# Post-print: Application of PMP Combined with Checklist Management in Emergency Care of Critically Ill Children in Pediatric Emergency Department

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## Abstract

Objective To investigate the efficacy of PMP combined with checklist management in the emergency rescue of critically ill pediatric patients. Methods A total of 268 pediatric patients who underwent emergency rescue in the pediatric emergency department from January to December 2020 were selected as the control group, and 283 pediatric patients who underwent emergency rescue from January to December 2021 were selected as the observation group. The control group received conventional emergency management protocols for the rescue and nursing care of critically ill children, whereas the observation group implemented PMP combined with checklist management during the rescue process, with interventions spanning three domains: nurse training, management of equipment, supplies, and medications, and emergency rescue protocols for common critical pediatric conditions. The correct execution rate of rescue personnel' s actions and the incidence of adverse events related to rescue supplies, equipment, and medications were compared between the two groups. Results The correct execution rate of rescue personnel' s actions in the observation group was 98.94% (280/283), significantly higher than that in the control group (91.42% [245/268]), with a statistically significant difference (P<0.01). The incidence of adverse events related to equipment malfunction and insufficient supplies in the observation group was significantly lower than that in the control group (P<0.01). Conclusion PMP combined with checklist management can significantly reduce the incidence of adverse events during the emergency rescue of critically ill children and ensure patient safety.

## Full Text

# Application of Person-Material-Process Combined with Checklist Management in the Emergency Rescue of Critically Ill Children in Pediatric Emergency Departments

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### Abstract

**Objective:** To investigate the effect of Person-Material-Process (PMP) combined with checklist management in the emergency rescue of critically ill children in pediatric emergency departments. **Methods:** A total of 268 pediatric patients who underwent emergency rescue between January and December 2020 were selected as the control group, and 283 pediatric patients rescued between January and December 2021 were selected as the observation group. The control group received conventional emergency management protocols for critically ill children, while the observation group implemented PMP combined with checklist management during rescue operations, with interventions focusing on three aspects: nurse training, equipment and medication management, and standardized rescue protocols for common pediatric emergencies. The accuracy of rescue personnel' s disposal behaviors and the incidence of adverse events related to rescue equipment, instruments, and medications were compared between the two groups. **Results:** The accuracy rate of rescue personnel' s disposal behaviors in the observation group was 98.94% (280/283), significantly higher than the 91.42% (245/268) in the control group ($P < 0.01$). The incidence of adverse events related to equipment function and insufficient supplies in the observation group was significantly lower than in the control group ($P < 0.01$). **Conclusion:** PMP combined with checklist management can significantly reduce the incidence of adverse events during the rescue of critically ill children and ensure patient safety.

**Keywords:** person; material; process; checklist management; pediatric emergency; critically ill; nursing management

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### Introduction

Pediatric patients often experience rapid, insidious, and swift disease progression. Rapid emergency treatment for critically ill children is crucial for improving survival rates [1-8]. The American Academy of Pediatrics' "Emergency Care for Children: Emergency Response Guidelines" identifies three key elements affecting pediatric emergency outcomes: emergency personnel (P), equipment (M), and processes (P) [2]. Establishing a rapid-response, efficient pediatric

emergency nursing team to ensure safe and effective pediatric emergency care is a consistent goal among pediatric emergency managers both domestically and internationally [1-12]. Research on emergency nursing staff competency management, emergency equipment management, and improvement of emergency nursing processes centered on these three elements has become a hot topic among emergency nursing professionals in recent years [6-10,12-14].

The core concept of checklist management is to list key steps for verification and reminder to ensure essential steps are completed, thereby reducing the risk of errors [15]. Researchers have applied checklist concepts to flexible endoscope cleaning and disinfection [16] and companion management [17], achieving positive results. Since January 2020, our department has designed three checklists: a standardized training checklist for pediatric emergency nurses, an inventory checklist for pediatric emergency equipment and medications, and a standardized observation and disposal process checklist for pediatric emergency conditions. These checklists have been applied to the rescue of critically ill children in pediatric emergency departments with good results, which we now report.

## 1 Materials and Methods

**1.1 Study Subjects** A total of 551 critically ill children who underwent emergency rescue in our hospital's pediatric emergency department between January 2020 and December 2021 were selected as study subjects. The 268 children rescued between January and December 2020 served as the control group (142 males, 126 females; age range 2 months to 10 years; mean age 2.37 $\pm$ 1.88 years). The 283 children rescued between January and December 2021 served as the observation group (153 males, 130 females; age range 3 months to 9 years; mean age 2.74 $\pm$ 2.28 years). There were no statistically significant differences in general demographic data between the two groups ($P > 0.05$).

**1.2 Methods** The control group followed conventional emergency and nursing protocols for equipment, medications, supplies inventory, and rescue procedures for critically ill children. The observation group rescue nurses implemented the three key elements of PMP according to the standardized training checklist for pediatric emergency nurses, the equipment and medication inventory checklist, and the standardized observation and disposal process checklist to complete daily emergency rescue work in the pediatric emergency department.

**1.2.1 Establishment of the PMP Project Checklist Team** The team consisted of 8 members: 1 head nurse serving as team leader responsible for task assignment and coordination; 2 physicians responsible for reviewing standardized processes; 2 pediatric nursing experts responsible for reviewing checklists; 1 department education supervisor; and 2 master's degree students responsible for literature retrieval, checklist development, revision, and finalization to produce standardized checklists.

**1.2.2 Checklist Design** The team retrospectively analyzed pediatric emergency rescue records and shift handover data from 2019 to identify 8 common and critical diseases/symptoms in pediatric emergency: high fever convulsions/seizures, allergy/anaphylactic shock, acute asthma attack/dyspnea, status epilepticus, food/drug poisoning, consciousness disturbance, choking on milk/sputum, and dehydration/shock/drowning. The team integrated the nursing skills, equipment, instruments, and medications that pediatric emergency nurses must master. Finally, based on the three aspects of emergency personnel (P), equipment (M), and processes (P), combined with departmental realities and referencing relevant guidelines and literature, three types of checklists were designed:

The **Standardized Training Checklist for Pediatric Emergency Nurses** includes basic nurse information, specific training items, assessment methods, and competency requirements [Figure 1: see original paper]. The **Equipment and Medication Inventory Checklist for Pediatric Emergency** includes specific inventory items, standards, verification times, and responsible persons [Figure 2: see original paper]. The **Standardized Observation and Disposal Process Checklist for Pediatric Emergency Conditions** includes patient basic information, preliminary diagnosis, symptoms/diagnostic basis, reference measures, and implemented measures. Reference measures encompass emergency processes, rescue location, patient positioning, key observation points and timing, retrieval and return of rescue supplies, requirements for special examinations during patient instability, and patient disposition and handover. Implemented measures refer to specific emergency actions performed by rescue nurses, with high fever convulsions/seizures as an example [Figure 3: see original paper].

**1.2.3 Nurse Training and Assessment** The education supervisor organized training for all nurses on the 8 standardized observation and disposal processes, including key points of medical-nursing cooperation, precautions, and adverse drug reactions for each condition. All practical operations involved in each standardized emergency nursing process were screened and organized, with on-site training and assessment conducted in the resuscitation room. When standardized processes changed due to medical advances or guideline updates, the education supervisor promptly organized training to ensure everyone was informed. After training, all nurses were assessed using the "Tongji Hospital Clinical Nursing Technical Operation Standards (2016 Edition)" on the operational assessment items in the standardized training checklist, with each item evaluated against assessment criteria. After passing all assessments, the head nurse randomly assigned nurses to emergency shifts to perform rescue tasks.

**1.2.4 Implementation** During each shift handover, rescue nurses used the equipment and medication inventory checklist to verify equipment, emergency supplies, and medications, checking each item to ensure they were in good standby condition. During rescue operations, nurses followed the standardized

observation and disposal process checklist to grasp key links and nodes, ensuring orderly and efficient rescue work. After rescue, nurses reviewed the process, completed the verification checklist, reflected on the rescue, and identified problems and causes. At the end of each month, the department used the PDCA method to conduct centralized analysis of problems encountered during rescue and propose improvement measures.

**1.3 Statistical Methods** SPSS 20.0 software was used for statistical analysis. Count data were expressed as percentages (%) and analyzed using the chi-square test. A significance level of $\alpha = 0.05$ was set, with $P < 0.05$ considered statistically significant.

## 2 Results

**2.1 Comparison of Rescue Personnel Disposal Behavior Accuracy** The accuracy rate of rescue personnel's disposal behaviors was 91.42% (245/268) in the control group and 98.94% (280/283) in the observation group, showing a significant improvement in the observation group ( $^2 = 17.32$, $P < 0.01$).

**2.2 Comparison of Adverse Events Related to Equipment and Emergency Supplies** Regarding adverse events related to equipment and instruments, the incidence of equipment dysfunction, insufficient power, and missing accessories in the observation group was significantly lower than in the control group ($P < 0.01$). Regarding adverse events related to emergency supplies, the incidence of insufficient supplies in the observation group was significantly lower than in the control group ($P < 0.01$). Details are shown in Table 1 .

## 3 Discussion

Pediatric emergency patients often have acute onset with rapid disease changes and lack subjective expression abilities. During emergency rescue, if emergency nursing staff lack proficient rescue skills and clear rescue processes, it can lead to chaotic rescue procedures and affect rescue efficiency and quality [18-19]. Standardized training for emergency nurses and standardization of emergency nursing behaviors can reduce medical risks and improve rescue quality. Since January 2021, our emergency center has analyzed current clinical work conditions and, following the latest domestic and international guidelines, developed a nurse standardized training checklist and a standardized observation and disposal process checklist. Results showed that after implementing these checklists, the accuracy rate of rescue personnel's disposal behaviors significantly improved ($P < 0.01$).

The standardized training checklist for pediatric emergency nurses covers common emergency operations, medications, and equipment in pediatric emergency departments. It was initially developed by experienced education supervisors

and senior nurses, discussed and analyzed by all nursing staff, and finally reviewed and approved by pediatric nursing experts, fully reflecting a "participatory management" process that encourages active participation in this nursing reform measure. Additionally, review by nursing experts further ensures the scientific validity and guidance of the checklists. The standardized training checklist lists all required competencies, helping nurses adapt to work needs quickly and providing clear goals for self-improvement.

The standardized observation and disposal process checklist, designed following evidence-based medicine principles, addresses eight common diseases in pediatric emergency. It provides clear, procedural guidance on patient positioning, initial emergency management, medical-nursing cooperation, condition observation, and documentation, offering nurses clear direction during emergency rescue to ensure medical safety and standardized rescue quality. This study also incorporated daily quality control supervisors to participate in rescue process evaluation, achieving continuous quality improvement through monthly recording, statistical analysis, and identification of gaps and improvements.

Orderly management and good working condition of emergency equipment and instruments are prerequisites for winning rescue time and represent an important component of nursing quality evaluation. As users of rescue equipment, nurses' inspection and maintenance of instruments to ensure standby status has always been part of daily work. However, due to the wide variety of instruments, medications, and supplies, expiration, malfunction, and other issues often occur, leading to adverse events and even patient death. Based on nearly one year of rescue records and shift handover data, this study identified commonly used emergency equipment, instruments, supplies, and medications in pediatric emergency and created an inventory checklist including item quantities, locations, and standby status requirements. This facilitates item-by-item verification for nurses, avoiding omissions, missing items, and errors, and ensuring smooth rescue operations. Since implementing the verification checklist in January 2021, no rescue delays or disputes due to equipment issues have occurred, ensuring patient safety.

Checklist management has been applied in many areas of nursing and has achieved good results in improving nursing quality. This study integrated all items based on the three PMP elements rather than listing them haphazardly, standardizing personnel competency, equipment standby status, and evidence-based processes to reduce nurse burden and improve nursing quality. While checklist management offers many benefits, checklists must be scientifically developed and personalized to maximize clinical safety while minimizing the verification burden on clinical nurses.

## Conflict of Interest Statement

The authors declare no conflict of interest in this article.

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*Note: Figure translations are in progress. See original paper for figures.*