

Application of Intelligent Nursing Combined with Child-Friendly Environmental Modification in Pediatric Nursing Management

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Abstract

Objective: To explore the practical effect of applying intelligent nursing competency-level matching management combined with child-friendly environmental modification in pediatric nursing management, and to provide evidence-based support for optimizing the quality of pediatric nursing services, reducing nursing safety risks, and improving the satisfaction of children's families. **Methods:** From July 1 to September 30, 2025, 100 hospitalized pediatric patients and 26 nurses were enrolled. Using cluster randomization with nurses as the unit, the 26 nurses were randomly assigned to either the control group or the intervention group (13 nurses each), and the patients under their care were automatically allocated to the corresponding group. Family satisfaction was the primary outcome. Based on a pilot study showing a 20% difference in satisfaction, with $\alpha = 0.05$ and $\beta = 0.2$, the required sample size was calculated to be at least 46 patients per group; ultimately, 50 patients per group were included. Because patient data were nested within nurses and the intra-class correlation coefficient (ICC) was < 0.05 , the clustering effect was minimal, supporting the use of independent t-tests and χ^2 tests. Patients and nurses were allocated via a random number table (50 patients and 13 nurses per group). The control group received playful environmental modifications, 6S lean management, and cartoon-style safety signage. The intervention group received the same measures plus intelligent nursing competency-matching management. Nursing quality scores, number of adverse events, and family satisfaction were compared between groups. **Results:** The intervention group scored significantly higher than the control group in nursing performance, task completion, professional skill mastery, adherence to regulations, teamwork, and hospital contribution (all $P < 0.05$). The nursing adverse-event risk score was significantly lower in the intervention group ($P < 0.001$). Family satisfaction was 94.00% in the intervention group versus 74.00% in the control group ($P =$

0.02). **Conclusion:** Intelligent nursing combined with playful environmental modifications effectively improves pediatric nursing quality and efficiency, reduces adverse events, and increases family satisfaction. The approach aligns well with pediatric nursing characteristics and has high potential for clinical implementation.

Keywords

Intelligent Nursing, Child-Friendly Environment, Competency-Level Matching, Pediatric Nursing, Nursing Management, Nursing Quality

1. Introduction

Pediatrics is a clinical department with special service recipients, prominent nursing risks, and relatively difficult management. Pediatric patients are generally young, have limited language expression ability, weak self-protection awareness, and poor treatment compliance. In addition, family members are highly concerned about treatment safety and are prone to anxiety, tension, and other negative emotions, making pediatric nursing work highly demanding, communication-intensive, and associated with a significantly higher incidence of adverse events than in other departments [1].

Traditional pediatric nursing management models are mostly centered on nurses' experience, lacking a scientific and quantitative basis for job assignment. The matching degree between nurses' competence levels and children's conditions and care needs is often insufficient, which may lead to imbalanced manpower allocation, inadequate implementation of basic nursing care, and insufficient professionalism in critical care. This not only wastes nursing human resources but also affects the stability and continuity of nursing quality [2].

Regarding ward environment construction, traditional pediatric wards mainly focus on medical functionality. Their color schemes are often monotonous and facilities tend to feel cold and impersonal, lacking humanized elements that meet children's psychological characteristics and aesthetic needs. This can increase children's unfamiliarity with and fear of the hospital environment, resulting in crying, resistance to diagnosis and treatment, and other behaviors, which not only interfere with normal treatment processes but also further aggravate family members' anxiety and reduce the overall nursing service experience [3].

With the continuous development of smart healthcare and high-quality nursing service concepts, modern management methods such as intelligent nursing systems, child-friendly environmental modification, 6S management, and graded safety warnings have gradually been applied in pediatric nursing practice. However, existing studies have mostly focused on the effect of a single measure, while there have been relatively few studies on synergistic interventions combining child-friendly environmental modification with intelligent nursing competency-level matching management, and the comprehensive application value of this

combination has not yet been fully verified [4] [5].

Based on this, this study took the pediatric department of the First Affiliated Hospital of Yangtze University as the research setting, organically integrating intelligent nursing competency-level matching management with child-friendly environmental modification, 6S refined management, and cartoon-style safety warnings to construct an integrated pediatric nursing management model of “humanized environmental support + intelligent manpower management”. By comparing nursing quality, incidence of adverse nursing events, and family satisfaction between the two groups, the study aimed to clarify the effectiveness of this model and provide scientific reference and practical guidance for optimizing pediatric nursing management systems and improving nursing service quality.

2. Materials and Methods

2.1. Clinical Data

A total of 100 hospitalized children and 26 nursing staff members from the pediatric department of the First Affiliated Hospital of Yangtze University were selected between July 1, 2025 and September 30, 2025. Cluster randomization was used: the 26 nurses were randomly assigned to the control or intervention group (13 nurses each). All patients cared for by the nurses in each group were automatically allocated to the corresponding group to avoid cross-group contamination. Using a random number table, patients and nurses were allocated to the control and intervention groups (50 patients and 13 nurses per group).

Inclusion criteria for children:

1. Met the diagnostic criteria for common pediatric diseases and had stable conditions;
2. Aged ≤ 7 years;
3. Conscious and free of cognitive dysfunction;
4. Family members provided informed consent and voluntarily participated in the study.

Exclusion criteria for children:

1. Presence of cognitive or psychiatric disorders making cooperation with treatment and nursing impossible;
2. Presence of severe underlying diseases such as congenital heart disease or immunodeficiency;
3. Transfer to another department/hospital or death during hospitalization;
4. Hospital stay less than 24 hours.

Inclusion criteria for nursing staff:

1. Registered nurses employed in the pediatric department of the First Affiliated Hospital of Yangtze University;
2. Working experience of ≥ 6 months;
3. Provided informed consent and were able to participate in nursing work throughout the study period.

Exclusion criteria for nursing staff:

1. Not employed by the First Affiliated Hospital of Yangtze University;
2. On leave for ≥ 2 weeks, resigned, or transferred during the study;
3. Failed to complete relevant training and assessment.

In the control group, among the children, 27 were boys and 23 were girls; age ranged from 1 to 7 years, with an average age of (4.26 ± 1.35) years. Disease types included 32 cases of respiratory diseases, 12 cases of digestive diseases, and 6 cases of other diseases. Nursing care levels: Level I in 7 cases, Level II in 26 cases, and Level III in 17 cases. The mean pediatric condition severity score was 6.82 ± 1.21 . In the study group, 29 were boys and 21 were girls; age ranged from 1 to 7 years, with an average age of (4.31 ± 1.28) years. Disease types included 30 cases of respiratory diseases, 13 cases of digestive diseases, and 7 cases of other diseases. Nursing care levels: Level I in 8 cases, Level II in 24 cases, and Level III in 18 cases. The mean pediatric condition severity score was 6.77 ± 1.18 . Comparison of additional baseline indicators between the two groups showed $P > 0.05$, confirming that the baselines were comparable.

Among the nursing staff in the control group, age ranged from 22 to 38 years, with an average of (28.65 ± 3.42) years; years of work ranged from 1 to 11 years, with an average of (5.42 ± 2.16) years. Professional titles included 7 nurses, 4 senior nurses, and 2 nurse supervisors. In the study group, age ranged from 21 to 39 years, with an average of (28.71 ± 3.38) years; years of work ranged from 1 to 12 years, with an average of (5.51 ± 2.23) years. Professional titles included 6 nurses, 5 senior nurses, and 2 nurse supervisors.

There were no statistically significant differences between the two groups in children's gender, age, disease type, or nurses' age, years of work, and professional titles ($P > 0.05$), indicating comparability. This study was approved by the Medical Ethics Committee of the First Affiliated Hospital of Yangtze University, and all participants signed informed consent forms.

2.2. Methods

2.2.1. Control Group

The control group received child-friendly environmental modification, 6S refined management, and optimized safety warning signs. The specific measures were as follows:

1. Child-friendly environmental modification

A comprehensive visual optimization was carried out in wards, corridors, and nursing stations. Wallpapers featuring cartoon animations, forest animals, stars, and oceans—elements favored by children—were placed on the walls, and hand-painted cartoon health education walls were set up in corridors. Exclusive play areas were designated in the wards and equipped with picture books, building blocks, plush toys, rocking rides, and other facilities, which were disinfected daily at fixed times. Cartoon-patterned bed sheets, quilts, and pillowcases were used, and children's animations and songs were played in rotation. Nursing staff wore uniform light pink or light blue cartoon-style work clothes and cute badges and

hair accessories. An interactive cartoon photo wall was also set up to display moments of children's recovery and nursing work scenes, thereby reducing psychological distance between nurses and patients.

2. 6S refined management

The 6S management standards of sorting, setting in order, sweeping, cleaning, discipline, and safety were strictly implemented. A zoned responsibility nursing system was adopted, and cleaning and disinfection of wards, treatment rooms, and nursing stations were completed daily at scheduled times to maintain a neat environment. Medical supplies, nursing instruments, and drugs were managed with fixed placement, categorization, and labeling, and the procedures for access and use were standardized. Monitoring and control of ward noise were strengthened, loud talking by visitors was restricted, and medical procedures were performed gently to create a quiet and comfortable hospitalization environment. Health education on disease care, feeding guidance, and safety protection was delivered through cartoon manuals, animated videos, and one-on-one explanations.

3. Optimization of safety warning signs

Red, yellow, and blue cartoon-style warning signs were adopted. Red signs indicated prevention of falls and scalds; yellow signs indicated prevention of bed falls and getting lost; blue signs indicated prevention of tube dislodgement and drug allergy. The signs were paired with cartoon images and concise text to make them intuitive and easy to understand. They were properly posted in high-risk areas such as bedside areas, corridors, bathrooms, and treatment rooms, and were checked and maintained daily by designated personnel to ensure that they remained clear and intact.

2.2.2. Study Group

On the basis of the control-group interventions, intelligent nursing competency-level matching management was implemented. To prevent contamination between groups, nurses in the two groups were stationed in separate ward areas with completely segregated work shifts. Throughout the study, there was no cross-area support, staff rotation, or personnel exchange, thereby eliminating cross-contamination of the interventions. Using the hospital's intelligent nursing management system, a full-process management mechanism was established that included competency-level assessment, position matching, and dynamic adjustment of nursing staff. The specific measures are as follows:

1. Precise classification of nursing staff competency levels

The intelligent nursing management system collected data on nurses' theoretical knowledge, professional skills, communication ability, work performance, and family evaluations. Based on comprehensive scores, nurses were divided into five levels, N0-N4, and the responsibilities of each level were defined:

N0 level: Working experience < 1 year, comprehensive score < 80. These nurses had relatively weak theoretical and practical foundations and completed operations such as vital sign monitoring and basic daily care under the guidance of senior nurses.

N1 level: Working experience ≥ 1 year, comprehensive score 80 - 85. These nurses could independently complete basic nursing and routine nursing operations and were responsible for children requiring Grade II and Grade III nursing care.

N2 level: Professional title of senior nurse or above, working experience ≥ 3 years, comprehensive score 86 - 90. These nurses were proficient in pediatric specialty nursing and early identification of critically ill conditions, could independently provide Grade I and Grade II nursing care, and were responsible for mentoring junior nurses.

N3 level: Professional title of nurse supervisor or above, working experience ≥ 6 years, comprehensive score 91 - 95. These nurses had rich clinical experience and emergency response capabilities and were responsible for the care of critically ill children, nursing quality control, and departmental teaching and training.

N4 level: Professional title of associate chief nurse or above, working experience ≥ 10 years, comprehensive score 96 - 100. These nurses mastered new specialty nursing technologies and were responsible for specialty consultation, nursing research, and technical guidance for pediatric nursing across the hospital.

2. Intelligent dynamic competency-level matching

The intelligent system entered information such as children's age, condition, nursing level, and risk level, automatically analyzed nursing needs, and intelligently matched the most suitable nurses based on competency level, workload, and on-duty status. Positions were dynamically adjusted every day according to changes in children's conditions and nurses' assessment results to achieve a high degree of matching between ability and demand.

3. Competency-level assessment and promotion incentives

The intelligent system conducted monthly quantitative assessments of work quality, operational skills, and family satisfaction. Competency levels were dynamically adjusted based on assessment results, and those with excellent performance and improved ability were promoted, thereby stimulating work enthusiasm and professional belonging among nursing staff.

2.3. Observation Indicators

2.3.1. Nursing Quality

Nursing quality was assessed using the Nurse Work Performance Self-Rating Scale, which comprises seven dimensions: nursing work (70 points), task completion (25 points), professional skills (35 points), compliance with regulations (40 points), proactive collaboration (28 points), hospital contribution (40 points), and adverse event risk (40 points). Higher scores on the first six dimensions indicate better nursing quality, whereas a lower score on the adverse event risk dimension reflects reduced potential safety risks. The scale demonstrated good reliability and validity (Cronbach's $\alpha = 0.92$). Higher total scores represent better nursing quality, while lower scores on the nursing adverse events dimension indicate lower safety risks.

Scale Collection Protocol: The Nurse Work Performance Self-Rating Scale and the NSNS were collected uniformly by hospital-level quality control personnel

who were independent of the study implementation. All questionnaires were completed on the day of the child’s discharge to minimize courtesy bias that could result from guidance by members of the intervention group.

2.3.2. Family Satisfaction

Family satisfaction was assessed using the Newcastle Satisfaction with Nursing Scale (NSNS), covering dimensions such as nursing attitude, skills, health education, and environment, with a total score of 100 points. Scores > 80 indicated “very satisfied”, 60 - 80 indicated “satisfied”, and < 60 indicated “dissatisfied”.

Overall satisfaction rate = (very satisfied + satisfied)/total number of cases × 100%

2.3.3. Adverse Nursing Events

The numbers of adverse events during hospitalization, including falls, bed falls, tube dislodgement, infusion extravasation, and scalds, were recorded, and the incidence rate was calculated.

2.4. Statistical Methods

Data were analyzed using SPSS 26.0 statistical software. Measurement data were expressed as ($\bar{x} \pm s$), and intergroup comparisons were performed using the independent-samples t test. Count data were expressed as cases (%), and intergroup comparisons were performed using the χ^2 test. Although the patient data were nested within nurses, the pilot-study ICC was < 0.05, indicating a weak clustering effect; therefore, the use of conventional independent t-tests and χ^2 tests was considered appropriate. A value of P < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of Family Satisfaction between the Two Groups

The overall satisfaction rate of family members in the study group was 94.00%, which was significantly higher than 74.00% in the control group, and the difference was statistically significant (P = 0.02). See **Table 1**.

Table 1. Comparison of nursing satisfaction of children’s family members between the two groups [n (%)].

Group	Cases	Very satisfied	satisfied	Dissatisfied	Overall satisfaction
Study Group	50	19 (38)	28 (56)	3 (6)	47 (94)
Control Group	50	17 (34)	20 (40)	13 (26)	37 (74)
χ^2 value	-	-	-	-	5.316
P value	-	-	-	-	0.02

3.2. Comparison of Nursing Quality Indicators between the Two Groups

Scores for all dimensions of nursing quality in the study group were higher than those in the control group, while the adverse nursing event score was lower than

that in the control group. All differences were statistically significant ($P < 0.05$). See **Table 2**.

Table 2. Comparison of nursing quality between the two groups (score, $\bar{x} \pm s$).

Item	Study Group (n=13)	Control Group (n=13)	t value	P value
Nursing work	65.40±2.85	51.24±1.79	15.68	<0.001
Task completion	22.16±2.15	18.52±1.32	3.83	0.001
Mastery of professional skills	30.26±3.05	27.40±1.98	3.40	0.002
Compliance with rules and regulations	35.26±2.27	32.68±1.43	2.76	0.011
Active and positive mutual cooperation	24.46±2.24	21.22±1.53	3.84	0.001
Contribution to hospital development	35.58±2.10	31.42±1.31	5.54	<0.001
Adverse nursing events	30.82±1.01	33.08±1.15	-5.98	<0.001

3.3. Comparison of the Incidence of Adverse Nursing Events between the Two Groups

The incidence of adverse nursing events in the study group was 4.00% (2/50), which was lower than 18.00% (9/50) in the control group, and the difference was statistically significant ($\chi^2 = 5.005$, $P = 0.025$).

4. Discussions

The core goals of pediatric nursing management are to reduce safety risks, improve diagnosis and treatment compliance, optimize manpower allocation, and improve service experience. The traditional management model has obvious shortcomings in environmental design, manpower allocation, and safety control, which makes it difficult to adapt to the high-quality development needs of modern pediatric nursing [6] [7]. The results of this study showed that the scores of each dimension of nursing quality and family satisfaction in the study group were significantly higher than those in the control group, and the incidence of nursing adverse events was significantly lower than that in the control group ($P < 0.05$), indicating that the collaborative model of smart nursing combined with child-friendly environmental renovation can comprehensively improve the efficiency of pediatric nursing management, ensure nursing safety, and improve service quality.

The child-friendly environmental renovation takes children's psychological needs as the core. Through visual beautification, facility optimization, and atmosphere creation, it breaks the inherent impression of cold and depressing traditional wards, and uses cartoon elements, entertainment facilities, and warm color tones to alleviate children's sense of unfamiliarity and fear, and improve children's diagnosis and treatment compliance [3]. The study of Ma and Chen [3] showed that the specialized nursing based on the child-friendly design of children's medical space can promote the improvement of pulmonary function of children with *Mycoplasma pneumoniae pneumonia* during nebulization inhalation and im-

prove their compliance with nebulization, which further confirmed the positive effect of the child-friendly environment in alleviating children's negative emotions and improving treatment compliance. At the same time, a comfortable and humanized hospitalization environment can effectively alleviate the anxiety of family members, create a good atmosphere for nurse-patient communication, and improve the initial recognition of family members for nursing services. The 6S fine management realizes the standardization of nursing workflow, the cleanliness of the environment, and the location-based management of articles, reducing the safety hazards caused by management confusion. The study of Zhou *et al.* [5] confirmed that the 6S management model applied to clinical nursing management can improve the quality of nursing management, reduce the incidence of nursing adverse events, and improve the nursing satisfaction of inpatients. Cartoon safety warning signs strengthen safety tips in an intuitive and easy-to-understand form, reducing the risk of adverse events such as falls, bed falls, and tube detachment [1].

Smart nursing competency-level matching management is the core support for improving nursing quality. Relying on the smart system, it realizes the precise grading of nursing staff and the dynamic matching of posts, completely subverting the traditional empirical manpower allocation model [8]. Through the division of N0–N4 competency levels, the responsibilities of each level are clarified, and the goal of "low competency level for basic work, high competency level for critical illness" is achieved, avoiding the mismatch and waste of human resources, and improving the professionalism and efficiency of nursing work [9]. Xu *et al.* [10] constructed a vascular grading and nurse competency-level matching system in the pediatric outpatient department, and the results showed that the system can automatically and accurately match the best puncture nurse for the children and improve the success rate of venipuncture, indicating that competency-level matching management has significant application value in pediatric nursing practice. The intelligent dynamic matching function can adjust nursing manpower in real time according to the condition of the children, ensuring that critically ill children receive specialized nursing and ordinary children receive high-quality basic nursing. The competency assessment and promotion incentive mechanism can effectively stimulate the learning motivation and professional belonging of nursing staff and promote the continuous improvement of the overall quality of the nursing team [11] [12].

In this study, the child-friendly environmental renovation and smart nursing competency-level matching management were organically combined to form a collaborative management model with a humanized environment, intelligent management, and high-quality services. The child-friendly environment provides a good foundation for nursing work, and the smart competency-level matching provides a core guarantee for quality improvement. The two complement each other and work together, which not only meets the physical and psychological needs of children but also realizes the optimal allocation of human resources, ultimately

achieving the comprehensive improvement of nursing quality, safety, and satisfaction [13].

There are some limitations in this study: it was a single-center, small-sample study with a short observation period and no cost-benefit analysis was carried out; the research subjects were only children ≤ 7 years old, and the application scope of the results was limited. In the future, the sample size can be expanded, multi-center long-term follow-up studies can be carried out, children of different age groups in pediatrics can be included, and health economics evaluation can be conducted, to provide a more comprehensive and rigorous evidence-based basis for the extensive promotion of this model.

5. Limitations

It was a single-center study with a small sample size and a short observation period, and no cost-effectiveness analysis was performed. In addition, only children aged ≤ 7 years were included, so the applicability of the results is limited. Future studies may expand the sample size, conduct multicenter long-term follow-up studies, include pediatric patients of different age groups, and perform health economic evaluations to provide more comprehensive and rigorous evidence for the wider promotion of this model.

6. Conclusion

The application of intelligent nursing combined with child-friendly environmental modification in pediatric nursing management can optimize human resource allocation, improve nurses' professional ability and work quality, reduce the risk of adverse nursing events, and significantly enhance the satisfaction of children's family members. It is a scientific and efficient nursing management model that fits the characteristics of pediatric departments and has high clinical application and promotion value.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Jiao, Y., Zhang, Y., Wang, X., *et al.* (2021) Application of Dynamic Post Matching Combined with Improved Risk Warning Signs in Pediatric Nursing Management. *Qilu Journal of Nursing*, **27**, 162-165. (In Chinese)
- [2] Qi, J.J. and Liu, S.L. (2020) Construction of Continuing Nursing Staff Professional Ability Evaluation System Based on Grey System Analysis. *Chinese Health Service Management*, **37**, 180-183.
- [3] Ma, L. and Chen, G. (2022) Effect of Specialized Nursing Based on Child-Friendly Design of Children's Medical Space on Children with *Mycoplasma pneumoniae* Pneumonia during Nebulization. *Journal of Bengbu Medical College*, **47**, 1306-1309.
- [4] Sun, J.X., Li, M. and Liu, M. (2021) Application and Effect of 6S Management Model in Psychiatric Nursing Management. *China Health Industry*, **18**, 4-7.

- [5] Zhou, G.Y., Zhou, X.Y., Chen, L., *et al.* (2022) Discussion on the Value of 6S Management Model in Improving Clinical Nursing Management Quality. *Guizhou Medical Journal*, **46**, 1824-1825.
- [6] Han, J.X. (2021) Analysis of Causes and Preventive Measures of Pediatric Nursing Adverse Events. *Heilongjiang Journal of Traditional Chinese Medicine*, **50**, 246.
- [7] Guo, Z.R. (2021) Analysis on the Application of Stratified Competency Management Concept of Nurses in Nursing Management Quality. *China Health Industry*, **18**, 81-84.
- [8] Chen, Q., Zhou, F.L., Zhang, J., *et al.* (2024) Research Progress on Smart Nursing Service Models at Home and Abroad. *Journal of Nursing Science*, **31**, 17-21.
- [9] Zhang, H. (2023) Effect Analysis of Stratified Competency Management of Nurses on Improving Ward Nursing Management Quality and Patient Satisfaction. *China Health Industry*, **20**, 81-84.
- [10] Xu, J.Y., Yu, G., Wei, L.L., *et al.* (2019) Construction and Application of Vascular Grading and Nurse Competency-Level Matching System in Pediatric Outpatient Department. *Journal of Nursing Science*, **34**, 52-55.
- [11] Zhou, Y.Q., Fang, R.H. (2022) Application Status and Development Prospect of Artificial Intelligence in the Nursing Field. *Chinese Nursing Research*, **36**, 1073-1076.
- [12] Yao, J.N., Cao, S.H., Shi, Y.K., *et al.* (2024) Visual Analysis of Research Hotspots and Frontiers of Artificial Intelligence in Nursing in China. *Chinese Journal of Modern Nursing*, **30**, 3401-3407.
- [13] Liu, D.D. (2024) Effect of Child-Friendly Nursing on Pulmonary Function and Treatment Compliance of Children with Bronchiolitis. *Home Health*, No. 5, 50-52.