the identified problems and took measures to ensure the effectiveness of patient care and staff training.
- (II) Any new or persistent problems were brought into the next round of the PDCA cycle for improvement. For example, the nursing department conducted timely discussions on the problems in the work processes or policies and made corresponding revisions.

# **Results**

#### Defining clean or contaminated areas

The awareness of medical staff on the concept of contaminated area was assessed within 2 weeks after the implementation of the countermeasures. As shown in *Figure 1*, after the countermeasures were implemented, the awareness rate increased from 91.1% to 100%; that is, all staff members were aware of these areas and could follow a safe workflow.

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#### Use of self-designed shoe storage cabinets

As shown in *Figure 2A,B*, waste cardboard boxes were used to make shoe storage cabinets, which allowed the orderly storage and retrieval of working shoes and the delineation of clean and contaminated areas.

As shown in *Figure 2C*, the proportion of medical staff who could store their shoes in orderly fashion was at 87.3% before the use of self-designed shoe storage cabinets and rose to 100% after.

# Defining the staff's roles and responsibilities

The workflow of each shift in the ICU was redesigned (*Figure 3A*) to ensure that all the nursing work in the ward was carried out in an orderly manner. The awareness of medical staff of their roles and responsibilities was surveyed by using a self-designed questionnaire form within 2 weeks after the implementation of the countermeasure. As shown in *Figure 3B*, the awareness level increased from 87.9% to 100%; that is, all the medical staff clearly knew their roles and responsibilities.

#### Establishing the staffing structure

As shown in *Figure 4A*, specialist nursing groups were established based on the professional background and skills of nursing staff. The awareness of medical staff of their posts was surveyed by using a self-designed questionnaire form within 2 weeks after the implementation of the countermeasure. As shown in *Figure 4B*, the awareness level increased from 90.6% to 100%; that is, all the medical staff clearly knew their post duties.

# Staff training

Staff members in all the intensive care rooms were trained on the first aid operations and the use of special instruments/catheters. Small training videos were recorded and shared in WeChat groups to ensure the homogeneity among nursing staff. Patient safety and quality of nursing care were always the top priorities (*Figure 5A*).

The professional skills of medical staff were evaluated by using a written examination within 2 weeks after the implementation of the countermeasure. As shown in *Figure* 5B, the average score increased from 73.2 to 92.1 after the countermeasure was implemented.



**Figure 2** Proportion of medical staff who could store their shoes in orderly fashion before and after the use of self-designed shoe storage cabinets. (A) Waste cardboard boxes were used to make shoe storage cabinets, (B) which allowed the orderly storage and retrieval of working shoes and the delineation of clean and contaminated areas. (C) The proportion of medical staff who could store their shoes in orderly fashion increased from 87.3% to 100%.



**Figure 3** Awareness of medical staff of their roles and responsibilities before and after the implementation of the countermeasure. (A) The workflow of each shift in the ICU was redesigned. (B) The awareness of medical staff of their roles and responsibilities increased from 87.9% to 100%; indication all the medical staff clearly knew their roles and responsibilities was surveyed by using a self-designed questionnaire form within 2 weeks after the implementation of the countermeasure.



**Figure 4** Awareness of medical staff of their posts before and after the implementation of the countermeasure. (A) Specialist nursing groups were established based on the professional background and skills of nursing staff. (B) The awareness of medical staff of their posts increased from 90.6% to 100%; indicating all the medical staff clearly knew their post duties.



**Figure 5** Professional skills of medical staff before and after the implementation of the countermeasure. (A) Staff members in all the intensive care rooms were trained on the first aid operations and the use of special instruments/catheters. (B) The professional skills score increased from 73.2 to 92.1 after the countermeasure was implemented.



Figure 6 Efficiency of medical staff in locating items. (A) All items were placed at fixed locations, and (B) the efficiency of medical staff in locating items increased from 88.6% to 97.8%.

# Placing items at fixed locations

Placing all items at fixed locations helped the medical staff to quickly locate a specific item and thus facilitated the execution of various duties (*Figure 6A*). As shown in *Figure 6B*, the efficiency of medical staff in locating items increased from 88.6% to 97.8% within 2 weeks after the implementation of the countermeasure.

#### Change of shift handovers

The use of the Situation, Background, Assessment, Recommendation (SBAR) handover sheet (*Figure 7A*) allowed the nursing staff to better understand the dynamic changes of patients' conditions, with more clearly presented the key points. The awareness of medical staff on SBAR handover was evaluated within 2 weeks after the implementation of the countermeasure. As shown in *Figure 7B*, the awareness rate increased from 85.7% to 100%.

# Improved handover communication by using bulletin boards

As shown in *Figure 8A,B*, a self-made memo bulletin board was used to list the key points in daily work. The awareness of medical staff on key points was evaluated within 2 weeks after the implementation of the countermeasure. As shown in *Figure 8C*, the awareness rate increased from 81.1% to 98.6%.

#### Use of reserved drugs cabinets

Reserved drugs cabinets were used (*Figure 9A*, *B*). The waiting time for drug transport was assessed within 2 weeks after the countermeasure was implemented (*Figure 9C*). It dropped from 60 to 5 min.

#### **Discussion**

The PDCA Cycle has been successfully applied to nursing

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**Figure 7** Awareness of medical staff on SBAR handover before and after the implementation of the countermeasure. SBAR, Situation, Background, Assessment, Recommendation. SBAR handover sheet (A) allowed the nursing staff to better understand the dynamic changes of patients' conditions, (B) the awareness rate on SBAR handover increased from 85.7% to 100%.



**Figure 8** Awareness of medical staff on key nursing information posted on a bulletin board. (A,B) A self-made memo bulletin board was used to list the key points in daily work, (C) the awareness rate on key points increased from 81.1% to 98.6%.



**Figure 9** Waiting time for drug transport before and after the implementation of the countermeasure. (A,B) Reserved drugs cabinets were used. (C) The waiting time for drug transport dropped from 60 min to 5 min after the countermeasure was implemented.

management in the diagnosis and treatment of a variety of diseases and plays an important role in the standardization of nursing management (11-14). In February 2020, our hospital (Zhongshan Hospital of Fudan University) sent its medical team to Hubei Province to support COVID-19 prevention and control (10) by taking over the ICU of the Department of Infectious Diseases of Eastern Campus, Renmin Hospital of Wuhan University. This task posed extreme challenges, and, in order to improve the quality and effectiveness of patient treatment and nursing, the aid team established a nursing management team (consisting of 12 nursing staff). Based on the previous experience and the status quo of the ICU, the nursing management team adopted the PDCA cycle to identify the problems, propose

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reasonable and effective suggestions, and implement continuous improvement, so as to ensure the quality and effectiveness of the nursing care.

Nine countermeasures were proposed and implemented accordingly. After 2 weeks of implementation and improvement, the existing problems were effectively addressed and the management of the ICU was gradually standardized, which ensured effective nursing care in the ICU. (I) For the poor awareness of medical staff on contamination and the disorderly placement of shoes, we clearly defined the contaminated areas, semi-contaminated areas, and clean areas, installed self-made shoe cabinets, and offered staff training sessions. After the implementation of these countermeasures, 100% of the medical staff could identify each area and place their shoes in an orderly manner. This strategy increased the awareness of medical staff on contamination and safeguarded their lives. (II) Based on the professional background of the nursing staff, the management team established specialist nursing teams. Two weeks after the roles and responsibilities of all nurses were defined, the awareness rate of job responsibilities was increased to 100%. We believe that the specialist nursing teams maximized the use of the professional skills of nurses, helped to establish multidisciplinary nursing teams, and implemented a comprehensive and responsive nursing system in the care of COVID-19 patients. Our current study confirmed that this countermeasure was effective and could be included in nursing management norms. (III) To reduce inefficiency and poor communication during shift handover, the management team adopted the SBAR handover sheet and bulletin board in the shift handover to ensure that all the nursing staff could receive handover information quickly and easily. The key points were clearly listed to improve handover communication, eliminate hidden risks, and ensure patient safety. (IV) Long wait times for drug transport was another problem. The management team used reserved drugs cabinets to dramatically shorten the waiting time and improve the efficiency of drug administration. In effect, the use of reserved drug cabinets created a local storage of pharmaceuticals, which saved the time spent in collecting drugs from the pharmacy. Commonly used medicines can be immediately applied to patients, which greatly improves the efficiency of drug administration and enables timely symptom relief. The optimized treatment processes ensures patient safety. This countermeasure was effective and can also be included in nursing management norms.

In addition, a series of training sessions and assessments

improved the professionalism and professional skills of nursing staff, which ensured the implementation of nursing measures and improved the quality and effectiveness of nursing.

To our knowledge, this is the first report on PDCA cycle that helps to standardize nursing management in COVID-19 ICU by developing and applying effective nursing management approaches.

In summary, the quality of nursing is closely related to the quality of nursing management. As a useful tool in nursing management, the PDCA cycle helps to standardize nursing management in the COVID-19 ICU by developing and applying effective nursing management approaches.

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# Footnote

*Reporting Checklist:* The authors have completed the SURGE reporting checklist. Available at http://dx.doi. org/10.21037/apm-20-1084

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*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Ethical approval for this study was waived as this study was performed during the COVID-19 epidemic. The nursing team approved the use of the nursing sheets and pictures relevant to this study for this article. All the medical staff participating in this study signed the informed consent documents.

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