Journal of Multidisciplinary Healthcare

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Construction and Multidimensional Verification of Clinical Practice Standards for Physical Restraint: A Four-Year Retrospective Quality Improvement Study

Yan Xu[1], Luman Zheng[2], Lixia Chen[3], Chunting Zhu[3], Juan Li[3], Gui Zheng[1,3], Lifen Lu[1,3]

[1]Department of Nursing, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang, People's Republic of China; [2]Department of Laboratory Medicine, Hunan Changsha Medical University, Changsha, Hunan, People's Republic of China; [3]Department of Nursing, The Fourth Affiliated Hospital, Zhejiang University School of Medicine, Yiwu, Zhejiang, People's Republic of China

Correspondence: Lifen Lu; Gui Zheng, Department of Nursing, The First Affiliated Hospital, Zhejiang University School of Medicine, Email 1197039@zju.edu.cn; zhenggui119@zju.edu.cn

Introduction: Physical restraint (PR) is widely used in inpatient clinical nursing. Unplanned extubation (UE) events among restrained patients account for nearly half of all hospital UE cases, leading to an increased risk of medical disputes. It is imperative to establish a standardized nursing quality evaluation system and optimize PR-related nursing practices to lower the incidence of UE.

Methods: This was a single-center retrospective longitudinal quality improvement study conducted based on inpatient data of a tertiary Grade A hospital in Zhejiang Province from 2018 to 2021. The PDCA cycle and multi-dimensional intervention strategies were adopted for practice optimization. A series of measures including setting up management teams, carrying out systematic training and applying the innovative hand-shake restraint technique were implemented. The PR utilization rate and relevant indicators were dynamically monitored, and independent influencing factors of UE were analyzed. This study was designed in compliance with the SQUIRE 2.0 standards.

Results: After intervention, the PR utilization rate decreased from 4.29% to 2.77%, and the daily incidence of PR-related UE fell from 0.89% to 0.24%. Advanced age, consciousness disorder, neurological diseases and catheter indwelling duration of 1–5 days were independent risk factors for UE, whereas female gender and family accompaniment were protective factors. The interventions effectively corrected the disconnection between nurses' knowledge, attitude and practice, and improved patients' mental state and treatment compliance.

Conclusion: This study established a standardized evaluation system for PR nursing quality. Innovative techniques and multi-dimensional interventions effectively optimized clinical nursing practices, reduced PR utilization and the occurrence of PR-related UE events. The results provide scientific evidence for clinical nursing management and promote the application of humanistic care philosophy in nursing practice.

Keywords: physical restraint, unplanned extubation, nursing quality, evidence-based intervention, humanistic care

Introduction

Physical Restraint (PR) is a commonly adopted nursing intervention in clinical practice. It restricts patients' voluntary movements to prevent adverse events such as unplanned extubation (UE) and falls, and is widely applied in intensive care units (ICUs), geriatric departments and neurosurgery departments. Nevertheless, despite its vital role in ensuring clinical treatment safety, the application of PR remains highly controversial.[1] Studies have demonstrated that prolonged or inappropriate use of PR may trigger neurovascular complications, pressure injuries and delirium, and even raise the risk of mortality.[2–6] Additionally, PR can impair patients' psychological status,[7] and undermine their cognitive function and social adaptability.[8] More concerningly, some medical staff employ PR as a management tool or disciplinary

https://doi.org/10.2147/JMDH.S605453
Received: 1 March 2026
Accepted: 2 June 2026
Published: 10 June 2026

measure, which not only violates professional ethics but also sets a negative example for novice nurses and nursing interns.[9] These dilemmas severely hinder the balance between clinical safety guarantee and protection of patients' rights and interests in nursing practice.

In light of the current status of clinical practice in China, restricted clinical application of sedative medications makes ICU nurses generally regard PR as an essential safety measure, even at the expense of patient comfort.[10–12] Such professional tendency stems from nurses' inherent professional responsibility to safeguard patient safety,[13] as well as practical risk aversion demands. Strict hospital supervision and prevention of adverse events including UE and falls have long placed frontline nurses in an ethical dilemma between safety management and patient right protection.[11,12,14] Evidently, PR implementation is far more than a simple technical operation. It is a complex nursing behavior that balances the demands of patients, medical staff and medical institutions, and involves multiple dimensions including physiology, psychology, ethics and health economics.[14] Standardized and prudent application of PR is therefore urgently required based on evidence-based foundations and humanistic care concepts.

At present, the PR minimization management model has been fully implemented in the global nursing field, and a series of mature practical systems have been developed, including comprehensive restraint intervention strategies, multidimensional management schemes, clinical restraint decision-making tools and multidisciplinary team intervention measures.[15–18] Multiple evidence-based studies have consistently verified that systematic professional training for nursing staff serves as the core and most effective measure to reduce inappropriate restraint and optimize restraint management.[13,14,16] Although relevant researches have been steadily carried out, two major deficiencies still remain in current PR research. Firstly, most existing studies mainly focus on evaluating the pros and cons of PR, while specialized studies on the prevention and control of UE among restrained patients are relatively insufficient. Secondly, clinical PR practice lacks unified implementation standards and operational norms, and there are obvious disparities in caregivers' cognition, attitudes and practical behaviors regarding PR.[19]

In view of the above situation, this study aimed to reduce the PR utilization rate and the incidence of PR-related UE events. Combined with the latest domestic and international evidence-based evidence and clinical practice, we constructed a standardized nursing quality system and adopted the innovative handshake restraint technique to integrate safety management with humanistic care in PR practice. Multidimensional interventions were also conducted in terms of nursing education and management optimization, so as to fill the gaps in current research.

Methods

Study Design and Evaluation Indicators

This retrospective longitudinal quality improvement study was carried out in a tertiary Grade A general hospital in Zhejiang Province. Inpatients hospitalized from January 1, 2018 to December 31, 2021 were selected as research subjects. Relevant clinical information and monitoring data of patients receiving PR during hospitalization were extracted via the Hospital Information System (HIS). The collected data covered patients' gender, age, consciousness status, primary disease diagnosis, surgical history, catheter risk grade, catheter indwelling duration, family accompaniment status and UE occurrence. Monitoring data included total length of hospital stay, total days of PR application, total number of UE events and PR-related UE events. Uniform judgment criteria were established in this study: clear consciousness was defined as clear mentation, intact orientation and capability to follow verbal instructions; those who failed to meet the above criteria were defined as unconscious.[20] Diseases were categorized into neurological, respiratory, circulatory, digestive, urinary and other systemic diseases based on involved organ systems. Indwelling catheters were classified into high-risk, medium-risk and low-risk levels in accordance with internal hospital standards. Restraint straps and restraint gloves were the mainstream clinical restraint tools, and bilateral upper limb restraint was the primary restraint mode, whereas lower limb restraint was seldom used in clinical practice. Inclusion criteria: ① Aged ≥ 18 years old; ② Received PR on unilateral or bilateral limbs with restraint straps or gloves during hospitalization; ③ Indwelled one or more internal catheters during hospitalization. Exclusion criteria: Patients with a confirmed history of severe mental disorders. The research was divided into three phases by timeline: 2018 served as the baseline control phase, 2019 as the intervention implementation phase, and 2020–2021 as the sustained long-term efficacy evaluation

phase. The main monitoring indicators included PR utilization rate, daily incidence of PR-related UE, proportion of PR-related UE and nursing quality assessment scores. The calculation formulas for each indicator are shown as follows:

PR utilization rate = (Total PR days/Total hospitalization days) × 100%

Daily incidence of PR-related UE = (Cases of PR-related UE/Total PR days) × 100%

Proportion of PR-related UE = (Cases of PR-related UE/Total UE cases) × 100%

Intervention Measures

Establishment of Management System

In 2019, the hospital established the PR Nursing Quality Improvement Committee. Led by the Deputy Director of the Nursing Department, a management team was set up together with head nurses from eight departments with high PR utilization rates. Clear job responsibilities were assigned to team leaders, coordinators and team members. The committee formulated a three-year PR nursing quality improvement plan in a holistic manner and conducted full-process supervision over its implementation. In accordance with hospital management goals, the committee allocated resources in an overall arrangement and dynamically adjusted meeting frequency. Monthly regular meetings were held in the first year, followed by quarterly regular meetings in the subsequent years. The team regularly reviewed the effects of rectification and submitted routine work reports. Adopting the PDCA cycle management model and Normalization Process Theory (NPT), this study constructed a complete implementation pathway for quality improvement (Figure 1) focusing on four core dimensions: coherence, cognitive participation, collective action and reflexive monitoring.[21] Core implementation essentials of each intervention were defined (Figure 2), and a joint collaborative management mechanism was built through multi-departmental linkage.

Current Situation Investigation and Analysis

A total of 165 UE adverse events were recorded among inpatients in this hospital in 2018, including 78 PR-related UE events, accounting for 47.27%. The closed-loop Root Cause Analysis (RCA) method combining dual independent evaluation and third-party verification was applied to identify event triggers. More than 85% of these adverse events were summarized into four major causes (Figure 3): Lack of supervision during restraint release, Restraint detachment due to patient agitation, Improper restraint device selection, and Ineffective restraint fixation. In terms of departmental distribution, insufficient monitoring during restraint loosening was the leading problem in general wards, whereas

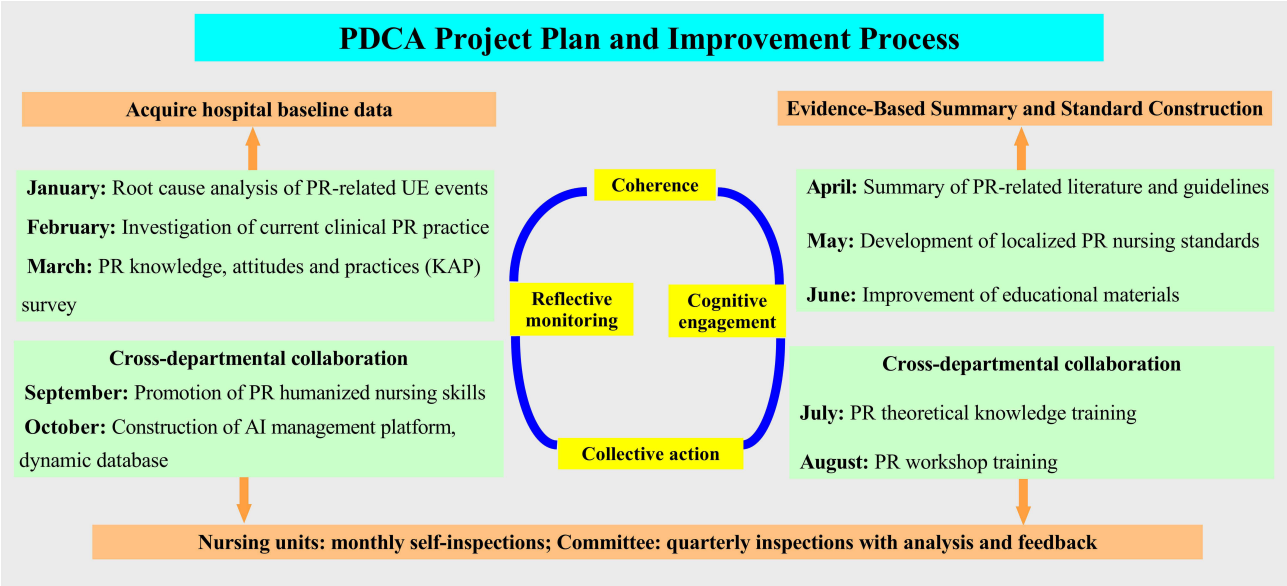

Figure 1 Presents the PDCA project plan and process. The project follows the PDCA cycle: plan (define goals, resources and risks), do (strengthen collaboration and tracking), check (identify deviations against standards), act (summarize experience and correct problems). Coherence, cognitive engagement, collective action and reflexive monitoring are integrated to ensure closed-loop management.

https://doi.org/10.2147/JMDH.S605453

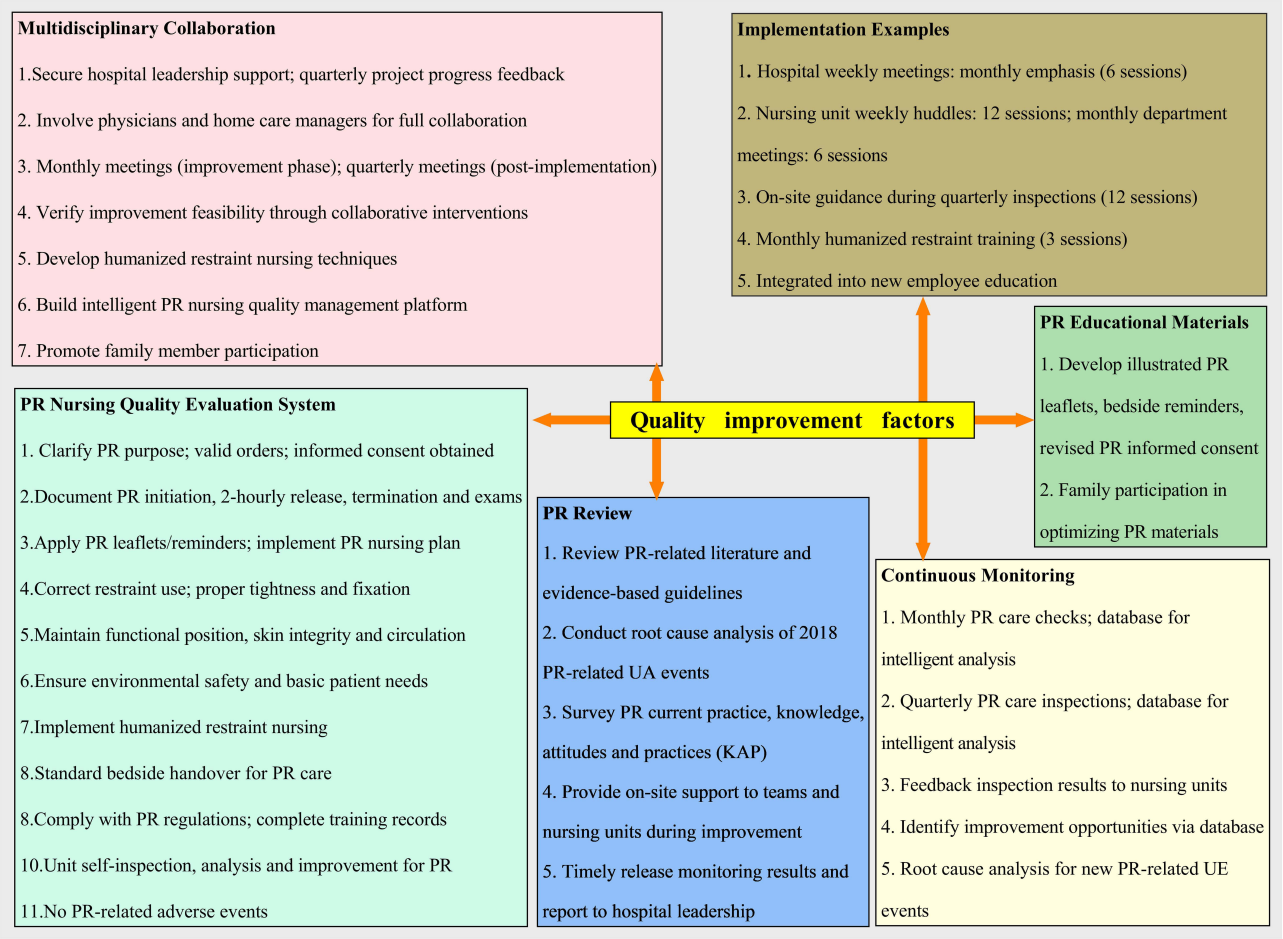

Figure 2 Key Components of a Comprehensive PR Intervention. Six core elements constitute the PR intervention: reviewing and standardizing PR application, forming a multidisciplinary team, organizing PR professional training, upgrading PR educational materials, establishing a PR nursing quality assessment system, and conducting sustained monitoring to ensure intervention outcomes.

inappropriate selection of restraint tools constituted the main challenge in intensive care units. A full-scale investigation on the actual clinical practice of PR nursing revealed prominent deficiencies, such as non-standard restraint operating procedures, inadequate skin care, monotonous health education modes and insufficient implementation of humanistic nursing services. The revised PR Knowledge-Attitude-Practice (KAP) Scale[22] was adopted to conduct a hospital-wide survey among nurses. The scale comprises 3 dimensions (knowledge, attitude and practice) with 36 items in total. Items are scored from 1 to 3 points, and the total score ranges from 36 to 108 points. The survey results showed that the overall average score of nurses was (87.56±5.28) points, including (32.68±2.73) points for knowledge dimension, (26.08±3.10) points for attitude dimension and (28.80±2.05) points for practice dimension. Demographic analysis demonstrated that junior nurses had better command of restraint-related professional knowledge. Only marital status exerted significant effects on nurses' attitudes towards PR, and no statistically significant differences were found in other demographic indicators (Table 1).

Establishment of a Closed-Loop Quality Control Model

By integrating domestic and international research literatures and clinical authoritative guidelines on PR nursing, combined with the results of the hospital's baseline survey, we constructed a PR nursing quality evaluation system and a specialized checklist[23] covering 3 core dimensions and 26 specific evaluation indicators, and refined the full-process standardized operating procedures for PR (Supplementary Document 1). Jointly with the multidisciplinary team, we compiled PR nursing health education manuals, bedside risk warning signs and specialized informed consent

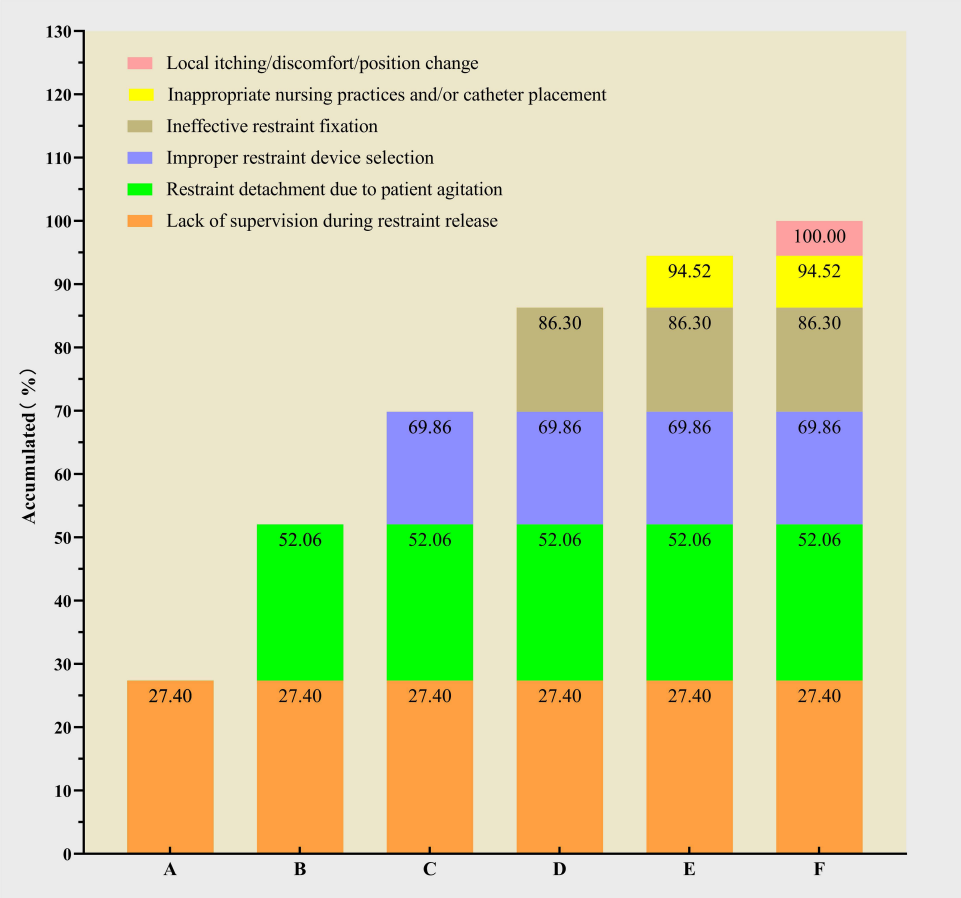

Figure 3 Causes and Proportions of PR-Related Adverse Events in Inpatients (2018). More than 85% of UE events were mainly induced by: lack of supervision during restraint release, restraint detachment due to patient agitation, improper restraint device selection, and ineffective restraint fixation.

documents, and standardized clinical health education through visualized health education materials (Supplementary Documents 2 and 3). A full-process closed-loop management model for quality improvement featuring "education-monitoring-feedback-improvement" was established.

Promotion of Innovative Techniques

Guided by the philosophy of humanistic nursing, the innovative hand-shake restraint intervention was developed and implemented jointly by nurses, nursing assistants, caregivers and patients' family members. Prior to application, ensure the assisting personnel are free from work distractions and competent in basic nursing cooperation. In practice, remove the restraint device on one side of the patient's limbs first, conduct passive limb functional training and skin cleaning care, and carry out emotional communication meanwhile. After obtaining the patient's understanding and cooperation, the assisting staff gently hold 1 to 3 fingers of the patient to restrict limb movement range instead of gripping the wrist directly. The contralateral limb is kept unrestrained to facilitate emergency management, and the same intervention procedures are performed on the other limb subsequently. This technique is suitable for inpatients with confused consciousness, mild emotional agitation and intact basic emotional perception ability.

Data Analysis

All clinical data were imported into a database established with Excel and independently double-checked by two researchers to ensure data authenticity and accuracy. Statistical analysis was performed using SPSS 26.0 software. Measurement data were presented as mean ± standard deviation. Independent-samples *t*-test was used for between-group comparisons of two groups, and one-way ANOVA was adopted for comparisons among multiple groups. Enumeration

https://doi.org/10.2147/JMDH.S605453

Table 1 Comparison of Knowledge, Attitudes, and Behavior Scores Regarding Physical Restraint in Demographics

Project	N (%)	Dimension of Knowledge			Attitude Dimension			Behavioral Dimension			Total Score		
		Mean (SD)	t/F	P	Mean (SD)	t/F	P	Mean (SD)	t/F	P	Mean (SD)	t/F	P
Department			1.279	0.202		0.189	0.850		0.846	0.398		1.102	0.271
ICU	63(17.0)	33.08 (2.90)			26.14 (3.31)			29.00 (1.93)			88.22 (5.41)		
Nursing unit	308(83.0)	32.60 (2.68)			26.06 (3.06)			28.76 (2.08)			88.42 (5.24)		
Age			1.900	0.058		−0.347	0.729		−0.060	0.952		0.750	0.453
Under 30 years old	296(79.8)	33.81 (2.74)			26.05 (3.13)			28.80 (2.00)			87.66 (5.39)		
Over 30 years old	75(20.2)	32.16 (2.62)			26.19 (2.99)			28.81 (2.29)			87.15 (4.82)		
Gender			0.817	0.414		0.626	0.532		−0.052	0.958		0.770	0.442
Male	37(10.0)	33.03 (2.71)			26.38 (3.86)			28.78 (2.58)			87.19 (6.13)		
Woman	334(90)	32.64 (2.73)			26.04 (3.01)			28.80 (2.00)			87.49 (5.18)		
Marriage			−2.504	0.013		−1.187	0.236		2.332	0.020		−1.118	0.264
Married	130(35.0)	32.20 (2.69)			25.82 (2.90)			29.12 (1.85)			87.14 (4.60)		
Unmarried	241(65.0)	32.94 (2.72)			26.21 (3.20)			28.63 (2.14)			87.78 (5.60)		
Level			1.552	0.187		0.739	0.566		1.206	0.308		1.206	0.308
N0	59(15.9)	33.29 (3.03)			26.27 (3.24)			28.69 (2.28)			88.25 (5.92)		
N1	161(43.4)	32.81 (2.70)			26.16 (3.10)			28.85 (1.96)			87.82 (5.23)		
N2	115(31.0)	32.32 (2.58)			25.72 (3.02)			28.59 (2.17)			86.63 (5.02)		
N3	22(5.9)	32.27 (2.37)			26.77 (3.70)			29.32 (1.67)			88.36 (5.20)		
N4	14(3.8)	32.21 (3.21)			26.07 (2.13)			29.57 (1.50)			87.86 (4.77)		
Academic qualifications			−0.845	0.398		0.633	0.527		−0.013	0.989		−0.075	0.940
Vocational college English	46(12.4)	32.80 (2.74)			25.80 (3.56)			28.80 (2.00)			87.41 (5.89)		
Undergraduate degree	325(87.6)	32.66 (2.73)			26.11 (3.03)			28.80 (2.07)			87.58 (5.19)		
Working hours			2.617	0.035		1.045	0.384		0.579	0.678		0.926	0.449
Less than one year	46(12.4)	33.37 (3.25)			26.17 (3.38)			28.67 (2.41)			54.04 (5.73)		
1–3 years	126(34.0)	33.06 (2.52)			26.27 (2.97)			28.68 (2.08)			54.63 (5.57)		
3–5years	86(23.2)	32.45 (2.80)			22.53 (3.11)			28.80 (1.95)			55.38 (5.43)		
5–10years	101(27.2)	32.18 (2.45)			26.32 (3.16)			28.92 (2.00)			54.03 (4.98)		
Over 10 years	12(3.2)	31.92 (3.58)			25.50 (2.74)			29.50 (1.45)			55.92 (4.25)		

Note: Data are Mean (SD).

data were described by case number and constituent ratio, and inter-group differences were compared via the Chi-square test. GraphPad Prism 8.0.2 was used to draw relevant statistical graphs and charts.

Multivariate Logistic regression model was used to explore the independent influencing factors of UE in hospitalized patients with PR. All statistical tests were two-sided with the significance level set at $\alpha=0.05$, and $P<0.05$ was regarded as statistically significant.

Results

This study spanned from 2018 to 2021, with data analyzed annually. The main statistical indicators included total hospitalization days, total PR application days, total UE cases and PR-related UE cases. The total hospitalization days from 2018 to 2021 were 204,629, 286,506, 284,795 and 356,927 days respectively; the total PR application days were 8787, 10,813, 10,105 and 9900 days in sequence. Correspondingly, the PR utilization rates were 4.29%, 3.77%, 3.55% and 2.77%; the numbers of PR-related UE cases were 78, 82, 41 and 24; the daily incidence of PR-related UE were 0.89%, 0.76%, 0.41% and 0.24%. The total UE cases were 165, 198, 131 and 78, and the proportion of PR-related UE accounted for 47.27%, 41.41%, 31.30% and 30.77% respectively (Table 2). After the implementation of standardized and multi-dimensional restraint nursing interventions, the clinical PR utilization rate decreased year by year in the order of 2021 < 2020 < 2019 < 2018, with a statistically significant overall inter-group difference ($\chi2=1006.300$, $P<0.0001$), and significant differences were observed in all pairwise comparisons ($P<0.0001$) (Figure 4A). The annual average score of hospital-wide PR nursing quality assessment increased steadily from 2019 to 2021, which were 84.40, 91.73 and 93.45

Table 2 Various Data of Inpatients in the Hospital During Four Phases from 2018 to 2021

Annual	Total PR Days	Total Hospitalization Days	PR Utilization rate	Total UE Cases	Cases of PR-Related UE	Daily Incidence of PR-Related UE	Proportion of PR-Related UE
2018	204,629	8787	4.29%	165	78	0.89%	47.27%
2019	286,506	10,813	3.77%	198	82	0.76%	41.41%
2020	284,795	10,105	3.55%	131	41	0.41%	31.30%
2021	356,927	9900	2.77%	78	24	0.24%	30.77%

Note: PR utilization rate = (Total PR days/Total hospitalization days) × 100%, Daily incidence of PR-related UE = (Cases of PR-related UE/Total PR days) × 100%, Proportion of PR-related UE = (Cases of PR-related UE/Total UE cases) × 100%.

points respectively (Figure 4B). The daily incidence of PR-related UE also declined annually with significant overall statistical difference ($\chi2$=46.123, P<0.0001). Pairwise comparisons showed no significant difference between 2018 and 2019 (P>0.05), while significant differences existed in other year groups (P<0.05) (Figure 4C). The proportion of PR-related UE presented a downward trend year by year, with statistically significant overall difference ($\chi2$=10.663, P=0.0137). Pairwise comparisons revealed significant differences between 2018 and 2019, as well as between 2018 and 2021 (P<0.05), and an extremely significant difference between 2018 and 2020 (P<0.001), whereas no statistical differences were found among the remaining year groups (P>0.05) (Figure 4D). Note: During the same study period, a special quality control group for catheter nursing was established in our hospital to standardize hospital-wide catheter nursing procedures, leading to a synchronous annual decline in the overall incidence of in-hospital UE (Table 2).

A total of 1874 hospitalized patients receiving PR from 2018 to 2021 were further enrolled and divided into the UE-negative group and UE-positive group according to the occurrence of UE. Univariate analysis indicated that gender ($\chi2$=6.131, P=0.013), age (t=−4.393, P<0.001), involved disease systems ($\chi2$=104.884, P<0.001), consciousness status ($\chi2$=41.318, P<0.001), catheter risk grade ($\chi2$=13.211, P=0.001), accompaniment status ($\chi2$=17.067, P<0.001) and catheter indwelling duration were closely associated with the occurrence of UE. No significant difference was found in surgical-related factors between the two groups (P>0.05) (Table 3). Variables with statistical significance in univariate analysis were included to construct a binary Logistic regression model via dummy variable assignment for screening independent influencing factors of UE. The regression results demonstrated that male gender, advanced age, consciousness disturbance, neurological system involvement and catheter indwelling duration of 1–5 days were independent risk factors for UE, while full-time family accompaniment served as an independent protective factor. After adjustment for confounding factors, catheter risk grading showed no significant independent predictive effect on UE occurrence (P>0.05) (Table 4).

Discussion

This study focused on UE events in patients receiving PR. Taking systematic professional training for nurses as the core measure, we established a PR nursing quality evaluation system on the basis of baseline data and evidence-based clinical findings. Supported by multidisciplinary collaboration, humanized intervention approaches including the hand-shake restraint technique were widely applied. The above strategies effectively reduced the PR utilization rate, daily incidence of PR-related UE and proportion of PR-related UE, and further identified the independent influencing factors for UE occurrence among restrained patients.

Pain Points and Difficulties in PR Practice Improvement and Educational Intervention

The clinical pain points of PR practice and the direction of educational intervention are important bases for this quality improvement and also lay the foundation for subsequent intervention research. Relevant studies have shown that nurses generally have cognitive and attitudinal biases and irrational operations in PR practice, and the correlation between PR and UE is the core target of educational intervention.[24] By reviewing the RCA of PR-related UE events in the past year, this study accurately identified key failure links, clarified the occurrence rules of events, and provided data support for formulating targeted intervention strategies.[25] The survey on nurses' PR KAP found that the score of the knowledge

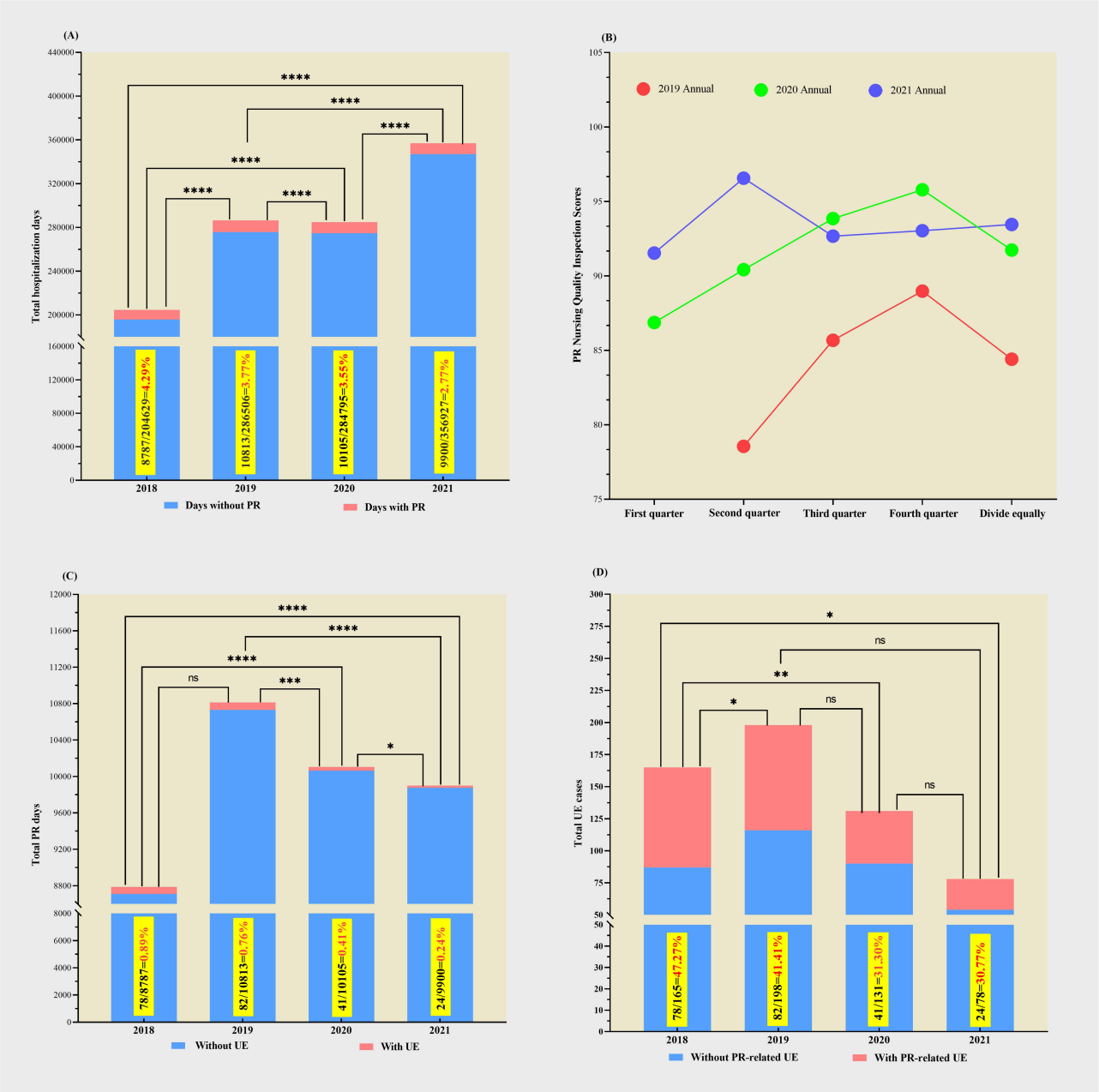

Figure 4 Comparison of Key Monitoring Indicators.

Note: PR = Physical Restraint; UE = Unplanned Extubation. Statistical significance thresholds: ****P<0.0001, ***P<0.001, **P<0.01, *P<0.05, ns, P>0.05. (**A**) PR utilization rate = (Total PR days/Total hospitalization days) × 100%. Hospital-wide PR utilization rates across the four phases (2018–2021) were 4.29%, 3.77%, 3.55% and 2.77%, respectively (COVID-19 patients were excluded in 2020). (**B**) Quarterly scores and annual average scores of PR nursing quality audits (2019–2021). Data for Q1 2019 were unavailable, as the audit form was not yet developed. (**C**) Daily incidence of PR-related UE = (Cases of PR-related UE/Total PR days) × 100%. Hospital-wide daily incidence of PR-related UE across the four phases (2018–2021) was 0.89%, 0.76%, 0.41% and 0.24%, respectively. (**D**) Proportion of PR-related UE = (Cases of PR-related UE/Total UE cases) × 100%. Hospital-wide proportion of PR-related UE across the four phases (2018–2021) was 47.27%, 41.41%, 31.30% and 30.77%, respectively.

dimension showed a trend of "the lower the seniority, the higher the score", which is speculated to be related to junior nurses receiving more on-the-job training and higher frequency of clinical inspections. Although the performance in the knowledge dimension was good, the scores in the attitude and practice dimensions were relatively low, and this phenomenon showed no significant difference among nurses with different demographic backgrounds. The above characteristics formed cross-validation with the results of the quality census, jointly confirming the phenomenon of "the disconnection between knowledge and practice transformation" in the PR field.[26,27] Therefore, to solve the above

Table 3 Univariate Analysis of Influencing Factors of UE Among Hospitalized Patients with PR (N=1874)

Variables	UE-negative Group	UE-positive Group	χ2/t	P
	N=1649	N=225		
Gender			6.131	0.013
Male	889 (53.9)	141(62.7)		
Female	760 (46.1)	84 (37.3)		
Age	64.86 (16.2)	69.96 (17.2)	−4.393	<0.001
Main lesion system			104.884	<0.001
Nervous system	409 (24.8)	121 (53.8)		
Respiratory system	213 (12.9)	36 (16.0)		
Circulatory system	118 (7.2)	17 (7.6)		
Digestive system	607 (36.8)	30 (13.3)		
Urinary system	84 (5.1)	11 (4.9)		
Others	218 (13.2)	10 (4.4)		
Consciousness level			41.318	<0.001
Clear	1082 (65.6)	98 (43.6)		
Unclear	567 (34.4)	127 (56.4)		
Surgery status			3.758	0.053
Surgery	758 (46.0)	88 (39.1)		
Non-surgery	891 (54.0)	137 (60.9)		
Catheter risk grade			13.211	0.001
High-risk	259 (15.7)	34 (15.1)		
Medium-risk	440 (26.7)	36 (16.0)		
Low-risk	960 (57.6)	155 (68.9)		
Companion			17.067	<0.001
None	258 (15.6)	60 (26.7)		
Present	1391 (84.4)	165 (73.3)		
Catheter indwelling days			44.115	<0.001
1~5	380 (23.0)	95 (42.2)		
6~10	502 (30.4)	46 (20.4)		
11~15	359 (21.8)	28 (12.4)		
16~30	212 (12.9)	27 (12.0)		
>30	196 (11.9)	29 (12.9)		

Notes: UE-positive group:unplanned extubation occurring during the restraint period; UE-negative group:No unplanned extubation occurred during the constraint period. High-risk catheters: endotracheal intubation, tracheotomy tube, pericardial drainage tube, thoracic drainage tube, nasoenteric tube, etc. Medium-risk catheters: abdominal drainage tube, wound drainage tube, central venous catheter, hemodialysis catheter, etc. Low-risk catheters: ordinary gastric tube, conventional urinary catheter, peripheral venous indwelling needle, midline catheter, etc.

problems, it is necessary to construct a trinity educational intervention program of "knowledge consolidation, attitude transformation, and behavior correction", strengthen nurses' attitude reshaping and skills training, and provide a scientific basis for formulating targeted nursing quality improvement strategies.

Construction and Clinical Transformation of the PR Nursing Quality Evaluation System

The construction and clinical transformation of the PR nursing quality evaluation index system serve as the core support for this intervention. A study by Tsang et al[28] confirmed that evidence-based tools can optimize patient outcomes, reduce the inappropriate use of PR, and provide medical staff with a structured decision-making framework. However, there is

Table 4 Multivariate Logistic Regression Analysis of Factors Influencing UE in Hospitalized Patients with PR

Variable	B	SE	Wald	P	Exp(B)	95% Confidence Interval for Exp(B)	
						Lower Bound	Upper Bound
Gender (reference: Male)	−0.442	0.160	7.606	0.006	0.643	0.470	0.880
Age	0.025	0.005	23.260	0.000	1.025	1.015	1.036
Nervous system (reference)	–	–	77.543	0.000	–	–	–
Respiratory system	−1.019	0.238	18.327	0.000	0.361	0.226	0.575
Circulatory system	−0.748	0.307	5.940	0.015	0.473	0.259	0.864
Digestive system	−1.828	0.230	63.278	0.000	0.161	0.102	0.252
Urinary system	−0.795	0.366	4.724	0.030	0.452	0.221	0.925
Others	−1.654	0.357	21.415	0.000	0.191	0.095	0.385
Consciousness level (reference: Clear)	0.754	0.157	23.022	0.000	2.125	1.562	2.892
Catheter indwelling 1–5 days (reference)	–	–	42.154	0.000	–	–	–
Catheter indwelling 6–10 days	−1.081	0.206	27.533	0.000	0.339	0.227	0.508
Catheter indwelling 11–15 days	−1.226	0.241	25.956	0.000	0.293	0.183	0.470
Catheter indwelling 15–30 days	−0.817	0.250	10.687	0.001	0.442	0.271	0.721
Catheter indwelling >30 days	−0.789	0.251	9.869	0.002	0.454	0.278	0.743
Companion (reference: None)	−0.552	0.193	8.151	0.004	0.576	0.394	0.841
High-risk catheter (reference)	-	-	0.721	0.697	-	-	-
Medium-risk catheter	−0.181	0.280	0.418	0.518	0.834	0.482	1.445
Low-risk catheter	0.004	0.223	0.000	0.987	1.004	0.648	1.555
Constant	−1.852	0.439	17.780	0.000	0.157		

Notes: Dummy variables were assigned for all categorical variables. The reference groups were male, neurological diseases, clear consciousness, high-risk catheters, no accompanying care, and catheter indwelling duration of 1–5 days, respectively.

still a lack of a standardized PR education and guidance system in current clinical practice, especially insufficient support from senior nursing staff and significant differences in cognition and behavior among the care team (nurses, nursing assistants, caregivers, and family members).[19,29] Therefore, we developed a PR nursing quality evaluation system and promoted its clinical transformation.

Specific measures include: based on the training models proposed by Wang et al[30] and Pu et al,[31] designing a hierarchical and classified education plan to popularize full-process PR nursing knowledge; conducting workshop training for frontline implementers (nurses, nursing assistants, and caregivers), enhancing empathy through simulated restraint experience, and optimizing the PR-related cognition and practical behaviors of nurses and caregivers;[32] at the same time, introducing bedside visual warning signs to address the management pain point of high turnover of caregivers in general wards and improve risk alertness.

In addition, by constructing an AI intelligent decision-making system for "restraint nursing quality evaluation indicators", we realized monthly self-inspection, quarterly inspection, and real-time monitoring, formed closed-loop management, and promoted the transformation of PR nursing quality from experience-based to data-driven.[33] The effective implementation of this system not only significantly reduced the PR utilization rate and UE incidence but also steadily improved the nursing quality assessment scores, serving as an important support for the intervention effect.

Multidimensional Interventions and Innovative Practices

In the practice of improving PR nursing quality, this study broke through the boundaries of traditional medical teams and for the first time included housekeeping company managers in the core intervention team. This targeted the problem of insufficient training coverage caused by the "high turnover and diverse backgrounds" of nursing assistants and caregivers. By extending the management chain, this study effectively enhanced the executability of intervention

measures in actual care scenarios and ensured the comprehensive penetration of the quality improvement plan. Meanwhile, this study constructed a complete implementation pathway of "baseline survey—root cause analysis—evidence-based intervention—effect verification",[34] filling the research gap in the integration of PR nursing quality and UE prevention and control. On this basis, combined with the PDCA cycle and NPT, a multidisciplinary collaborative management system was established to enhance the systematicness and sustainability of intervention measures. Notably, the innovative nursing skill of "hand-shake restraint" with humanistic care became an important feature of this intervention. As a core measure for UE prevention and control, PR is widely used in high-risk groups such as elderly patients and those with cognitive impairment.[35,36] To address the limitation of traditional restraint being "safety-oriented while neglecting humanism", this study introduced the biopsychosocial-spiritual holistic care model, effectively alleviating patients' negative emotions through empathic care. During the restraint process, nurses, caregivers, or family members establish connections through patient-respecting communication methods, while gently holding 1 to 3 fingers of the patient. This replaces the traditional sense of restraint with safe and kind physical interaction, providing patients with psychological "temporary freedom". This method activates patients' internal psychological resources,[37] improves their psychological resilience,[38,39] not only effectively relieves negative emotions such as fear and anger during restraint[40] and improves sleep status,[41] but also promotes treatment compliance by strengthening emotional connections,[16,42] redefining the core value of "equal emphasis on safety and humanism" in restraint nursing. In addition, to ensure the long-term effectiveness of intervention measures, this study emphasized leadership participation and interprofessional collaboration, and continuously optimized intervention measures through regular inspection and feedback mechanisms.[34,42] These achievements provide important practical basis and support for standardizing clinical PR management and balancing clinical safety with patients' rights and interests.

Analysis of Intervention Efficacy and Independent Influencing Factors

The synergistic effect of this multidimensional intervention was the core reason for the substantial reduction in PR utilization rate. The constructed standardized PR nursing quality evaluation system achieved standardized full-process management of PR clinical operations.[23] Systematic training effectively resolved the disconnection between nurses' knowledge, attitude and practice in PR application, and promoted the translation of theoretical knowledge into clinical practice. In addition, correcting the biased cognition that "restraint equates to safety"[34,43] helped nursing staff fully understand how to strike a balance between guaranteeing patient safety and satisfying humanistic care needs in PR practice. Relevant data showed that the hospital's PR utilization rate decreased markedly from 4.29% to 2.77% from 2018 to 2021, with statistically significant inter-group differences ($\chi 2=1006.300$, $P<0.0001$). Meanwhile, the daily incidence and constituent ratio of PR-related UE declined year by year, and the average annual score of hospital-wide PR nursing quality assessment increased from 84.40 points to 93.45 points during 2019–2021.

Univariate analysis and binary Logistic regression analysis confirmed that the independent risk factors for UE in patients with PR were advanced age, consciousness disturbance, neurological diseases, and catheter indwelling duration of 1 to 5 days, whereas female gender and family accompaniment were independent protective factors. Owing to the natural decline in physiological function, elderly patients have poor tolerance to PR. Long-term restraint easily induces adverse physical and psychological reactions, thus increasing the risk of UE. Patients with consciousness disturbance cannot actively cooperate with nursing care, and their impaired cognitive and behavioral competence also puts them at high risk. Patients with neurological diseases often suffer from severe abnormal mental status and behaviors such as restlessness and emotional dysregulation, which further raises the incidence of PR-related UE. In addition, the first 1 to 5 days after catheterization was identified as a high-risk period for UE. This may be related to severe physical discomfort in the early catheter indwelling stage and inadequate focused nursing supervision by clinical nurses during this period. This result suggests that individualized nursing interventions and intensive monitoring should be strengthened in the early phase of catheter placement. By comparison, female patients have more stable emotions and better nursing cooperation, which lowers UE risk. Family caregivers can assist in daily supervision and ease patient restlessness, which reflects the importance of family-participatory nursing.[16,42] The above conclusions not only define clear directions for targeted interventions, but also offer practical references for optimizing PR nursing strategies in clinical settings.

Limitations and Improvement Directions of PR Practice

Although this study significantly reduced the PR utilization rate and the incidence of PR-related UE, further analysis revealed that approximately 70% of UE events involved low-risk catheters (such as ordinary gastric tubes, urinary catheters, etc). This finding prompts us to reflect on the current management model of UE. If UE of some low-risk catheters is excluded from the statistics of adverse events, it can not only effectively reduce the psychological pressure on nurses, but also further reduce the use of PR.[13,43] At the same time, adverse extubation events should be linked to doctors' clinical decisions, because not all extubations require re-intubation. This suggests that the medical team needs to more strictly implement the concept of "early extubation" to optimize catheter management from the source. A study showed that under high-frequency and low-frequency PR strategies, although the dosage of sedative drugs and the actual sedation depth were comparable, there were no significant differences between the two groups in adverse events such as delirium, coma, self-extubation and catheter displacement.[44] This indicates that high-frequency PR strategies may not bring additional safety benefits, while low-frequency PR strategies may be more conducive to improving the humanism and safety of nursing practice by reducing unnecessary restraints. This further supports the potential feasibility and necessity of reducing PR and optimizing extubation management.

Limitations and Future Recommendations

This study has certain limitations. Firstly, it is a single-center retrospective study, with all research subjects recruited from a tertiary Grade A hospital in Zhejiang Province. The limited sample representativeness means that the results cannot be directly generalized to primary care institutions and medical facilities in other regions. Secondly, only 4 years of clinical data from 2018 to 2021 were included, and the long-term intervention effects require longer follow-up for verification. Thirdly, there is a lack of data on nurses' PR KAP survey after training. Fourthly, the calculation of PR duration was based on days rather than hours, which may limit the precision of related analyses.

Conclusion

This study constructed a scientific and standardized PR nursing quality evaluation system and innovatively introduced the humanistic care-based "hand-shake restraint" technique, which significantly reduced the PR utilization rate and the incidence of PR-related UE events. Professional training corrected the "disconnection between knowledge, attitude and practice" among nursing staff and improved the standardization of their operations. The study confirmed that male gender, advanced age, consciousness disturbance, and catheter indwelling duration of 1–5 days are risk factors for PR-related UE, while family accompaniment is a protective factor. Specific suggestions for improving nursing practice were put forward, providing an evidence-based basis for clinical nursing management and promoting the transformation of PR practice towards standardization and humanization.

Data Sharing Statement

Regarding the data presented in this paper, the corresponding author (Lu Lifen) can provide it upon formal request from scientific peers or relevant parties to facilitate in-depth communication and application of the research.

Ethical Considerations

This study was approved by the Ethics Committee of the Fourth Affiliated Hospital, Zhejiang University School of Medicine (Approval Number: K2021099). It was conducted in strict accordance with the ethical principles, protocols, and guidelines set forth in the Declaration of Helsinki. Prior to participation, the guardians of all participants provided written informed consent, fully meeting the study's requirements.

Acknowledgment

We extend our gratitude to everyone involved.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This research was independently funded by the authors without external financial support.

Disclosure

The authors state no conflicts of interest regarding this work.

References

1. Albalat-Rodríguez A, Fernández-García A, Hernández-De Arribas V, et al. Physical restraint use in acute care hospitals: a diagnostic study on knowledge, documentation, and patient safety from a humanization perspective. *Healthcare*. 2026;14(5):694. doi:10.3390/healthcare14050694
2. Berger S, Grzonka P, Amacher SA, Hunziker S, Frei AI, Sutter R. Adverse events related to physical restraint use in intensive care units: a review of the literature. *J Intensive Med*. 2023;4(3):318–325. doi:10.1016/j.jointm.2023.11.005
3. Özdemir Y, Uslu Y. Physical restraint-related skin injuries among patients in intensive care: a prospective cohort study. *Adv Skin Wound Care*. 2026;39(2):E93–E99. doi:10.1097/ASW.0000000000000399
4. Sonneville R, Couffignal C, Sigaud F, et al. Restrictive use of restraints and delirium duration in the intensive care unit (R2D2-ICU): protocol for a French multicentre parallel-group open-label randomised controlled trial. *BMJ Open*. 2024;14(4):e083414. doi:10.1136/bmjopen-2023-083414
5. Okumura Y, Sakata N, Ogawa A. Association of physical restraint duration and undesirable outcomes amongst inpatients comorbid with dementia and pneumonia in acute care settings. *J Clin Nurs*. 2023;32(17–18):6394–6402. doi:10.1111/jocn.16643
6. Delgado SA. Physical restraints: protecting patients or devices? *Am J Crit Care*. 2020;29(2):103. doi:10.4037/ajcc2020742
7. Nielson S, Bray L, Carter B, Kiernan J. 'In the midst of a thunderstorm': young people's experiences of physical restraint in inpatient mental health services in the UK. *Int J Ment Health Nurs*. 2026;35(1):e70209. doi:10.1111/inm.70209
8. Girard TD, Thompson JL, Pandharipande PP, et al. Clinical phenotypes of delirium during critical illness and severity of subsequent long-term cognitive impairment: a prospective cohort study. *Lancet Respir Med*. 2018;6(3):213–222. doi:10.1016/S2213-2600(18)30062-6
9. Ye J, Wang C, Xiao A, et al. Physical restraint in mental health nursing: a concept analysis. *Int J Nurs Sci*. 2019;6(3):343–348. doi:10.1016/j.ijnss.2019.04.002
10. Cui N, Qiu R, Zhang Y, Jin J. "patient comfort can be sacrificed for patient safety"-perception and practice reported by critical care nurses toward physical restraints: a qualitative descriptive study. *Front Med*. 2021;8:573601. doi:10.3389/fmed.2021.573601
11. Lao Y, Chen X, Zhang Y, Shen L, Wu F, Gong X. Critical care nurses' experiences of physical restraint in intensive care units: a qualitative systematic review and meta-synthesis. *J Clin Nurs*. 2023;32(9–10):2239–2251. doi:10.1111/jocn.16528
12. Smithard D, Randhawa R. Physical restraint in the critical care unit: a narrative review. *New Bioeth*. 2022;28(1):68–82. doi:10.1080/20502877.2021.2019979
13. Via-Clavero G, Sanjuán-Naváis M, Romero-García M, et al. Eliciting critical care nurses' beliefs regarding physical restraint use. *Nurs Ethics*. 2019;26(5):1458–1472. doi:10.1177/0969733017752547
14. Lei R, Jiang X, Liu Q, He H. Nurse education to reduce physical restraints use in ICU: a scoping review. *Nurs Crit Care*. 2022;27(6):824–837. doi:10.1111/nicc.12557
15. Vidal P, Lambert C, Pereira B, et al. Stepped wedge cluster randomised controlled trial to assess the impact of a decision support tool for physical restraint use in intensive care units (ARBORea Study): a study protocol. *BMJ Open*. 2025;15(5):e085674. doi:10.1136/bmjopen-2024-085674
16. Cui N, Yan X, Zhang Y, et al. Non-pharmacological interventions for minimizing physical restraints use in intensive care units: an umbrella review. *Front Med*. 2022;9:806945. doi:10.3389/fmed.2022.806945
17. Doğu Ö, Bozkurt R, Ziyai NY, Doğan HK, Süner KÖ, Erdem AF. A comparison of restraint decision tools in intensive care unit: an observational cross-sectional study. *Nurs Crit Care*. 2026;31(2):e70358. doi:10.1111/nicc.70358
18. Otani K, Yamada K, Terada M, et al. Multidisciplinary Team intervention successfully reduces physical restraint use in a Japanese acute care hospital. *Asian J Psychiatr*. 2025;114:104766. doi:10.1016/j.ajp.2025.104766
19. Luo R, Yu M, Zhou C, et al. Development and validation of clinical practice standards for physical restraint in hospitalized patients: a multi-method study. *J Multidiscip Healthc*. 2025;18:7919–7931. doi:10.2147/JMDH.S541461
20. Giacino JT, Katz DI, Schiff ND, et al. Practice guideline update recommendations summary: disorders of consciousness: report of the guideline development, dissemination, and implementation subcommittee of the American academy of neurology; the American congress of rehabilitation medicine; and the national institute on disability, independent living, and rehabilitation research. *Neurology*. 2018;91(10):450–460. doi:10.1212/WNL.0000000000005926
21. Murray E, Treweek S, Pope C, et al. Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. *BMC Med*. 2010;8:63. doi:10.1186/1741-7015-8-63
22. Kor PP, Kwan RYC, Liu JY, Lai C. Knowledge, practice, and attitude of nursing home staff toward the use of physical restraint: have they changed over time? *J Nurs Scholarsh*. 2018;50(5):502–512. doi:10.1111/jnu.12415
23. Hu Y, Huo J, Zou H, et al. Construction of evaluation index system for nursing quality of physical restraint in ICU patients. *J Nurs Sci*. 2025;40(11):1148–1153. doi:10.16821/j.cnki.hsjx.2025.11.005

24. Cui N, Long M, Zhou S, Zhang T, He C, Gan X. Knowledge, attitudes, and practices of chinese critical care nurses regarding physical restraint. *J Contin Educ Nurs*. 2019;50(3):121–126. doi:10.3928/00220124-20190218-07
25. Spaar P, Krevat SM, Boxley CL, Mohan V, Ratwani RM, Gold JA. Analysis of patient safety event report to understand the contribution of health IT to diagnostic error. *J Patient Saf*. 2026;22(2):162–167. doi:10.1097/PTS.0000000000001434
26. Gupta I, Nelson-Greenberg I, Wright SM, Harris CM. Physical restraint usage in hospitals across the United States: 2011-2019. *Mayo Clin Proc Innov Qual Outcomes*. 2024;8(1):37–44. doi:10.1016/j.mayocpiqo.2023.12.003
27. Almomani MH, Khater WA, Qasem BAA, Joseph RA. Nurses' knowledge and practices of physical restraints in intensive care units: an observational study. *Nurs Open*. 2020;8(1):262–272. doi:10.1002/nop2.625
28. Tsang LF, So KF, Ng CF, et al. Development of an evidence-based instrument to justify the use of physical restraint in general adult ward settings: a systematic review. *J Patient Saf*. 2025;21(7):e126–e144. doi:10.1097/PTS.0000000000001380
29. Teece A, Baker J, Smith H. Identifying determinants for the application of physical or chemical restraint in the management of psychomotor agitation on the critical care unit. *J Clin Nurs*. 2020;29(1–2):5–19. doi:10.1111/jocn.15052
30. Wang L, Zhu XP, Zeng XT, Xiong P. Nurses' knowledge, attitudes and practices related to physical restraint: a cross-sectional study. *Int Nurs Rev*. 2019;66(1):122–129. doi:10.1111/inr.12470
31. Pu P, Tu X, Yang L, et al. Design of physical restraint training and its application among neurosurgical intensive care unit nurses. *Chin J Nurs Educ*. 2025;22(5):585–591. doi:10.3761/j.issn.1672-9234.2025.05.012
32. Eweida RS, Altheeb M, Ali F, et al. Nurses' emotional regulation capacity as a determinant of attitudes and practice toward physical restraint in psychiatric institutions: a quantitative survey. *J Psychosoc Nurs Ment Health Serv*. 2026:1–4.doi:10.3928/02793695-20260417-01
33. Arnold PB, Tate MD, Holmes-Green L, et al. Structured quality improvement to reduce hospital-acquired pressure injuries. *J Patient Saf*. 2025;21(6):437–443. doi:10.1097/PTS.0000000000001363
34. Abraham J, Neef R, Meyer G, Möhler R. Entwicklung und Machbarkeit einer Intervention zur Vermeidung freiheitsentziehender Maßnahmen im Krankenhaus [Development and feasibility of an intervention to reduce physical restraints in hospitals: a mixed methods study]. *Pflege*. 2022;35(3):155–163. doi:10.1024/1012-5302/a000864
35. Chien CF, Huang LC, Chang YP, Lin CF, Hsu CC, Yang YH. What factors contribute to the need for physical restraint in institutionalized residents in Taiwan? *PLoS One*. 2022;17(11):e0276058. doi:10.1371/journal.pone.0276058
36. Pu H, Zhang X, Luo L, et al. Use of physical restraints and its associated risk factors in the aged care facilities: a multicentre cross-sectional study. *J Clin Nurs*. 2023;32(13–14):3504–3515. doi:10.1111/jocn.16406
37. Lu L, Zheng L, Zhu Q, et al. Current landscape and multidimensional determinants of spiritual coping mechanisms among tuberculosis patients in zhejiang, china: a population-based cross-sectional investigation. *Risk Manag Healthc Policy*. 2025;18:2445–2459. doi:10.2147/RMHP.S532707
38. Lu L, Zheng G, He J, et al. Stress response and influencing factors among fever outpatients and children's families during normalisation of the COVID-19 epidemic: a cross-sectional study. *Nurs Open*. 2023;10(5):3285–3294. doi:10.1002/nop2.1580
39. Chen Q, Lin R, Zhu X, et al. Pathway analysis of psychological resilience levels and influencing factors in ICU physically restraint patients. *Chin J Crit Care Nurs*. 2024;5(1):10–15. doi:10.3761/j.issn.2096-7446.2024.01.001
40. Lu L, Sheng D, Xia X, et al. Emotional responses of hospital staff to the DASS-21 survey during mass COVID-19 testing after the relaxation of prevention and control measures in Zhejiang, China, and their change trajectory. *Risk Manag Healthc Policy*. 2024;17:2467–2482. doi:10.2147/RMHP.S475482
41. Lu L, Sheng D, Zhu Y, et al. Nurses' sleep quality and its influencing factors during the first explosive COVID-19 outbreak in Zhejiang, China, after the relaxation of epidemic prevention and control measures: a multicentre cross-sectional study. *Nurs Open*. 2025;12(1):e70127. doi:10.1002/nop2.70127
42. Alostaz Z, Rose L, Mehta S, Johnston L, Dale C. Physical restraint practices in an adult intensive care unit: a prospective observational study. *J Clin Nurs*. 2023;32(7–8):1163–1172. doi:10.1111/jocn.16264
43. Cui N, Qiu R, Zhang Y, et al. Why are physical restraints still in use? A qualitative descriptive study from Chinese critical care clinicians' perspectives. *BMJ Open*. 2021;11(11):e055073. doi:10.1136/bmjopen-2021-055073
44. Sonneville R, Couffignal C, Sigaud F, et al. Restrictive vs liberal physical restraint strategies in critically ill patients: the R2D2-ICU randomized clinical trial. *JAMA*. 2026;335(14):1232–1242. doi:10.1001/jama.2026.2897