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Table of Contents

- 1 Nonverbal Communication in Dementia Care: A Review of Its Application and Influence on Patients' Quality of Life**
Lijia Liu, Di Wang

- 11 Firsekibart in Reducing High-Sensitivity C-reactive Protein Levels of Gout**
Yu Xue, Yi Li, Yuling Lian, Fei Gu, Chunxia Chen, Qian Xu

- 19 The Optimization of the Handover Process Between the Disinfection Supply Center and the Geriatric Department Material Promotes the Prevention and Control of Hospital Infection**
Fengjuan Wang, Jiawei Zhang

- 24 Effectiveness of a Phase I Cardiopulmonary Rehabilitation Nursing Protocol on Functional Outcomes in Patients after Open Type A Aortic Dissection Surgery: A Case-Control Study**
Hui Yang

- 30 Practice and Effectiveness Analysis of Electricity Conservation in Pediatric Wards Based on a Multi-Dimensional Collaborative Intervention Strategy**
Ruizhi Huang, Qiuqing Jin, Jialin Ye

- 38 Analysis of the Effectiveness of Precision Nursing Based on the KANO Model in Improving Health Outcomes for Patients with Threatened Abortion**
Yongju Xu, Jianying Zhu, Jiamin Xu, Xiaoqun Zhang, Li Wen

- 44 Application and Development of Nursing Education in the Emergency Department and Surgical Critical Care**
Feifei Liang

- 51 Yinao Capsules Combined with Memantine Hydrochloride in the Treatment of Alzheimer's Disease in the Elderly**
Jian Zhao, Xuelian Jia

- 59 Application of the MDT Clinical Teaching Model in Screening for Geriatric Sarcopenia and Nutrition Intervention Education**
Qing Ma

- 65 Effect of Magnesium Sulfate Wet Compress Intervention During the Second Stage of Labor on Maternal and Neonatal Outcomes in Vaginal Delivery**
Qian Ye, Shaoxin Kong, Meifang Yuan, Yinmei Huang, Chunqi Hu
- 71 Application Effect of Team Responsibility System Nursing in the Care of Patients in the Intensive Care Unit**
Lingyu Li, Xiang Ma, Jiao Yan, Haijing Han
- 77 Summary of the Best Evidence for Wound Care Management in Pediatric Burn Patients**
Yu Bian, Jing Yang, Rongmei Geng, Liping Li, Yuting Zheng
- 90 Summary of Best Evidence for Disease Management of Primary Nephrotic Syndrome in Children**
Jing Yang, Yu Bian, Xiaojie Zhang, Yihua Fang, Yuting Zheng
- 103 Research on the Exploration and Implementation Methods of Ideological and Political Education Elements in Internal Medicine Nursing Teaching from the Perspective of Teachers' and Students' Sense of Gain**
Ping Li, Rui Tao, Ronglin Lin, Tingxi Li, Wei Wang, Ting Jiang, Ying Hu, Zhixia Yang, Min Lu

Nonverbal Communication in Dementia Care: A Review of Its Application and Influence on Patients' Quality of Life

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Abstract: *Objective:* To review the mechanism, application scenarios, and existing problems of nonverbal communication in improving dementia patients' quality of life and to provide a reference for nursing practice and future research. *Methods:* Literature related to "dementia", "non-verbal communication", and "quality of life" published from 202 to 2024 was searched through CNKI, Wanfang, PubMed, etc., are included in studies on clinical nursing, non-pharmacological interventions, and communication strategies for narrative integration. *Results:* Existing studies show that nonverbal communication elements (eyes, gestures, touch, spatial distance, intonation, and environmental cues) can improve patients' subjective security and quality of life through cognitive activation, emotion regulation, memory arousal, behavioral stability, self-care promotion, and social participation. Application needs and implementation priorities differ across hospitals, elderly care institutions, and home care. Current evidence is limited by small sample sizes, high heterogeneity, and a lack of standardized assessment tools and high-quality randomized controlled trials. *Conclusion:* Nonverbal communication is a key nursing strategy to compensate for language barriers and improve quality of life in dementia care. In the future, it is necessary to establish a unified evaluation system, conduct high-quality multi-center research, and explore AI's potential to support objective quantification and individualized intervention of nonverbal signals.

Keywords: Dementia; Touch; Facial expression; Gesture; Intonation

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1. Introduction

Dementia is a primary cause of disability and dependency in aging societies across the world. The global prevalence of dementia continues to rise, significantly increasing the pressure on healthcare and caregiving systems ^[1]. As the disease progresses, patients experience gradual impairment of language expression, comprehension, and executive functioning. Traditional care interaction models centered on verbal commands have become less effective, and unmet needs can easily manifest as behavioral issues such as anxiety, agitation, and

refusal of care, further eroding the quality of life (QoL) ^[2-4]. Compared with verbal processing, many patients with moderate-to-severe dementia retain partial abilities to perceive and emotionally interpret nonverbal cues, such as facial expressions, touch, intonation, rhythm, spatial distance, and familiar objects ^[5-6]. Therefore, systematically utilizing nonverbal communication (NVC) to support information exchange, emotional soothing, and social connection is recognized as a critical nursing strategy to compensate for language barriers, preserve dignity, and enhance QoL ^[7-9].

Despite a significant increase in research on nonverbal communication interventions over the past decade—including touch, gaze/facial expressions, gestures, music and rhythm, spatial and environmental optimization, identity/appearance consistency, and multimodal perception with AI assistance—the evidence base remains constrained by heterogeneous intervention composition and dosage descriptions, inconsistent implementation, a lack of objective quantification, and fragmented QoL-related outcomes.

This review synthesizes nursing and related interdisciplinary literature from 2002 to 2024, elucidating the key elements and pathways of action, comparing application differences across scenarios, summarizing existing challenges, and proposing future research and practical directions. This provides evidence for the development of standardized and contextualized nursing strategies.

2. Conceptual definition and characteristics of communication impairment in dementia

2.1. Definition of nonverbal communication

Nonverbal communication is a multimodal process that conveys information and regulates interactions without relying on spoken or written language. It utilizes facial expressions, eye contact, gestures, body posture and movement, touch, spatial distance and positioning, paralinguistic features (intonation, volume, speech rate, rhythm, pauses), appearance and identity markers, and environmental/physical cues (lighting, color, familiar objects, sounds, smells, etc.) to convey information and regulate interactions ^[5-6]. This concept originated from early research on “body language”, which subsequently incorporated dimensions such as eye contact, facial expressions, touch, and spatial cues in communication. Wanko Keutchafo et al. further expanded it to include personal positioning, appearance, and environmental factors, establishing it as a crucial channel in dementia care for compensating for language deficits, sustaining the expression of needs, and regulating emotions ^[10].

Based on nursing practice and intervention feasibility, nonverbal communication can be categorized as follows: (1) Visual and Postural/Facial: Gentleness of expression, consistency of smiling, duration of eye contact, body orientation, and gestural demonstration ^[3]; (2) Tactile: Forewarned light touch, supportive handholding, and rhythmic stroking ^[4, 9]; (3) Paralinguistic/Acoustic: Affable tone, slowed speech rate, volume control, and rhythmic structure with pauses ^[3, 7]; (4) Spatial and Kinesthetic: Angle of entry into visual field, 45° lateral-anterior approach, interactive distance, and synchronized movement/rhythm ^[11]; (5) Environmental and Object Cues: Familiar photographs and personalized furnishings, noise and glare control, and soothing music ^[5-6]; (6) Appearance and Identification: Uniform work attire, name tags, neatness, and recognizability ^[12-13]; (7) Multimodal Integration and Technology Support: Sensor, video, and AI recognition feedback assistance ^[11]. This classification emphasizes quantifiable and trainable intervention units, providing a framework for subsequent dose titration, implementation consistency, and mechanistic chain development.

2.2. Communication impairments in dementia and residual capabilities

Dementia involves network degeneration across multiple brain regions (particularly the left temporal, parietal, and frontal lobes), impairing semantic retrieval, syntactic processing, working memory, and executive function. This manifests as word-finding difficulties, speech simplification, and impaired comprehension of complex instructions^[2–3]. Slowed information processing and reaction times further impair recognition and verbal expression of basic needs, such as pain or thirst, diminishing the quality of life^[14]. Relatively, processing of emotional salience, recognition of basic facial expressions and affective intonation, along with nonverbal channels such as rhythm and tactile cues, show delayed impairment in mid-stage disease^[6], forming exploitable residual “islands of function.” Based on emotion salience and multisensory integration theories, cues such as facial expressions, gaze, intonation, rhythm, and tactile feedback can enhance attention orientation and situational inference while reducing the cognitive load on language and executive circuits, thereby amplifying residual communication abilities^[7–8]. Therefore, nursing assessments should focus on the imbalance between “impaired language” and “relatively preserved emotion/multisensory processing.” Strategically employing slowed, clear speech, short sentences, synchronized gestures, emotional intonation, appropriate tactile cues, and intuitive objects or visual aids can enhance information transfer efficiency while preserving patient dignity and establishing a foundation for patient-centered communication.

3. Search and data sources

This review retrieved literature published from January 2002 to June 2024 from CNKI, Wanfang, VIP, PubMed, and Web of Science. Search terms: (dementia OR Alzheimer*) AND (“nonverbal communication” OR gesture OR “eye contact” OR touch OR proxemics OR paralinguistic OR “environmental cues”) AND (“quality of life” OR mood OR behavior OR ADL OR “social participation”). Supplementary manual tracing of the references. Included: Clinical or care studies on patients with dementia (interventions, observational, qualitative, mixed-methods) with explicit links to nonverbal elements; excluded: studies solely on medication, single-case reports, conference abstracts without full-text access.

4. Effects of nonverbal communication mechanisms on dimensions of quality of life

4.1. Cognitive facilitation (attention and orientation support)

“Cognitive facilitation” refers to the process of externalizing task steps through structured, predictable, multimodal, nonverbal cues, thereby offloading the working memory and semantic retrieval burdens. This enhances attention orientation, command compliance, and completion rates of activities of daily living (ADL) steps. Wanko Keutchafo et al.’s review indicates that gaze, facial expressions, gestures, spatial positioning, tactile cues, and rhythmic intonation collectively form an “external working memory scaffold”, substituting sequential cues for internal retention^[10]. Communication adaptation studies have demonstrated that adjusting speech rate/pauses to match the patient’s processing speed while synchronizing pointing and sequential gestures improves instruction decoding and reduces mis-initiation^[7–8]. Results from Gitlin et al.’s RCT and domestic activity-customized studies indicate that step-by-step verbal cues combined with redundant pointing gestures, facial “start-maintain-end” markers, rhythmic slowed intonation, 45° lateral-frontal visual field entry paired with “anticipatory light touch”, and single-sample presentation can improve step completion and duration in sequential tasks such as eating, dressing, and personal hygiene while enhancing self-efficacy^[4, 11].

Current evidence is limited by the lack of standardization in intervention dosage and implementation consistency (no systematic reporting of gesture frequency, eye contact proportion, tactile cue hierarchy, or number of simultaneously presented objects), outcomes predominantly consisting of macro-level or subjective metrics, absence of process-oriented objective data such as eye-movement tracking, action-posture synchronization indices, and response latency, and insufficient examination of moderating or mediating effects related to disease stage, sensory function, and cultural differences. To enhance comparability and mechanism validation, it is recommended to establish a minimum reporting set (gesture frequency per minute, speech rate and pause structure, tactile cue hierarchy, number of simultaneously visible objects), introduce multimodal quantification using video, wearable, and acoustic data, and validate the pathway “attention maintenance → reduced error rate → functional improvement” using multi-level or structural equation modeling. Additionally, stratification by disease stage, sensory status, and cultural preferences should be conducted [7–8, 10].

4.2. Memory retrieval

Memory loss is a core symptom of dementia. The progressive forgetting of past events and significant individuals (relatives and spouses) continuously erodes patients’ sense of identity and amplifies orientation anxiety [1–3]. Against the backdrop of declining verbal processing, nonverbal, multisensory, and emotionally potent cues emerge as compensatory pathways. Nonverbal cues bridge the externalization of autobiographical and situational emotional memories: familiar objects (old photographs, habitual tools), personalized contextual arrangements (family or occupational symbols), rhythmic touch, and emotional intonation can trigger synergistic scene re-enactment and emotional tagging, reducing anxiety caused by temporal and personal misattribution [3–4, 7–8]. Multisensory/multimodal environmental stimuli (targeted lighting + vintage music + visual nostalgia displays) enhance memory retrieval fluency by activating residual affective-sensory pathways [5–6]; Music and rhythmic interventions (tapping, rhythmic gestures) provide a “beat framework” for procedural and emotional memory, encouraging patients to hum along or mimic movements [15–16]; Anthropomorphic or symbolic objects (dolls) provide tactile-visual dual input, enhancing emotional memory network activation and buffering experiences of loneliness and identity drift [17–18]; Evidence indicates that multisensory stimulation yields higher response rates than single-channel stimulation in evoking “narratable fragments” and emotional positivization. However, the heterogeneity across studies partly stems from the unstandardized stimulation intensity and individualized matching of participants. Future research should quantify memory recall quality using objective metrics (reaction time and automatic facial emotion encoding) [4, 6, 9, 19].

4.3. Emotional regulation and security

Nonverbal communication serves as a channel for information exchange and is a critical medium that influences patients’ emotional states. The emotional regulation function of nonverbal communication relies on the synergistic modulation of autonomic arousal, threat assessment, and social soothing cues, such as soft tones, slow approaches, anticipatory touch, and stable facial expressions, which collectively reduce sympathetic arousal and minimize startle responses and resistance. Tactile contact and mirrored facial expressions promote oxytocin/endorphin-related calming responses [8]. Liao Aiwu et al. noted that appropriate distance, neat appearance, appropriate eye contact, and friendly expressions can alleviate anxiety and fear in dementia patients [13]. More importantly, these carefully calibrated nonverbal cues allow patients to genuinely perceive caregivers’ warmth, kindness, and respect. This fosters a crucial sense of security and belonging at the psychological level, enabling patients to experience

warmth, intimacy, and respect. Concurrently, Zhao Yan et al.'s research on doll therapy supports this conclusion: nonverbal interactions with dolls create a sense of companionship, reducing loneliness and depressive moods while effectively buffering underlying depressive tendencies, thereby providing indispensable emotional relief to older adults ^[20]. Furthermore, the background environment (uniform lighting, noise < 55 dB, low-intensity familiar music) combined with identity recognition (uniform appearance, name tags) jointly creates a “predictable-low-threat” situational framework, reducing agitation triggers ^[12–13]. Comprehensive interventions demonstrated effects on moderately reduced anxiety, depression, and agitation. However, many studies lack objective physiological synchronization evidence (skin conductance and heart rate variability). Future research should incorporate multimodal physiological data collection and standardized nonverbal dose recordings to confirm these causal links.

4.4. Behavioral synchrony and stability

Agitated behaviors (such as shouting, aggression, and refusal of care) are common and challenging psychosocial symptoms in patients with dementia ^[21]. Behavioral synchrony and rhythmic coordination in interactions are key nonverbal mechanisms for reducing misinterpretation and agitated behaviors: caregivers establish an immediate collaborative framework by matching the patient's current movement speed, sitting height, and micro-gestures (nodding, breathing rhythm), thereby diminishing the perceived power imbalance between “control and being controlled” and reducing defensive behaviors ^[3–4, 7]. During initial and sustained interactions, caregivers match patients' movement speed, seating height, and nodding/breathing rhythms while guiding the interaction pace through gradual deceleration and clear pauses foster the perception of “support rather than imposition” ^[3–4, 7, 19]. Adapting the speech rate and pause structure reduces cognitive processing load and defensive responses ^[3, 7]. Forewarned light touch and postural synchronization have been reported to correlate with reduced aggression and shouting ^[8, 19]. Home care observations also indicate that tailored nonverbal interactions—such as timely eye contact, emotionally congruent smiles, brief repetitive questioning, and gentle shoulder taps—can restore a sense of being understood and calm agitated emotions ^[10]. Complementary environmental and spatial strategies (avoiding sudden approaches from behind, maintaining a visible side-front angle, establishing clear personal space boundaries, low noise levels, and procedural cues) further reduce the triggering of external stimuli ^[9, 19]. Multicomponent nonverbal interventions integrating synchrony and contextual adaptation elements have shown moderate effects in multiple studies, reducing agitation frequency or intensity and potentially yielding indirect improvements in quality-of-life measures (though still constrained by a lack of operational standardization and objective synchrony metrics) ^[6, 10, 19].

4.5. Self-Efficacy and functional maintenance

Increasing evidence suggests that optimized nonverbal communication is associated with enhancements in key dimensions of quality of life for individuals with dementia (including autonomy, sense of dignity, safety, social engagement, emotional well-being, and reduced caregiver burden. Preserving functional independence and self-efficacy adheres to the “Minimal Sufficient Cueing” principle: sequential gesture demonstrations (indicating the next action), contextual pointing (with an open palm directed toward the target object), directional tactile guidance through light touches on the elbow or hand, and distraction-free environments (presenting only the necessary items at a time) work in concert to decrease task complexity and decision/choice load, thereby improving ADL step completion rates ^[11]. Positive facial feedback and intonation (with an encouraging rising pitch) reinforce

patients' sense of self-efficacy, reducing learned helplessness; individualized activity matching (aligning interests with residual abilities) promotes persistence and agency by enhancing the perceived meaning of the intervention; and structured documentation of prompt frequency, prompt level, and patient response (independent/prompted/assisted) facilitates replicable “dose-response” data. Research indicates that in activities such as dressing and eating, gesture cues (precise pointing to fastening locations) paired with encouraging expressions maintain patient autonomy in decision-making while providing necessary support, thus reducing functional decline from over-substitution^[22]. After systematic nonverbal communication training, improvements in independent living skills were observed, along with reductions in safety incidents, such as aspiration and falls, highlighting the dual value of functional maintenance and safety^[23]. Randomized controlled trials and practice trials have shown that integrating nonverbal step-by-step cues with individualized activity plans can maintain or reverse declining ADL trajectories during extended follow-ups, while also reducing caregiver burden scores^[11, 22–23]. Future research should incorporate dual metrics—self-efficacy scales and objective activity tracking (wearable step counts/upper limb movement complexity)—to strengthen the evidence for the mechanism of the intervention.

4.6. Social participation and belonging

In the mid-to-late phases of dementia, compromised language comprehension and expression, along with recurrent verbal frustration, give rise to a “failure-withdrawal-reduced opportunity” cycle. This cycle reduces the frequency of social interactions, exacerbates loneliness, and undermines the dimensions of social participation and belonging in the quality of life. Nonverbal behaviors emerge as essential compensatory mechanisms: body orientation/leaning forward, positioning near group centers, eye contact, and nodding indicate “joining/maintaining attention” or seeking clarification; light touches on forearms, shoulders, or tabletops, combined with gaze, initiate turns, evoke responses, and maintain shared presence; immediate gaze reciprocation, emotional attunement, rhythmic nodding, and subtle posture mirroring from caregivers/peers enhance perceived visibility and interaction effectiveness, mitigating further withdrawal^[3–4, 7, 10]. Structured group activities (music, rhythmic movement, crafts, reminiscence) facilitate access and sustained participation through circle/ring seating, visual object-passing sequences, explicit tactile/visual turn cues, and optimized low noise, familiar object cues, and lighting contrast. Rhythm and synchronized emotional expressions further bolster group identification^[9, 19]. Situational observations indicate that leaning forward, approaching, and touching act as pivotal signals for patients to actively seek inclusion and attention when they are verbally impaired^[24]. Companion objects/comfort dolls, pet interventions, and affective tactile media serve as “emotional anchors” during periods of low motivation or emotional defensiveness, boosting spontaneous initiation rates, response likelihoods, and positive emotion sharing^[17–18]. The integration of comprehensive strategies with person-centered care models significantly elevated group activity attendance, spontaneous nonverbal communication initiation, and subjective sense of belonging. However, current research necessitates addressing the evaluation and quantification of interaction quality metrics, as well as the inadequate cross-cultural adaptation of touch/interpersonal distance protocols.

4.7. Comprehensive quality of life findings

While existing studies predominantly report outcomes in single domains (emotional stability, reduced behavioral issues, improved participation), the integrated mechanism chain reveals that nonverbal communication (NVC) interventions exert their effects through several channels: (1) attention orientation and emotional regulation

(facial expressions, intonation, rhythm); (2) enhanced security and familiarity (environmental/object cues, identity recognizability); (3) guiding execution and intentional behavior (gesture modeling, tactile cues, rhythmic synchronization); and (4) accumulating interaction cycles and a sense of belonging (gaze-nod-posture mirroring loop). These mechanisms collectively reduce the frequency of unmet needs and behavioral and psychological symptoms of dementia (BPSD) triggers, enhance self-efficacy in daily functioning, and improve subjective evaluations of social connections. This ultimately contributes to an indirect increase in the overall quality of life. Most small-sample trials or quasi-experiments observed within 4–12 weeks of follow-up showed modest increases in QoL scale scores (QoL-AD/DEMQOL or proxy versions), approximately 5%–10% of baseline total scores, alongside reductions in depression/apathy items and agitation scores (NPI, CMAI, etc.), supporting the “multiple-pathway synergistic” hypothesis^[9, 11].

5. Application of nonverbal communication in different dementia care settings

5.1. Application of nonverbal communication in hospitals

In hospital settings, nurse-patient communication is crucial for maintaining high-quality healthcare services and building trust. When interacting with patients with dementia who have language barriers, nonverbal communication is vital for sustaining connections and ensuring effective communication. The core value of this approach lies in its ability to convey instructions and care more directly, fostering patient security and alleviating negative emotions in patients. Bender et al. noted that hospital nurses employing strategies such as eye contact, hand gestures, and maintaining a distance of ≤ 1.2 meters during communication effectively reduced patients' cognitive burden^[25]. This approach particularly enhances patient cooperation during procedures, such as intravenous punctures and examinations. Clinical practice by Zhang et al. confirmed that nurses can significantly alleviate patient anxiety and improve treatment compliance by employing nonverbal approaches, such as smiling, maintaining calm eye contact, and offering gentle touch or handshakes, while attentively observing facial expressions and body language to anticipate needs^[26].

5.2. Application of nonverbal communication in nursing homes

In elderly care settings, nonverbal communication is crucial for overcoming barriers with dementia patients whose verbal abilities are impaired and who often exhibit ritualistic characteristics. Compared with verbal communication, the proficient use of nonverbal methods facilitates more effective interaction between caregivers and patients. As Wanko Keutchafo noted in their research, caregivers in nursing homes commonly rely on nonverbal communication because this consistency reduces the cognitive burden for residents; they need not repeatedly adjust to different communication styles when interacting with various caregivers^[10]. Zalete corroborated this in nursing home research, finding that when caregivers establish positive relationships through eye contact, nods, and smiles, residents' well-being and satisfaction significantly improve^[27]. Based on these findings, Zalete advocated integrating nonverbal communication skills into caregiver education and pre-service training to elevate the quality of eldercare services^[27].

5.3. Application of nonverbal communication in home-based elderly care

As the primary long-term living environment for patients with dementia, the home setting holds irreplaceable value in accelerating patients' physical and mental recovery through its design and atmosphere. In family caregiving, nonverbal communication serves as a unique bridge, effectively fostering emotional bonds between patients and

family members, infusing the household with warmth, and enhancing caregivers' convenience and comfort. The daily companionship of family members vividly exemplifies nonverbal communication. Zhu Hongwei et al. also highlighted this in their comprehensive care intervention study, demonstrating that this sustained sense of presence effectively soothes patients' emotional fluctuations, providing them with solid psychological support and a profound sense of security ^[28]. Building on this, Chen et al.'s research on home-based elderly care needs assessment emphasizes that nonverbal cues within the home environment—such as family-specific gestures, body language, intonation, and even familiar room arrangements—can profoundly resonate with patients' emotional dimensions ^[29]. These seemingly insignificant details carry profound family memories, effectively stimulating the patients' sense of belonging. They allow patients to feel valued and recognized as integral members of their families, even while facing illness.

6. Challenges in applying nonverbal communication with dementia patients

The variation in nonverbal communication abilities among patients with dementia is directly correlated with disease severity: patients with mild dementia may effectively utilize facial expressions and gestures, while those with moderate dementia begin to experience diminished comprehension and expression capabilities. However, patients with severe disease commonly exhibit widespread, nonverbal communication impairments. Particularly in the severe stage, patients often display confused, disordered, or difficult-to-interpret nonverbal behaviors, significantly increasing the difficulty and error rate for caregivers to accurately interpret them, thereby complicating nonverbal communication. Furthermore, even when faced with interpretable signals, caregivers' energy and acuity diminish under prolonged high-pressure caregiving, inevitably leading to missed or misinterpreted nonverbal cues. Additionally, in institutional settings, differences in geographical backgrounds and cultural habits between patients and nursing staff create another layer of barriers. This leads to divergent interpretations and expressions of nonverbal behaviors, further exacerbating the difficulties in nonverbal communication.

7. Summary

Nonverbal communication interventions leverage the relatively preserved emotional and multisensory processing pathways in patients with dementia. Through multiple mechanisms, including cognitive activation, memory recall, emotional regulation, behavioral synchronization, self-efficacy, and social engagement, they can promote multidimensional improvements in the quality of life across various care settings. Current evidence shows an overall positive trend but remains constrained by limitations, including suboptimal research design quality, insufficient operationalization of interventions and dosages, gaps in outcome and mechanism chains, inadequate characterization of disease stages and cultural variations, and the exploratory stage of objective quantification and AI technology. Future efforts should establish standardized reporting and evaluation frameworks, conduct high-quality, mechanism-driven, technology-enabled multicenter studies, and enhance cultural and ethical considerations and individual adaptation. This will advance nonverbal communication from experiential practice toward standardized, precision-based, and intelligent care strategies, providing robust evidence to support higher-quality and more dignified care for individuals with dementia.

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Firsekibart in Reducing High-Sensitivity C-reactive Protein Levels of Gout

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Abstract: *Background:* Gout remains a challenging condition with rising global prevalence. The IL-1 β drives disease pathogenesis, and high-sensitivity C-reactive protein (hsCRP) correlates with gout activity. Firsekibart, a novel fully human anti-IL-1 β monoclonal antibody, has proven its efficacy on gout, while the data on reducing hsCRP remains limited. *Methods:* This multicenter, randomized, double-blind phase III trial compared Firsekibart (200 mg subcutaneous) with compound betamethasone (7 mg intramuscular) in acute gout patients who were contraindicated to, intolerant of, or unresponsive to NSAIDs and/or colchicine. Serum hsCRP levels were measured at 72 hours, 7 days post-dose, and 4 weeks post-dose. *Results:* Both groups achieved comparable hsCRP reduction at 72 hours (Firsekibart: -14.68 mg/L [95% CI: -15.75, -13.61] vs. compound betamethasone: -14.58 mg/L [-15.66, -13.50]; $P=0.898$). Firsekibart demonstrated better sustained suppression at 7 days post-dose (-18.63 vs. -9.28 mg/L, $P<0.001$) and 4 weeks (-18.37 vs. -12.65 mg/L, $P<0.001$). *Conclusion:* Compared with compound betamethasone, Firsekibart showed a longer-lasting anti-inflammatory effect on gout patients. This result may provide significant clinical value in the management of gout and its associated complications.

Keywords: Gout; Anti-IL-1 β monoclonal antibody; Firsekibart; hsCRP; Inflammation

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1. Introduction

The incidence of gout has steadily increased over the past decades, yet its management remains suboptimal^[1]. The prevalence of gout is higher in developed countries and is closely associated with genetic factors, high-purine diet, metabolic syndrome, alcohol consumption, and renal dysfunction. Gout patients often present with comorbidities, including diabetes, hypertension, and cardiovascular diseases, with elevated serum urate levels being the core pathogenic factor. Urate crystal deposition not only triggers joint inflammation but also directly contributes to hypertension and atherosclerosis development through activation of the renin-angiotensin system and induction of endothelial dysfunction^[2-4].

The inflammatory cascade triggered by monosodium urate (MSU) crystals represents the cornerstone of gout pathophysiology. MSU crystals activate the NLRP3 inflammasome, leading to caspase-1-mediated processing and secretion of interleukin-1 β (IL-1 β)^[5-6]. As the principal inflammatory mediator in gout, IL-1 β initiates downstream signaling through Nuclear Factor- κ B (NF- κ B) and Mitogen-Activated Protein Kinase (MAPK) pathways, resulting in transcriptional upregulation of proinflammatory cytokines (including TNF- α and IL-6) and chemokines^[7]. These molecular mediators recruit and activate neutrophils, which release reactive oxygen species and proteolytic enzymes that cause tissue damage and amplify the inflammatory response^[8]. This process establishes a self-perpetuating cycle wherein sustained NLRP3 inflammasome activation maintains IL-1 β production, thereby reinforcing the inflammatory cascade and contributing to disease progression^[7].

High-sensitivity C-reactive protein (hsCRP) serves as an established biomarker for low-grade systemic inflammation and cardiovascular risk assessment^[8]. In patients with gout, reductions in serum urate levels correlate with decreased hsCRP concentrations, suggesting its potential utility as a therapeutic response marker^[9]. Elevated hsCRP levels may help identify patients with inflammatory phenotypes who could benefit from targeted anti-inflammatory therapies^[10].

Clinical evidence demonstrates that canakinumab, an anti-IL-1 β monoclonal antibody, provides rapid pain relief and reduces recurrence risk in refractory gout arthritis^[11]. The CANTOS trial revealed that IL-1 β inhibition with canakinumab significantly lowered cardiovascular event rates, particularly in patients achieving hsCRP levels below 2 mg/L after initial treatment^[12]. Rilonacept and Anakinra, IL-1 receptor antagonist, showed efficacy in CRP reduction while relieving symptoms of gout patients^[13-15]. HsCRP is widely acknowledged as a marker to evaluate the efficacy of anti-inflammatory drugs.

Targeted inhibition of IL-1 β has demonstrated therapeutic efficacy in gout management^[6, 16]. Current clinical guidelines recommend anti-IL-1 β therapy for acute gouty arthritis patients with contraindications, intolerance, or inadequate response to NSAIDs and/or colchicine^[17]. Firsekibart (previously called Genakumab), a novel fully human monoclonal antibody against IL-1 β , represents a promising therapeutic alternative for gout patients^[18]. However, existing evidence regarding Firsekibart's effects on hsCRP modulation in gout remains limited and requires further investigation.

This post-hoc analysis evaluated the efficacy of Firsekibart versus compound betamethasone (CB) in reducing hsCRP levels at 72 hours, 7 days post-dose, and 4 weeks post-treatment, presenting more details for the anti-inflammatory effects of Firsekibart.

2. Materials and methods

2.1. Study design

This was a multicenter, randomized, double-blind, active-controlled phase III trial conducted from January 2023 to June 2024 across 51 centers in China. The trial protocol was approved by the Ethics Review Committee of Huashan Hospital Affiliated to Fudan University (Ethics Number: 2022 (976)) and conformed to the principles of the Declaration of Helsinki. All participants provided written informed consent before enrollment.

2.2. Participants

Patients who met the 2015 American College of Rheumatology (ACR) preliminary criteria for the classification of acute primary gouty arthritis (GA) were screened for eligibility. Key inclusion criteria included patients who:

1) Aged 18 to 75 years. 2) Contraindicated for, intolerant of, or unresponsive to NSAIDs and/or colchicine. 3) Experienced ≥ 2 gout flares in the preceding year. Key exclusion criteria were: 1) Secondary gout (such as rheumatoid arthritis, psoriatic arthritis). 2) Severe organ dysfunction (including hepatic cirrhosis, New York Heart Association class III–IV heart failure, or estimated glomerular filtration rate < 30 mL/min/1.73 m²). 3) Active systemic infection or history of recurrent infections. 4) Pregnant or breastfeeding women. 5) Participation in another interventional clinical trial within 30 days before enrollment. 6) History of malignancy within the past 5 years.

2.3. Randomization

A total of 313 patients were randomized with a ratio of 1:1 to receive a single subcutaneous dose of Firsekibart (200 mg) or intramuscular CB (7 mg), with VAS (visual analog scale) scores at screening ($50 \leq \text{VAS} < 70$ mm vs. $70 \leq \text{VAS} < 100$ mm) as the stratification factor. Randomization was conducted through an Interactive Web Response System.

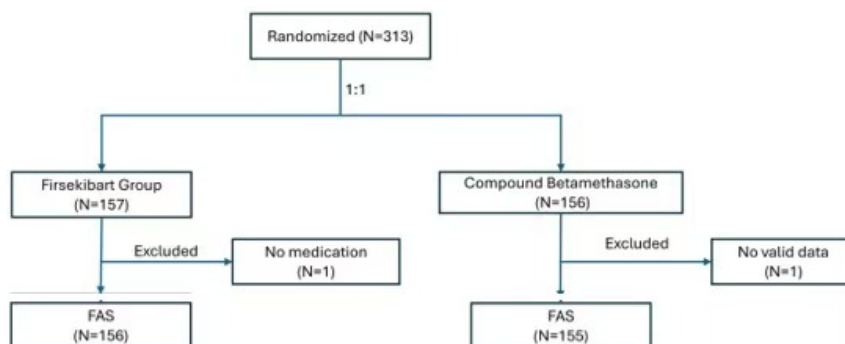


Figure 1. Flowchart for this post-hoc analysis of hsCRP

2.4. Procedure

Measuring hsCRP levels was one of the exploratory endpoints in this phase III trial. A 2 mL serum sample from venous blood was collected to measure hsCRP levels. Serum hsCRP levels were measured at baseline, 72 hours, 7 days, and 4 weeks post-dose using immunoturbidimetry with a hsCRP kit.

2.5. Statistical analysis

Continuous variables were reported as mean \pm SD, and categorical variables as counts (%). HsCRP differences were analyzed using an ANCOVA (Analysis of Covariance) model, adjusting for baseline hsCRP values and VAS scores. A two-sided $P < 0.05$ was considered significant. The statistical analyses were conducted using SAS (9.4).

3. Results

3.1. Baseline characteristics

313 patients were randomized, and 311 were included in FAS (**Figure 1**). The mean ages of 45.7 ± 13.73 years and 44.1 ± 12.16 years in Firsekibart and the CB groups, respectively. A majority of patients in both groups had a history of ≥ 3 gout flares in the previous year. The presence of tophi was noted in 39.1% of the Firsekibart group and 41.9% of the CB group. The baseline characteristics of the patients were well-balanced between the two groups (**Table 1**).

Table 1. Baseline characteristics and efficacy of Firsekibart/Compound betamethasone-treated patients (FAS)

	Firsekibart (N = 156)	Compound betamethasone (N = 155)
Male (%)	100	97.4
Age (years), mean \pm SD	45.7 \pm 13.73	44.1 \pm 12.16
BMI (kg/m ²), mean \pm SD	27.45 \pm 3.89	27.55 \pm 3.79
≥ 3 flares reported during the prior one year N (%)	143 (91.7)	135 (87.1)
Percentage of patients with tophus N (%)	61 (39.1)	65 (41.9)

BMI: Body Mass Index; FAS: Full Analysis Set

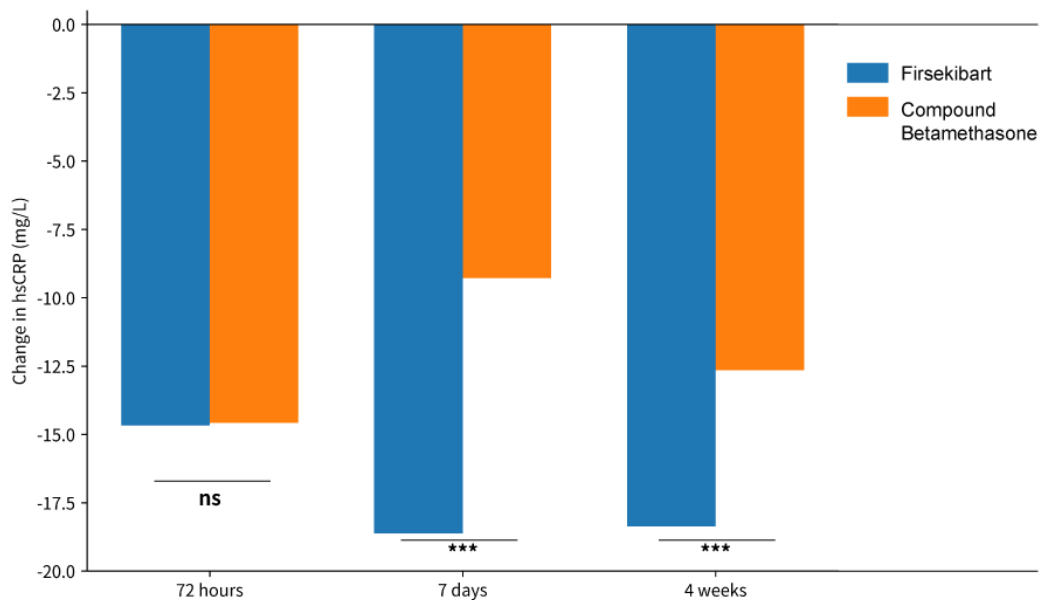
3.2. Serum HsCRP levels over time

At 72 hours, both groups showed comparable reductions in hsCRP, and the reduction was -14.68 mg/L (95% confidence interval [CI]: -15.75, -13.61) in the Firsekibart group versus -14.58 mg/L (95% CI: -15.66, -13.50) in the CB group ($P = 0.8980$), respectively. While both treatments showed rapid initial declines in hsCRP, the Firsekibart group maintained lower hsCRP levels at day 8 (7 days post-dose) (-18.63 mg/L [95% CI: -21.96, -15.30] versus -9.28 mg/L [95% CI: -12.64, -5.92] in the CB group, $P < 0.001$). This superiority also persisted at 4 weeks (-18.37 mg/L [95% CI: -20.24, -16.50] versus -12.65 mg/L [95% CI: -14.73, -10.57] in the CB group, $P < 0.001$). The change of hsCRP suggested a prolonged anti-inflammatory efficacy in the Firsekibart group. (**Table 2**, **Figure 2**)

Table 2. Comparison of hs-CRP levels and changes between treatment groups

Time point/interval	Firsekibart	Compound betamethasone	<i>P</i> -value
Absolute values (mg/L), mean \pm SD			
Baseline	19.35 \pm 36.15	23.05 \pm 37.50	-
72 hours	6.01 \pm 7.61	6.42 \pm 9.82	-
7 days	1.91 \pm 2.74	11.53 \pm 30.17	-
4 weeks	2.52 \pm 11.29	8.35 \pm 12.42	-
Change from baseline (mg/L),LSM (95 CI%)			
72 hours	-14.68 (-15.75, -13.61)	-14.58 (-15.66, -13.50)	0.898
7 days	-18.63 (-21.96, -15.30)	-9.28 (-12.64, -5.92)	<0.001
4 weeks	-18.37 (-20.24, -16.50)	-12.65 (-14.73, -10.57)	<0.001

SD: Standard Deviation; LSM: Least Squares Mean; CI: Confidence Interval



ns: Not significant; “***” indicates $P < 0.001$.

Figure 2. Comparison of hsCRP reduction between treatment groups

At 72 hours, no significant difference was revealed between the groups; however, Firsekibart achieved a more substantial hsCRP reduction than compound betamethasone at 7 days and 4 weeks.

4. Discussion

Firsekibart demonstrated a obvious effect in reducing hsCRP levels. Within 72 hours, Firsekibart’s ability to lower hsCRP was comparable to that of CB, indicating that both drugs can quickly respond to acute gout inflammation. However, at 7 days and 4 weeks, Firsekibart showed a more pronounced advantage in inhibiting hsCRP.

The core pathological mechanism of gout is the chronic inflammatory response induced by MSU crystals. MSU crystals interact with macrophages and activate the NLRP3 inflammasome through the TLR2/4 signaling pathway or mitochondrial ROS production. This activation leads to caspase-1 activation, which subsequently cleaves pro-IL-1 β into its active form [6, 11]. IL-1 β , which is a key proinflammatory cytokine that triggers gout flares and drives downstream inflammatory cascades, activates NF- κ B through the IL-1R receptor, further amplifying the inflammatory response and promoting the infiltration of neutrophils and the release of chemokines (such as IL-6 and CXCL8) [19]. IL-1 β also upregulates adhesion molecules on endothelial cells (such as selectins), exacerbating the recruitment of inflammatory cells [6]. IL-1 β also induces neutrophils to release neutrophil extracellular traps (NETs), which further release oxidative stress substances (such as myeloperoxidase), thereby exacerbating tissue damage [20–22].

Therapeutic strategies targeting IL-1 β have been proven effective. Canakinumab effectively alleviates acute pain in refractory gout patients and reduces the risk of recurrent flare-ups. However, an increased risk of infection is a safety concern that needs to be carefully considered in the clinical use of canakinumab [11, 16]. Firsekibart, as a novel IL-1 β monoclonal antibody, exerts its effects through sustained blockade of IL-1 β . By the process, the hepatic synthesis of hsCRP could also be inhibited [23]. Its prolonged half-life is similar to other IL-1 β monoclonal antibodies, such as canakinumab, which has shown long-term efficacy in related autoinflammatory disorders and

thereby enables persistent inhibition of the IL-1 β pathway while maintaining sustained suppression of hsCRP [24–28]. This mechanistic distinction explains why the anti-inflammatory effects of Firsekibart are sustained beyond the initial 72 hours, whereas the hsCRP-lowering effect of CB diminishes over time. Study confirmed that, in comparison to etoricoxib, Firsekibart showed better pain relief by 72 hours, faster onset of 50% pain reduction (2.0 days vs. 4.0 days), and a dramatically lower 12-week recurrence rate (6.6% vs. 66.1%) in gout patients experiencing frequent flares [29]. These benefits supported our findings that Firsekibart delivered both rapid and sustained anti-inflammatory effects on hsCRP from a clinical perspective. This sustained hsCRP inhibition likely underpins the drug's ability to prevent flare recurrence, as reduced hsCRP levels correlate with diminished inflammatory activity that triggers gout exacerbations.

Firsekibart introduces a novel dimension to gout therapy, particularly for patients who were contraindicated to, intolerant of, or unresponsive to NSAIDs and/or colchicine [25]. A stable and sustained inhibition of hsCRP hints at a more durable inflammatory control, which addresses both acute and chronic gout in pathophysiology. Colchicine significantly reduces inflammatory markers such as CRP during acute attacks by inhibiting the activation of the neutrophil NLRP3 inflammasome, blocking IL-1 β release, and disrupting microtubule assembly [30]. As an anti-IL-1 β monoclonal antibody, Firsekibart has a more stable hsCRP inhibitory effect that breaks the “inflammation-damage” vicious cycle in gout patients, especially for those with frequent flare-ups or concomitant metabolic syndrome. IL-1 inhibitors, including the anti-IL-1 β monoclonal antibody, have been acknowledged as an effective option for gout, rheumatoid arthritis, and cardiovascular diseases [11, 31]. Firsekibart may have both anti-inflammatory and cardiovascular protective effects, and this will be further investigated in future studies.

This study contains several limitations. First, the relatively short observation period precludes assessment of the long-term impact of sustained hsCRP suppression on joint structural repair and recurrence rates. Second, the absence of in-depth analysis correlating hsCRP reduction with functional joint improvement limits the clinical utility of hsCRP as a therapeutic biomarker. Third, exclusive focus on treatment-refractory populations may introduce selection bias, restricting generalizability to the broader gout population. Future large-scale, longitudinal studies incorporating diverse cohorts and clinical outcome measures are warranted to further validate the therapeutic potential of Firsekibart.

5. Conclusion

Compared with the compound betamethasone, Firsekibart maintained hsCRP suppression over a longer follow-up period. This result may provide significant clinical value in the management of gout and its associated complications.

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Disclosure statement

The authors declare no conflict of interest.

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The Optimization of the Handover Process Between the Disinfection Supply Center and the Geriatric Department Material Promotes the Prevention and Control of Hospital Infection

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Abstract: As a critical department for hospital infection control, the disinfection supply center is responsible for cleaning, disinfecting, sterilizing, and distributing reusable medical devices and items across the hospital. Geriatric departments, due to their patient population's weakened immune systems and multiple underlying conditions, are particularly vulnerable to infection outbreaks. The material transfer process between these two departments directly impacts infection prevention effectiveness. This study analyzes existing issues in current material transfer procedures between disinfection centers and geriatric departments, proposes targeted optimization measures, and explores how process improvements enhance standardized material management, reduce contamination risks, and strengthen staff infection control awareness. The findings aim to provide practical references for hospitals to refine infection control systems and ensure elderly patient safety, ultimately advancing comprehensive infection management capabilities.

Keywords: Disinfection supply center; Geriatric department; Material handover process; Process optimization; Hospital infection prevention and control

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1. Introduction

Hospital infection control serves as the cornerstone for ensuring medical quality and patient safety, permeating every aspect of healthcare services. As a vital department in modern hospitals, the disinfection and supply center manages the distribution and recycling of clinical medical supplies. The operational efficiency of this department directly impacts hospital operations and patient safety, necessitating enhanced management practices. Implementing efficient and rigorous management models is crucial to optimizing supply center operations and ensuring smooth workflow. Surgical instrument management plays a pivotal role in supply center management,

as its quality directly affects patient safety during surgeries and infection risks. Conventional management approaches fail to meet modern medical demands for surgical instruments. The disinfection and supply center's sterile assurance of equipment and materials directly impacts clinical safety. Geriatric patients, with their weaker immune systems, require heightened sterility standards. The handover process between these groups constitutes a critical juncture, where non-compliance with some hospitals' procedures may lead to infection risks. Therefore, optimizing this process and analyzing its impact on infection prevention holds significant importance.

2. Existing problems in the material handover process between the disinfection supply center and the geriatric department

2.1. The handover process is not standard, and the division of responsibilities is vague

Current hospital disinfection supply centers and geriatric departments lack standardized procedures for material handover, resulting in arbitrary practices. Upon delivery, staff often conduct only basic quantity checks while superficially verifying critical quality parameters like packaging integrity and sterilization indicator status. Some even skip inspections and sign off without proper documentation. When issues such as non-compliant sterilization or damaged packaging are later identified, unclear accountability becomes problematic due to missing handover records. The frequent turnover between disinfection center personnel and geriatric department staff exacerbates irregularities. New hires often lack mastery of standardized handover protocols, creating contamination risks during material transfers and hindering infection control efforts.

2.2. Poor information transmission of materials and lack of coherence in management

The disinfection supply center and geriatric department have yet to establish a comprehensive material information sharing mechanism. Critical details such as sterilization duration, batch numbers, expiration dates, and storage requirements are exclusively transmitted through paper records provided by the disinfection center. When geriatric department staff need to access these documents for subsequent material management and usage, they must repeatedly search through physical records—a process that not only reduces efficiency but also increases risks of document loss and data inaccuracies. Furthermore, the geriatric department's delayed reporting of material consumption and damage situations prevents the disinfection center from accurately tracking actual needs, leading to either insufficient supplies or excessive stockpiles. This communication gap results in disjointed management between the two departments, failing to establish a cohesive management chain that spans sterilization, supply, usage, and feedback. Consequently, this undermines the systematic effectiveness of hospital infection control measures.

3. Optimization measures of material handover between the disinfection supply center and the geriatric department

3.1. Formulate standardized handover procedures and clarify the subject of responsibility

The hospital should collaborate with the disinfection supply center, geriatric department, infection control department, and other relevant departments to establish a “Standardized Material Transfer Protocol between Disinfection Supply Center and Geriatric Department.” This protocol specifies detailed procedures for material handover. Before transferring materials, the disinfection supply center's staff must prepare a comprehensive inventory list, ensuring all items are properly packaged, display valid sterilization status indicators, and carry detailed quality documentation. Upon delivery, geriatric department staff and disinfection personnel must verify

each item against the list, checking for intact packaging, proper sterilization status, accurate quantity specifications, and matching sterilization batches/validity dates. Both parties must sign the electronic transfer system or paper record to clarify responsibilities. Any non-compliant items should be immediately marked and returned to the disinfection center for processing. The transfer record must clearly document the reasons for non-compliance and corrective actions to ensure accountability^[1]. Additionally, designated positions for disinfection supply center staff and geriatric department personnel must be established. All staff must complete training on transfer protocols and infection control knowledge, with certification required before employment to ensure standardized implementation of handover procedures.

3.2. Establish an information management system to realize material information sharing

The hospital has established a disinfection supply center and an elderly care department material information management system. Critical data, including sterilization records, packaging details, expiration dates, and storage requirements, is entered into the system. When materials are released from the disinfection center, the system generates electronic delivery notes that staff members carry to deliver items to the elderly care department. Receiving personnel can quickly verify and confirm all material details by scanning QR codes or barcodes on packaging through the system. The system automatically logs handover times, personnel information, and material specifications, creating digital documentation of the transfer process. The elderly care department can also report real-time material consumption, damage status, and demand plans via the system. Based on this data, the disinfection center adjusts supply schedules to ensure timely and accurate distribution. Meanwhile, the infection control department monitors material transfer processes and quality information in real-time through the system, providing early warnings for anomalies. This integrated approach enhances both material management consistency and infection control precision.

3.3. Strengthen the management of the handover environment and reduce pollution risks

To optimize the transportation routes between the disinfection supply center and the geriatric department, dedicated corridors should be selected to avoid high-risk infection areas such as ward corridors and waste disposal rooms, thereby minimizing contact between supplies and external contaminants. Vehicles and containers used for transporting materials must undergo regular cleaning and disinfection. After daily deliveries, vehicles and container surfaces should be wiped with chlorine-based disinfectants, followed by a thorough weekly sterilization to ensure equipment remains sterile. The geriatric department should establish a designated material receiving area located away from patient treatment zones and waste storage areas. This area should maintain clean, dry conditions with proper ventilation, equipped with UV disinfection devices that undergo double daily disinfection sessions lasting no less than 30 minutes each. During material handovers, staff must strictly adhere to hand hygiene protocols by wearing disposable gloves and masks to prevent manual contact with packaging materials, thereby reducing infection risks through both environmental and operational measures^[2].

4. The promotion effect of optimizing the material handover process between the disinfection supply center and the geriatric department on hospital infection prevention and control

4.1. Standardize material management and reduce the source of infection

The optimized standardized handover process enables the disinfection supply center and geriatric department

to conduct rigorous quality inspections during material transfers, effectively preventing substandard supplies from entering clinical use. Through meticulous checks on packaging integrity and sterilization indicator status, potential issues like inadequate sterilization or damaged packaging can be promptly identified and intercepted before clinical application, thereby reducing infection risks at their source. The digital management system ensures full traceability of materials throughout their life cycle—from sterilization and storage to distribution, handover, usage, and disposal. In the event of an infection incident, this system allows swift tracing of material origins and circulation paths, enabling timely source identification and targeted containment measures to prevent spread. This standardized management not only guarantees sterile and safe supplies for geriatric departments but also provides robust quality assurance for infection control, significantly reducing root causes of nosocomial infections.

4.2. Improve the awareness of personnel prevention and control, and strengthen the implementation of hospital infection prevention and control

During the process optimization, specialized training was conducted for disinfection supply center staff and geriatric department reception personnel. This initiative aimed to help staff fully recognize the critical role of material handover procedures in hospital infection control, clarify their responsibilities, and operational standards within these processes. The training covered relevant laws and regulations on infection prevention, standardized material transfer protocols, hand hygiene guidelines, and personal protective equipment knowledge. Through diverse formats including theoretical explanations, case analyses, and live demonstrations, it effectively enhanced staff's professional expertise and practical skills ^[3]. In daily handover operations, standardized procedures combined with real-time monitoring through information systems create dual constraints, ensuring strict compliance with protocols. This approach effectively addresses previous issues of non-standardized procedures caused by weak prevention awareness and arbitrary operations. The improved prevention consciousness and standardized practices have made infection control measures during material handovers truly effective, reducing infection risks from improper handling. Furthermore, this strengthens the overall execution of hospital infection control efforts, building a robust defense for patient safety in geriatric care.

4.3. Improve the hospital infection prevention and control system, and improve the overall management level of hospital infection

The optimization of material handover procedures between the disinfection supply center and the geriatric department constitutes a vital component of hospital infection control systems. This process refinement addresses existing gaps in infection prevention during material transfers while promoting deeper collaboration among hospital departments. The Infection Control Department plays a pivotal role in guiding and supervising these processes through procedure development, training assessments, and inspections, thereby enhancing interdepartmental coordination ^[4]. The information management system provides innovative solutions for infection control operations. Analysis of material transfer data enables timely identification of potential risks, offering robust data support for developing targeted strategies. The standardized management frameworks and digital methodologies established during process optimization can be extended to material handovers across clinical departments and disinfection centers, driving hospital-wide standardization and digital transformation in material management. This advancement strengthens infection control systems, improves overall infection management efficiency, and establishes a solid foundation for patient safety and medical quality enhancement.

5. Conclusion

The optimization of material handover procedures between the disinfection supply center and geriatric departments significantly enhances hospital infection control. By addressing existing issues such as non-standard operations and information flow bottlenecks, implementing standardized protocols, establishing digital systems, and strengthening environmental management, these measures standardize material management, cultivate staff awareness of infection prevention, and reinforce the hospital's infection control framework. This approach reduces infection risks at their source, improves operational efficiency, and elevates overall infection management standards. Hospitals should continuously monitor the implementation of these procedures, dynamically adjust optimization measures according to actual needs, and maintain the scientific validity and practical value of the processes. These efforts ensure safer, higher-quality medical services for elderly patients, consolidate infection control achievements, and support the hospital's high-quality development.

Disclosure statement

The authors declare no conflict of interest.

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Effectiveness of a Phase I Cardiopulmonary Rehabilitation Nursing Protocol on Functional Outcomes in Patients after Open Type A Aortic Dissection Surgery: A Case-Control Study

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Abstract: *Objective:* To explore the effectiveness of a Phase I cardiopulmonary rehabilitation nursing protocol on functional outcomes in patients after open Type A aortic dissection (TAAD) surgery. *Methods:* A total of 64 patients who underwent open TAAD surgery in the hospital from January 2023 to December 2024 were selected and randomly divided into the control group and the study group using a random number table, with 32 patients in each group. The control group received routine cardiopulmonary rehabilitation intervention, while the study group received a Phase I cardiopulmonary rehabilitation nursing protocol guided by the Theory of Planned Behavior. The 6-minute walk distance (6MWD), Borg Rating of Perceived Exertion (RPE) score, time to first postoperative ambulation, incidence of hypoxemia, incidence of hypoxemia-related complications, and incidence of rehabilitation nursing-related adverse events were compared between the two groups. *Results:* After intervention, the study group had a longer 6MWD, lower Borg RPE score, earlier time to first postoperative ambulation, and lower incidence of hypoxemia than the control group (all $P < 0.05$). There were no statistically significant differences in the incidence of hypoxemia-related complications or rehabilitation nursing-related adverse events between the two groups (both $P > 0.05$). *Conclusion:* The Phase I cardiopulmonary rehabilitation nursing protocol guided by the Theory of Planned Behavior is scientific, feasible, and clinically relevant for TAAD patients. It can improve patients' exercise capacity and reduce the incidence of hypoxemia.

Keywords: Type A aortic dissection; Cardiopulmonary rehabilitation; Theory of Planned Behavior; Motor function; Hypoxemia; Rehabilitation nursing

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1. Introduction

Type A aortic dissection (TAAD) is one of the most critical cardiovascular emergencies in clinical practice, with an acute-phase mortality rate as high as 73%. Surgical intervention is currently the core treatment modality. However,

postoperatively, patients often experience functional impairments such as decreased exercise tolerance, impaired pulmonary function, and reduced quality of life due to factors including myocardial ischemia, respiratory function suppression, and bed rest immobilization, which significantly increase the risk of long-term cardiovascular events ^[1]. Therefore, exploring effective postoperative rehabilitation interventions is crucial for improving functional outcomes. The value of cardiopulmonary rehabilitation in improving the functional status of patients with cardiovascular diseases through multidisciplinary comprehensive intervention has been well-documented ^[2]. However, in clinical practice, TAAD patients often fear activity due to concerns that exercise may increase blood pressure and induce aortic complications. Additionally, significant individual differences in personality traits, family support, and health literacy lead to generally poor exercise adherence ^[3]. The Theory of Planned Behavior explains the relationship between psychosocial factors and behavior formation. By adjusting patients' behavioral attitudes, strengthening subjective norms, and enhancing perceived behavioral control, it can promote the development of positive behavioral intentions, which have strong explanatory power for individualized behavioral interventions and help correct patients' cognitive biases, addressing the inadequacies of existing Phase I cardiopulmonary rehabilitation protocols in addressing psychosocial factors ^[4]. Based on this, this study aimed to apply a Phase I cardiopulmonary rehabilitation protocol guided by the Theory of Planned Behavior in post-TAAD surgery patients to improve their aerobic exercise capacity and reduce the risk of hypoxemia.

2. Materials and methods

2.1. General information

A total of 64 patients who underwent open TAAD surgery in our hospital from January 2023 to December 2024 were selected. They were randomly divided into the control group and the study group using a random number table, with 32 patients in each group. In the control group, there were 20 males and 12 females; aged 42–75 years, with an average of (58.62 ± 7.35) years; body mass index (BMI) ranging from 18.5–27.8 kg/m², with an average of (23.15 ± 2.41) kg/m²; operation duration ranging from 3.5–6.2 h, with an average of (4.81 ± 0.72) h; preoperative cardiac function classification: 19 cases of Grade II and 13 cases of Grade III. In the study group, there were 19 males and 13 females; aged 41–76 years, with an average of (59.17 ± 7.52) years; BMI ranging from 18.3–28.0 kg/m², with an average of (23.32 ± 2.38) kg/m²; operation duration ranging from 3.6–6.1 h, with an average of (4.75 ± 0.69) h; preoperative cardiac function classification: 20 cases of Grade II and 12 cases of Grade III. The general data of the two groups were balanced and comparable ($P > 0.05$). This study was approved by the Ethics Committee of our hospital.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Diagnosis of TAAD confirmed by imaging examinations, meeting indications for open surgery, and successfully undergoing the operation; (2) Clear consciousness, able to cooperate with rehabilitation training and data collection; (3) Informed consent obtained from patients and their families, who signed the informed consent form.

Exclusion criteria: (1) Complicated with end-stage diseases such as severe liver and kidney failure or malignant tumors; (2) Presence of severe cognitive impairment or mental illness; (3) Postoperative occurrence of severe complications (e.g., infection, massive hemorrhage) requiring delayed rehabilitation intervention; (4) Inability to complete walking tests due to limb dysfunction.

2.3. Intervention methods

2.3.1. Control group

A routine cardiopulmonary rehabilitation protocol was implemented. Intervention was initiated 24–48 h postoperatively when vital signs were stable, including: (1) Basic health education: Distribution of rehabilitation manuals, and explanation of postoperative activity precautions and hypoxemia prevention knowledge; (2) Exercise guidance: Assistance with bed turning, passive limb exercises, and gradual progression to bedside sitting, standing, and indoor walking; (3) Respiratory function training: Guidance on diaphragmatic breathing and effective cough and sputum excretion training, twice daily, 15–20 minutes per session; (4) Routine condition monitoring: Monitoring of heart rate, blood pressure, blood oxygen saturation, and other indicators.

2.3.2. Study group

A Phase I cardiopulmonary rehabilitation nursing protocol guided by the Theory of Planned Behavior was implemented, with the same intervention duration as the control group. The protocol was designed around three core dimensions: “behavioral attitude-subjective norm-perceived behavioral control”: (1) Behavioral attitude adjustment: Correction of cognitive biases through one-on-one communication, and explanation of the relationship between exercise and blood pressure control using successful cases to eliminate concerns about “exercise-induced complications”; (2) Subjective norm strengthening: Involvement of family members in rehabilitation plan formulation, guidance on encouraging companionship to create a family support environment; (3) Perceived behavioral control enhancement: Development of individualized exercise prescriptions based on patients’ tolerance (e.g., starting with bed ankle pump exercises and gradually increasing exercise intensity and duration), and provision of exercise monitoring bracelets to real-time feedback heart rate and blood oxygen data, thereby enhancing patients’ sense of self-control. Meanwhile, the basic rehabilitation content of the control group was integrated to ensure intervention systematicness.

2.4. Outcome measures

(1) Exercise capacity indicators: 6-minute walk test was used to assess 6MWD 4 weeks after intervention, and Borg RPE scale (6–20 points, higher scores indicating greater exertion) was used to evaluate exercise tolerance simultaneously; (2) Rehabilitation progress indicator: Recording of time to first postoperative ambulation; (3) Safety and outcome indicators: Statistics of incidence of hypoxemia (blood oxygen saturation < 93% lasting more than 5 minutes), incidence of hypoxemia-related complications (e.g., pulmonary infection, atelectasis), and incidence of rehabilitation nursing-related adverse events (e.g., orthostatic hypotension, wound discomfort) during the intervention period.

2.5. Statistical analysis

SPSS 26.0 statistical software was used for data analysis. Measurement data were expressed as mean \pm standard deviation (Mean \pm SD), and inter-group comparison was performed using an independent samples *t*-test. Count data were expressed as [n (%)], and inter-group comparison was performed using χ^2 test. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of 6MWD and Borg RPE score between the two groups

After intervention, the study group had a significantly longer 6MWD and lower Borg RPE score than the control group (both $P < 0.05$) (Table 1).

Table 1. Comparison of 6MWD and Borg RPE score between the two groups (Mean \pm SD)

Group	n	6MWD(m)	Borg RPE Score (points)
Control group	32	230.14 \pm 30.46	12.45 \pm 2.12
Study group	32	265.39 \pm 32.17	10.98 \pm 1.84
<i>t</i> -value		4.501	2.962
<i>P</i> -value		<0.001	0.004

3.2. Comparison of time to first postoperative ambulation between the two groups

The time to first postoperative ambulation was 5.12 ± 0.41 days in the control group and 4.71 ± 0.43 days in the study group, with the study group having a significantly earlier time to first ambulation ($t = 3.904$, $P < 0.001$).

3.3. Comparison of incidence of hypoxemia, hypoxemia-related complications, and rehabilitation nursing-related adverse events between the two groups

The incidence of hypoxemia in the study group was significantly lower than that in the control group ($P < 0.05$). There were no statistically significant differences in the incidence of hypoxemia-related complications or rehabilitation nursing-related adverse events between the two groups (both $P > 0.05$) (Table 2).

Table 2. Comparison of incidence of hypoxemia, hypoxemia-related complications, and rehabilitation nursing-related adverse events between the two groups [n (%)]

Group	n	Hypoxemia	Hypoxemia-related complications (pulmonary infection/atelectasis)	Rehabilitation nursing-related adverse events (orthostatic hypotension/wound discomfort)
Control group	32	11(34.38)	3(9.38)	2(6.25)
Study group	32	4(12.50)	2(6.25)	1(3.13)
χ^2 -value		4.267	0.217	0.350
<i>P</i> -value		0.039	0.641	0.554

4. Discussion

Open TAAD surgery is associated with severe trauma and a prolonged postoperative recovery period. Due to preoperative absolute bed rest, intraoperative trauma, and fear of complications, patients often develop exercise phobia, which leads to poor adherence to conventional rehabilitation protocols and limited functional recovery outcomes. In this study, a Phase I cardiopulmonary rehabilitation nursing protocol was constructed based on the Theory of Planned Behavior, providing a new pathway for postoperative rehabilitation of TAAD patients through three-dimensional interventions (behavioral attitude adjustment, subjective norm strengthening, and perceived

behavioral control enhancement). Its clinical value and feasibility warrant in-depth exploration.

Conventional cardiopulmonary rehabilitation protocols mostly focus on physical function training, while neglecting the impact of patients' psychological cognition and social support on rehabilitation behavior, resulting in low implementation rates ^[5]. The Theory of Planned Behavior addresses this dilemma through multi-dimensional interventions: correcting patients' cognitive bias that "exercise induces elevated blood pressure" through one-on-one knowledge explanation and sharing of successful cases to establish a positive attitude towards rehabilitation training; mobilizing family members to participate in the formulation of rehabilitation plans, building a family support system to strengthen subjective norms; and developing stepwise goals based on individual tolerance, equipped with real-time monitoring equipment to enhance patients' sense of perceived behavioral control ^[6]. In this study, there was no significant difference in the incidence of rehabilitation nursing-related adverse events between the two groups, confirming that the protocol can be implemented safely under precise assessment and dynamic monitoring, and has good clinical feasibility.

After intervention, the 6-minute walk distance of the study group was significantly longer than that of the control group, and the Borg Rating of Perceived Exertion score was significantly lower than that of the control group. This result stems from the protocol's dual focus on "physical training + motivation stimulation": at the physical level, individualized training plans were developed based on preoperative assessment of exercise capacity, progressing from passive bed exercises to indoor walking, ensuring the scientificity and gradual progression of training; at the motivation level, cognitive intervention and goal incentives were used to promote patients' transition from "passive cooperation" to "active participation", improving training adherence and effectiveness. This "integrated internal and external" intervention model not only mobilizes the body's motor function but also stimulates subjective initiative, ultimately achieving a significant improvement in exercise capacity.

The incidence of hypoxemia in the study group was significantly lower than that in the control group. The core mechanism lies in the protocol's targeted respiratory function training and improved patient adherence: early diaphragmatic breathing and pursed-lip breathing training can coordinate diaphragmatic movement, increase tidal volume, and improve pulmonary gas exchange function; subsequent breathing exercise training can promote alveolar re-expansion and reduce the risk of atelectasis. Meanwhile, the intervention based on the Theory of Planned Behavior enhances patients' attention to and implementation of respiratory training, ensuring the full exertion of training effects ^[7]; the improvement of aerobic exercise capacity further increases vital capacity and pulmonary blood flow, forming a positive cycle of "respiratory training—improved exercise capacity—alleviated hypoxemia." Although there was no significant difference in the incidence of hypoxemia-related complications between the two groups, it is speculated to be related to the short intervention period. In the future, the long-term effect of the protocol can be further verified by extending the intervention time.

5. Conclusion

In conclusion, the Phase I cardiopulmonary rehabilitation nursing protocol guided by the Theory of Planned Behavior is scientifically feasible for application in patients after TAAD surgery. By correcting cognitive biases, strengthening social support, and optimizing training models, it can not only significantly improve patients' aerobic exercise capacity but also reduce the incidence of hypoxemia without increasing the risk of adverse events, providing a promotable clinical pathway for rehabilitation nursing after TAAD surgery.

Disclosure statement

The author declares no conflict of interest.

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Practice and Effectiveness Analysis of Electricity Conservation in Pediatric Wards Based on a Multi-Dimensional Collaborative Intervention Strategy

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Abstract: As high-energy-consuming public buildings and medical institutions, hospitals hold profound significance for the realization of China's "dual carbon" goals through their energy management. Taking pediatric wards as the research object, this study constructed a three-dimensional collaborative intervention model of "institutional level—equipment level—behavioral level" targeting their energy consumption characteristics (dense wards, high accompanying rate, and continuous operation of medical equipment). Through a stepped controlled trial design (self-control during 2024—2025 and spatial control with gynecological wards), this study systematically evaluated the implementation effect of energy-saving measures. The research results show that after the implementation of intervention measures, the monthly average electricity savings in pediatric wards exceeded 900 kWh, with an average electricity saving rate of 21.36%. Through difference analysis, the impact of external environments was excluded, verifying the effectiveness of the three-dimensional collaborative mechanism. This study provides a comprehensive "technology-management-behavior" energy-saving path for medical institutions, which has high promotion value.

Keywords: Hospital energy conservation; Pediatric wards; Three-dimensional collaborative intervention model; Dual carbon goals

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1. Introduction

At the 75th Session of the United Nations General Assembly, China formally announced that it will strive to peak carbon emissions before 2030 and make every effort to achieve carbon neutrality before 2060, establishing the national-level "dual carbon" strategic goals. As a typical representative of energy-intensive buildings, hospitals have much higher energy consumption per unit area than ordinary commercial buildings^[1-2]. Globally, hospitals account for approximately 5.2% of total carbon emissions, making them an unignorable carbon source^[3]. Therefore, the effective implementation of energy management and carbon emission reduction in hospitals is

directly related to the progress of achieving China's national "dual carbon" goals.

With the continuous rise in energy demand in the medical industry, hospital energy management (especially the power system) has emerged as a core issue in the logistics support system. In addition to reducing operational costs, energy management can improve air quality, enhance patient comfort, boost public trust and competitiveness, forming a "health-environment" win-win situation^[4]. Relevant studies have shown that the air conditioning systems, lighting equipment, and office equipment in hospitals collectively consume more than 60% of the total electrical resources of the hospital, while the unique constant temperature and humidity requirements of medical buildings further exacerbate the pressure of energy consumption^[5]. The full implementation of China's national "dual carbon" action plan in 2025 has significantly increased the urgency of energy conservation and consumption reduction in medical institutions.

As a typical unit of high-energy-consuming areas in hospitals, pediatric wards exhibit a triple superposition effect in their energy consumption characteristics: concentrated spatial heat load caused by dense ward layout, continuous energy demand brought by the family accompanying rate exceeding 80%, and a basic energy consumption pool formed by the all-day operation of medical equipment (such as laminar flow beds). However, most current studies focus on buildings or single functional areas (e.g., operating rooms, diagnosis and treatment areas), lacking detailed analysis of the energy consumption behaviors of different departments and wards within hospitals^[6].

Based on this current situation, this study innovatively constructs a three-dimensional interactive and collaborative intervention model of "institutional level—equipment level—behavioral level", and conducts dual verification through a stepped controlled trial design: on the one hand, a self-control design from 2024 to 2025 is adopted to track the energy consumption changes in pediatric wards before and after the intervention; on the other hand, gynecological wards are set as the spatial control group to establish an inter-ward energy efficiency benchmark. By quantitatively evaluating the intervention effect, this study aims to explore a "technology + management + humanity" trinity path of energy conservation and efficiency improvement for medical institutions, provide replicable and promotable solutions, and assist the medical industry in achieving green and low-carbon transformation.

2. Construction of the three-dimensional collaborative intervention mechanism

As the three pillars of organizational management, the institutional level, equipment level, and behavioral level assume core functions of regulating operations, providing technical support, and guiding behaviors, respectively (**Figure 1**). The institutional level offers stability and order for the organization by formulating clear rules, processes, and standards, ensuring efficient collaboration across all links. The equipment level lays a material foundation for efficient operation and sustainable development through physical facilities and technical means, reducing energy consumption and risks. The behavioral level transforms the roles of systems and equipment into practical execution capabilities by standardizing employees' operational habits and strengthening cultural identity, thus promoting the achievement of organizational goals. The intervention mechanism co-constructed by the three levels enables closed-loop management of "rules—technology—practice": the institutional level provides the framework and constraints for the collaborative mechanism, the equipment level offers a guarantee for technical implementation, and the behavioral level ensures execution effects and cultural penetration. Such collaboration not only improves resource utilization efficiency and risk prevention and control capabilities (e.g., multi-

departmental collaboration in hospital energy conservation management and psychological crisis intervention) but also optimizes organizational performance through systematic integration, enhances resilience in responding to complex environments, and ultimately achieves sustainable development and value maximization.

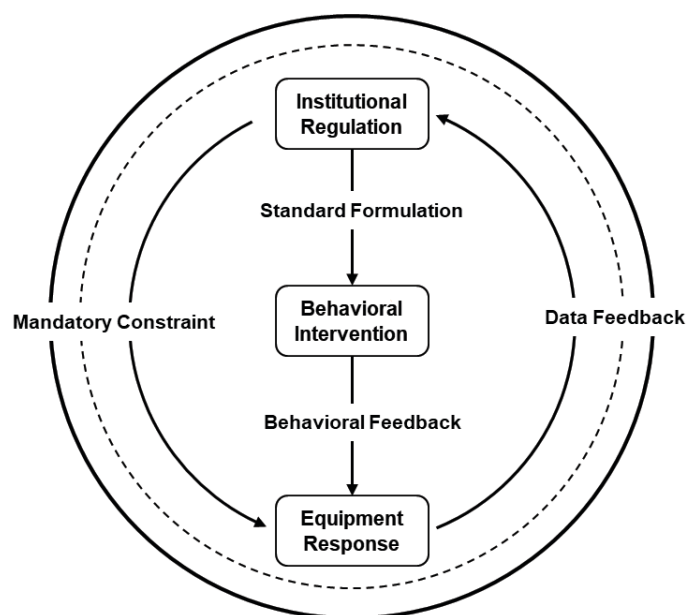


Figure 1. 3D interaction model

3. Methods: Stepped controlled trial design and mechanism implementation path

3.1. Trial design

This study adopted an experimental design combining before-and-after self-control and parallel spatial control. For the experimental group, energy consumption data of pediatric wards from January to June 2025 were selected, with the historical energy consumption data of the same wards during the corresponding period (January to June) in 2024 as the self-control; for the parallel spatial control group, energy consumption data of gynecological wards during the same periods (January to June 2024 and 2025) were used.

The gynecological wards were selected as the spatial control group mainly due to their adjacency to the pediatric wards and location on the same floor, which can effectively control air conditioning load changes caused by floor differences (e.g., higher floors being hotter and lower floors cooler), thereby eliminating the interference of this factor on energy consumption results.

Given that the overall energy consumption level of gynecological wards is usually higher than that of pediatric wards, direct comparison of absolute values is inappropriate. Therefore, this study adopted the difference comparison method to evaluate the energy-saving effect. Specifically, by calculating the difference in electricity consumption between pediatric and gynecological wards during the corresponding period in 2024 and comparing it with the difference during the same period in 2025, the actual electricity-saving effect of pediatric wards after implementing the energy-saving intervention measures based on the three-dimensional collaborative mechanism in 2025 was further verified (Table 1).

Table 1. Trial control design

Group	Data source	Time period	Description
Experimental Group	Pediatric Ward	2025.01-2025.06	Energy consumption data after implementing energy-saving intervention measures
Before-and-after Self-Control Group	Pediatric Ward	2024.01-2024.06	Historical data of the same period without implementing energy-saving intervention measures
Parallel Spatial Control Group	Gynecological Ward	2024.01-2024.06 2025.01-2025.06	Without energy-saving intervention, used to calculate the energy consumption difference with the experimental group to control the impact of time changes and external environments

3.2. Operational plan of the mechanism

3.2.1. Institutional level

The institutional level provides a standardized framework and implementation guarantee for energy conservation management through systematic rules and process design. Regarding the setting and management of air conditioning temperatures, relevant studies have shown that for every 1 °C increase in air conditioning temperature, the operating power of the compressor can decrease by approximately 7%–10%. Raising the set temperature from 25 °C to 26 °C in summer can save about 5%–10% of the total electricity consumption^[7]. International standards such as ASHRAE 55 and EN 15251 specify that the comfortable temperature range is 23 °C–26 °C in summer and 20 °C–24 °C in winter. Within this range, the human body experiences the most thermal comfort and is less prone to discomfort^[8]. Therefore, by collaborating with the logistics management department, the constant temperature of the central air conditioning system was set (26 °C in summer and 22 °C in winter), with clear regulations that doors and windows must be closed when the air conditioning is in use, and operation with open windows is prohibited to reduce energy waste. Energy conservation publicity and supervision are carried out by posting “Save electricity and turn off lights when leaving” signs near switches in wards and toilets to popularize energy-saving concepts among patients and their families. Meanwhile, nurses are required to actively check electricity usage during ward rounds to reduce unnecessary lighting. Time-phased electricity management further refines operational standards. For instance, during the lunch break (12:30–14:30), the main light strips in corridors and the lighting in corridors of office and living areas are turned off with one click; after 20:00, when pedestrian traffic in corridors is scarce, the main light strips in ward corridors and the lighting in office and living areas are switched off, with only basic brightness maintained; after 22:00, the auxiliary light strips in corridors are turned off. Regarding the scientific use of office equipment, it is specified that some devices (e.g., computers and printers) should be shut down after the P shift (18:00), and only one device is reserved for nursing documentation after the N shift (22:00) to minimize standby energy consumption. Through the full-chain standardization of temperature control, publicity and supervision, time-phased management, and equipment use at the institutional level, not only were refined energy-saving goals achieved, but also the combination of rule constraints and behavioral guidance promoted the improvement of organizational resource utilization efficiency and sustainable development.

3.2.2. Equipment level

The equipment level provides a solid material guarantee for the efficient operation and sustainable development of the organization through scientific maintenance and technical optimization. Studies have shown that cleaning air conditioners can reduce filter resistance and fan power, thereby lowering energy consumption and extending equipment service life^[9–10]. Therefore, in terms of equipment maintenance and efficiency optimization, the

logistics management department shall establish a systematic maintenance mechanism to ensure that key components such as air conditioning filters are regularly cleaned and replaced, thereby maintaining the equipment in a continuous optimal operating state. Specifically, the cleaning and replacement cycle of air conditioning filters should be dynamically adjusted based on the actual usage frequency of the equipment and the dust concentration of the surrounding environment: regular cleaning is usually performed monthly, while deep cleaning or replacement is required quarterly to sustain efficient equipment operation and reduce energy consumption. In addition, the role of the equipment level is not limited to the maintenance of individual devices, but also requires ensuring the stability and economy of the overall system through full-life-cycle management (e.g., regular inspection and maintenance of lighting systems, testing of energy consumption of office equipment). For example, conducting energy efficiency evaluations on lighting equipment such as corridor light strips and ward lighting, selecting low-power LED lamps, and optimizing control logic can further reduce power consumption during off-peak periods. The refined management at the equipment level not only directly improves resource utilization efficiency but also provides reliable technical support for the implementation of rules at the institutional level (e.g., time-phased electricity management) and energy-saving practices at the behavioral level (e.g., turning off lights when leaving). It forms a closed loop of “technical empowerment—rule constraints—behavioral collaboration”, ultimately achieving a win-win situation between energy-saving goals and organizational benefits.

3.2.3. Behavioral level

By standardizing employees’ operational habits and daily practices, the behavioral level transforms energy-saving concepts into actionable guidelines, serving as a key support for the collaborative implementation of systems and equipment. Regarding energy management in unoccupied areas, it is clearly required that air conditioning and lighting in non-active areas such as lecture rooms, wards, duty rooms, and offices must be turned off when unoccupied to avoid energy waste. Meanwhile, it is emphasized that all equipment in unoccupied areas (e.g., air conditioning and lighting in wards, offices, and duty rooms) should be fully inspected and turned off after work, forming a behavioral norm of “turning off power when leaving.” Regarding lighting and natural light utilization, the priority use of natural light is advocated to reduce the frequency of lighting fixture usage, with the requirement of “turning off lights when leaving.” For example, during periods of sufficient natural light, the main light strips in ward corridors or lighting in office areas are turned off, retaining only the necessary basic brightness. In addition, regarding ventilation and air conditioning usage habits, nurses actively guide patients to turn off the air conditioning and open windows for ventilation during morning and evening nursing rounds, which not only improves indoor air circulation but also reduces the operating load of the air conditioning. Through the standardization of daily operational details (e.g., regular inspections and active reminders), these specific behavioral norms not only strengthen energy conservation awareness but also form a closed loop with the time-phased management rules at the institutional level (e.g., turning off corridor light strips during lunch breaks) and the optimized maintenance at the equipment level (e.g., cleaning air conditioning filters). They jointly promote the achievement of resource conservation goals, ultimately establishing a trinity of sustainable management mechanisms featuring “rule constraints—technical guarantees—behavioral practices.”

4. Discussion on energy saving effects

This study adopted a quasi-experimental design combining before-and-after self-control and parallel spatial control to systematically evaluate the electricity-saving effectiveness of the “institution-equipment-behavior” three-

dimensional collaborative intervention mechanism. Electrical equipment in hospital wards is classified into four categories: lighting equipment, air conditioning equipment, office equipment, and clinical medical equipment. Among these, clinical medical equipment is classified as an essential electrical load and excluded from the scope of electricity-saving interventions; energy-saving measures mainly target lighting, air conditioning, and office equipment. When analyzing energy-saving effects, the baseline energy consumption of clinical medical equipment is deducted from the total electricity consumption to accurately reflect the impact of intervention measures on the target equipment.

The results of the before-and-after self-control in the pediatric ward (**Table 2**) showed that after the implementation of the multi-dimensional collaborative intervention, the total electricity consumption from January to June 2025 decreased significantly compared with the same period in 2024. The average monthly electricity savings exceeded 900 kWh, with an average electricity saving rate of over 20%. To exclude interference from external factors such as climate, this study introduced the gynecological ward as a parallel spatial control. No energy-saving measures were implemented in this ward, and its energy consumption in the same period of 2025 fluctuated minimally compared with 2024 (the average monthly electricity consumption was 7587.44 kWh and 7653.59 kWh, respectively, with a difference of only 0.08%).

Given that the overall energy consumption level of the gynecological ward is usually higher than that of the pediatric ward, this study adopted a difference comparison method for in-depth analysis. By calculating the monthly electricity consumption difference between the pediatric and gynecological wards from January to June 2024 and 2025 (**Table 3**) and plotting a comparative line chart (**Figure 2**), it was found that the average monthly electricity consumption of the pediatric ward from January to June 2024 was 4269.66 kWh, which was 44.21% lower than that of the gynecological ward. In 2025, after the implementation of electricity-saving interventions, the electricity consumption of the pediatric ward further decreased, and the difference from the gynecological ward expanded to 56.17% (pediatric ward: 3255.11 kWh vs. gynecological ward: 7587.44 kWh). **Figure 2** shows that the monthly electricity consumption difference curve from January to June 2025 shifted upward overall. This result strongly supports that the electricity-saving effect stems from the three-dimensional collaborative intervention mechanism rather than changes in the external environment over the years.

Table 2. Comparison of electricity consumption in pediatric ward between January–June 2024 and January–June 2025 (Unit: kWh)

Month	Self-Time Control			
	2024	2025	Energy Saving Effect	
	Electricity Consumption of Target Control Electrical Equipment	Electricity Consumption of Target Intervention Electrical Equipment	Electricity Saving	Electricity Saving Rate
January	4131.13	3422.27	708.86	17.16%
February	3391.18	2955.88	435.3	12.84%
March	4359.38	3152.67	1206.71	27.68%
April	4766.13	3325.4	1440.73	30.23%
May	4818.02	3341.77	1476.25	30.64%
June	4152.12	3752.66	399.46	9.62%
Average	4,269.66	3,325.11	944.55	21.36%

Table 3. Statistics of electricity consumption in pediatric and gynecological wards from January to June 2024 and 2025 (Unit: kWh)

Month	Spatial Control				Pediatric vs. Gynecological Reduced Electricity Consumption	
	2024		2025			
	Pediatric Target Intervention Electrical Equipment Consumption	Gynecological Target Control Electrical Equipment Consumption	Pediatric Target Intervention Electrical Equipment Consumption	Gynecological Target Control Electrical Equipment Consumption	2024	2025
	January	4131.13	6,882.84	3422.27	6509.23	2751.71
February	3391.18	6,399.78	2955.88	6,129.91	3,008.60	3174.03
March	4359.38	7,337.96	3152.67	8,475.48	2,978.58	5322.81
April	4766.13	8,459.69	3325.4	7,484.14	3,693.56	4158.74
May	4818.02	8,498.10	3341.77	8,788.33	3,680.08	5446.56
June	4152.12	8,343.18	3752.66	8,137.54	4,191.06	4,384.88
Average	4,269.66	7,653.59	3,325.11	7,587.44	3,383.93	4,262.33

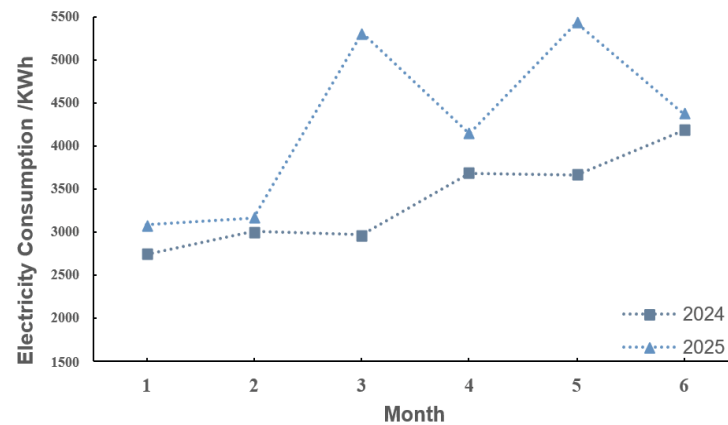


Figure 2. Reduced power consumption in pediatrics vs. gynecology

5. Conclusion

By constructing and practicing the “institutional—equipment—behavioral” three-dimensional collaborative intervention mechanism, this study significantly reduced the non-medical electricity consumption of the pediatric ward, with an electricity-saving rate exceeding 20%. This proves that the model can effectively integrate technical optimization, management standardization, and behavioral guidance to achieve refined energy-saving goals. The multi-dimensional controlled trial design scientifically excludes interfering factors such as climate and floor environment, enhancing the reliability of the conclusions. This practice not only provides a reusable systematic solution for energy conservation management in pediatric wards but also offers empirical support for medical institutions to promote overall green and low-carbon development. It can be promoted and further practiced at more ward levels in the future.

Disclosure statement

The authors declare no conflict of interest.

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Analysis of the Effectiveness of Precision Nursing Based on the KANO Model in Improving Health Outcomes for Patients with Threatened Abortion

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Abstract: *Objective:* To explore the application effect of a continuous precision nursing model based on the KANO model in patients with threatened abortion and evaluate its improvement on patients' clinical symptoms, psychological state, and sleep quality. *Methods:* A total of 100 patients with early threatened abortion admitted to the hospital from January 2023 to December 2024 were randomly divided into a control group and an intervention group, with 50 cases in each group. The control group received routine nursing, while the intervention group received continuous precision nursing under the guidance of the KANO model. The improvement time of clinical symptoms, changes in the Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), and Pittsburgh Sleep Quality Index (PSQI) scores were compared between the two groups. *Results:* The intervention group had significantly shorter times for cessation of vaginal bleeding, relief of abdominal pain and low back pain, and total hospital stay compared to the control group ($P < 0.05$). After the intervention, the SAS, SDS, and PSQI scores in the intervention group were significantly lower than those in the control group ($P < 0.05$). *Conclusion:* Continuous precision nursing based on the KANO model can effectively promote symptom relief, improve psychological state, and enhance sleep quality in patients with threatened abortion, demonstrating its value for promotion.

Keywords: KANO model; Continuous nursing; Precision intervention; Threatened abortion; Psychological state; Sleep quality

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1. Introduction

Threatened abortion, a common obstetric and gynecological pregnancy complication, is characterized by symptoms such as a small amount of vaginal bleeding, paroxysmal abdominal pain, or lumbago before 28 weeks of gestation. Gynecological examinations reveal that the cervix remains closed, the fetal membranes are intact, no products of conception have been expelled, and the size of the uterus corresponds to the gestational age based on the last menstrual period. With the advancement of requirements for fertility-friendly hospital construction, the

traditional, singular mode of tocolytic nursing care has found it difficult to meet patients' demands for specialized and personalized care. Consequently, improving patient health outcomes through precise nursing interventions has become a focal point of clinical research^[1-2]. The KANO model, proposed by Japanese quality management expert Noriaki Kano, has gradually been applied in the field of medical care in recent years. However, systematic research on its application in threatened abortion nursing remains scarce. This study constructed a precise nursing plan based on the KANO model, aiming to explore its impact on patients' clinical symptoms, psychological state, and sleep quality by analyzing their core nursing needs and implementing targeted interventions. The findings provide a reference for optimizing nursing strategies for threatened abortion.

2. Objects and methods

2.1. Objects

A total of 100 patients diagnosed with early threatened abortion who met the criteria and were treated in the outpatient and inpatient gynecology departments of the hospital from January 2023 to December 2024 were selected. Inclusion criteria were as follows: (1) meeting the diagnostic criteria for threatened abortion outlined in "Obstetrics and Gynecology (Ninth Edition)": a small amount of vaginal bleeding after amenorrhea, accompanied by mild lower abdominal pain; (2) B-mode ultrasound examination showing a viable gestational sac in the uterine cavity, with serum human chorionic gonadotropin (hCG) and progesterone levels consistent with the corresponding gestational age; (3) gestational age between 6 and 12 weeks; (4) female patients aged between 20 and 35 years; (5) patients with full civil capacity and autonomous consciousness, able to understand the trial content, voluntarily participate in this study, and having signed a written informed consent form. Exclusion criteria were: (1) threatened abortion clearly caused by embryonic chromosomal abnormalities, abnormal uterine morphology or structure, cervical incompetence, etc.; (2) concurrent severe primary heart disease, hypertension, diabetes, or functional failure of other vital organs. (3) A history of mental illness or neurological and psychological developmental delay caused by brain injury. (4) Those who withdrew from the clinical trial for some reason. Patients were randomly assigned to a control group ($n = 50$) and an intervention group ($n = 50$) using a random number table method. The mean age of the control group was 27.84 ± 3.56 years, with a ratio of primiparas to multiparas of 17:33; the mean age of the intervention group was 27.88 ± 3.56 years, with a ratio of primiparas to multiparas of 18:32. The general data of the two groups were comparable ($P > 0.05$).

2.2. Methods

2.2.1. Routine nursing care

The control group received routine nursing measures, which included strengthening the monitoring of patients' vital signs, observing for the presence of vaginal bleeding, and instructing patients to contact healthcare personnel promptly when experiencing uterine contractions. Patients were advised to avoid spicy and irritating foods and to consume a diet primarily consisting of stewed or steamed dishes. Patients were also instructed to reduce unnecessary activities and to take precautions against cold and ensure warmth.

2.2.2. KANO model-based precision nursing

The intervention group received a clinical nursing needs analysis for patients with threatened abortion based on the KANO model. Based on the analysis results of the KANO model, continuous precision nursing was developed and implemented as follows:

2.2.3. KANO model nursing needs survey

A nursing team consisting of one obstetrician and gynecologist, one head nurse, two senior nurses, and one physiotherapist was formed. A questionnaire containing 20 nursing needs was designed based on the characteristics of threatened abortion and nursing standards. The questionnaire covered dimensions such as condition monitoring, pain management, psychological support, health guidance, and environmental care, and was divided into five options using the KANO evaluation criteria: satisfied, expected, indifferent, acceptable, and dissatisfied. A pre-survey was conducted on 100 patients, and 98 valid questionnaires were collected. Through data analysis, the needs were classified as follows: (1) Essential needs: dynamic condition monitoring, standardized drug use, and emergency handling; (2) Expected needs: pain relief interventions, psychological and emotional counseling, and personalized dietary guidance; (3) Attractive needs: family-participatory care, prenatal health salons, and post-discharge continuous care.

2.2.4. Continuation of precision nursing

Physiological continuation nursing: Ensure that patients have sufficient rest and avoid strenuous exercise and heavy physical labor to reduce the exacerbation of symptoms. Based on syndrome differentiation and the theory of the circadian flow, select the melodies of Yu mode Yang rhyme and Gong mode Yang rhyme to be played at the Si (9–11 AM) and You (5–7 PM) hours, respectively. For auricular acupressure, select the points Shenmen, Subcortex, Sympathetic Nerve, Endocrine, Spleen, and Kidney, and apply pressure alternately to both ears, changing the pressure every other day. Instruct patients to press at 9:00 AM, 3:00 PM, and 9:00 PM daily, for 1–2 minutes each time. Dietary continuation nursing: Different types of threatened abortion should be treated with different foods. Patients should consume foods with high nutritional value and that are easy to digest to avoid indigestion caused by spleen and stomach damage. Regardless of the deficiency or excess pattern, patients with threatened abortion should avoid job's tears, cinnamon, dried ginger, peach kernels, crabs, rabbit meat, hawthorn, winter melon seeds, and water chestnuts. Those with blood heat should avoid spicy, stimulating, greasy, and damp-heat foods, as well as cold and raw foods. Social support continuation nursing: Leveraging network platforms, establishing electronic medical records for patients, facilitating timely updates, and providing access to relevant members of the nursing team. Utilize WeChat mini-programs to encourage patients to actively engage in self-management, thereby enhancing their self-management effectiveness. Inform patients about the correlations between negative emotions, sleep disorders, and abortion, deepening their understanding of negative emotions and sleep disorders, enhancing their self-care abilities, and promoting a conscious shift towards behaviors beneficial to their health, thereby improving their compliance with medical advice. Establish QQ and WeChat groups to regularly send links to threatened abortion prevention manuals and health knowledge, guiding patients to view them in their spare time. Psychological support nursing: Strengthen communication with patients, introduce knowledge about threatened abortion to them, assess their psychological states, analyze the causes of their psychological issues, and take effective measures to address them. Share successful treatment cases from the past with patients to boost their confidence in recovery.

2.3. Observation indicators

Compare the improvement time of clinical symptoms and psychological states between the two groups of patients (using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) to evaluate psychological stress levels)^[3]. Both SAS and SDS comprise 20 items, each scored from 1 to 4, resulting in a total score range

of 20 to 80, with higher scores indicating greater psychological stress, as well as sleep quality (assessed using the Pittsburgh Sleep Quality Index (PSQI), with a maximum score of 21 points, where the score is inversely proportional to sleep quality) ^[4].

2.4. Statistical analysis

Data analysis was performed using SPSS 20.0 software. Measurement data were expressed using t-tests and “Mean \pm SD”, with $P < 0.05$ indicating statistically significant differences in the data.

3. Results

3.1. Comparison of time required for clinical symptom improvement between the two groups

The intervention group had significantly lower times for all items compared to the control group ($P < 0.05$) (Table 1).

Table 1. Comparison of time required for clinical symptom improvement between the two groups (d, Mean \pm SD)

Group	Number of Cases	Vaginal Bleeding Cessation (days, Mean \pm SD)	Abdominal Pain Relief (days, Mean \pm SD)	Lower Back Pain Relief (days, Mean \pm SD)	Total Hospital Stay (days, Mean \pm SD)
Intervention Group	50	5.41 \pm 1.79	3.22 \pm 1.59	3.72 \pm 1.08	5.34 \pm 1.35
Control Group	50	7.98 \pm 2.06	8.84 \pm 2.13	6.28 \pm 1.62	6.11 \pm 1.36
t-value	-	6.659	14.951	9.297	2.841
P-value	-	0.001	0.001	0.001	0.006

3.2. Comparison of emotional and sleep quality scores between the two groups

The intervention group had lower SAS and SDS scores, as well as a lower PSQI score, compared to the control group ($P < 0.05$), as shown in Table 2.

Table 2. Comparison of emotional and sleep quality scores between the two groups (Mean \pm SD)

Group	Number of Cases	SAS (Pre)	SAS (Post)	SDS (Pre)	SDS (Post)	PSQI (Pre)	PSQI (Post)
Intervention Group	50	62.43 \pm 3.51	27.72 \pm 3.51	60.33 \pm 4.25	30.47 \pm 2.24	14.35 \pm 4.31	7.36 \pm 2.37
Control Group	50	61.72 \pm 3.12	32.66 \pm 3.29	60.31 \pm 5.21	36.25 \pm 3.14	14.29 \pm 4.37	10.32 \pm 2.67
t-value	-	1.069	7.261	0.021	10.596	0.069	5.863
P-value	-	0.288	0.001	0.983	0.001	0.945	0.001

4. Discussion

The advantage of the KANO model primarily lies in breaking away from the traditional “one-size-fits-all” approach to nursing services and providing care “on demand” based on patients’ needs, making nursing work more targeted. Patients with threatened abortion are filled with concerns about their pregnancy outcomes and have a variety of complex and changing needs. However, current routine care can only meet their basic needs and fails to adequately address their special needs. After conducting a survey and analysis using the KANO model, this study concluded that disease observation and management, as well as medication guidance, are must-have needs;

emotional comfort and selection of pain relief methods are expected needs; and family companionship, continuous health education, and follow-up are attractive needs that can significantly enhance nursing satisfaction ^[5].

The results of this study showed that the intervention group outperformed the control group in terms of the time taken for clinical improvement, emotional scores, and sleep quality scores ($P < 0.05$). Analyzing the reasons, the KANO model is a quality management tool that, in the clinical care of patients with threatened abortion, categorizes their needs into three core types: basic needs, attractive needs, and expected needs ^[6]. In this study, through the KANO model, the nursing needs of patients with threatened abortion were divided into three aspects: physiological, psychological, and social support. Understanding and applying these need categories of the KANO model can help medical institutions better design services by identifying and prioritizing the fulfillment of basic, expected, and attractive needs, thereby enhancing the overall medical experience of patients ^[7]. Continuous precision nursing focuses on multi-dimensional interventions encompassing patients' physiological, psychological, dietary, and social support needs, which contribute to a comprehensive improvement in their physical and mental health, reduction of anxiety and depression, enhancement of sleep quality, and strengthening of self-management abilities and quality of life. Targeted nursing measures can promptly respond to changes in patients' symptoms, effectively control abdominal pain, low back pain, and vaginal bleeding, shorten the total hospital stay, and reduce unnecessary consumption of medical resources ^[8].

Psychological factors play a significant role in the prognosis of threatened abortion, as anxiety and depression can affect progesterone secretion through the neuroendocrine system, exacerbating the condition. In this study, the scores of the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) in the observation group were significantly lower than those in the control group after intervention. Unlike the general education provided in routine care, the "assessment-counseling-consolidation" three-step approach adopted by the observation group was more targeted: it identified the root causes of psychological issues through scale screening, boosted confidence with successful case studies, and utilized cognitive-behavioral therapy to correct negative cognitions, effectively alleviating patients' anxiety and depression ^[9]. The improvement in psychological state directly contributed to enhanced sleep quality, as evidenced by a significant reduction in the Pittsburgh Sleep Quality Index (PSQI) scores in the observation group, indicating good sleep quality. This is because emotional stability reduced nocturnal rumination, while interventions such as a comfortable hospital room environment and relaxation training further optimized sleep structure ^[10].

5. Conclusion

In conclusion, precision nursing based on the KANO model achieves stratified intervention in the care of patients with threatened abortion through need categorization, significantly shortening the time for clinical symptom improvement, alleviating anxiety and depression, and enhancing sleep quality, thus demonstrating its value for widespread implementation.

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Application and Development of Nursing Education in the Emergency Department and Surgical Critical Care

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Abstract: This paper explores theoretical frameworks in emergency and surgical critical care education, particularly the application and significance of situational simulation teaching. It analyzes teaching models, including traditional apprenticeship systems and micro-teaching methodologies, evaluating their respective advantages and limitations. The study identifies existing challenges such as fragmented curriculum development and faculty imbalance, while proposing targeted improvement measures. The paper emphasizes the strategic application of emerging technologies in educational reform.

Keywords: Emergency nursing education; Teaching models; Educational reform

Online publication: December 17, 2025

1. Introduction

With the continuous development of China's medical industry, the "Opinions on Deepening the Collaboration between Medical Education and Further Promoting the Reform and Development of Medical Education" issued in 2017 emphasized the importance of medical education reform. Nursing education, as an important component of medical education, plays a crucial role in emergency departments and surgical critical care. Various theories, such as situational simulation teaching, provide support for it, but there are currently many problems in teaching modes, resource allocation, curriculum construction, etc., such as the advantages and disadvantages of teaching modes in emergency departments of tertiary hospitals, insufficient teaching resources, and a gap between curriculum theory and practice. Therefore, conducting research on the reform of the nursing education system has important practical significance.

2. Theoretical foundations of nursing education in critical care nursing

2.1. Core theoretical framework of emergency nursing education

Situational simulation teaching has significant theoretical underpinnings in emergency nursing education, which is based on constructivist learning theory that emphasizes learners' active construction of knowledge and skills in real or near-real contexts ^[1]. By simulating emergency scenarios, nurses can experience and respond to various critical situations in a safe environment, thereby enhancing their clinical thinking and practical capabilities. The clinical decision tree model, grounded in evidence-based medicine, provides emergency nursing professionals with a systematic clinical decision-making approach, assisting nurses in making rapid and accurate diagnostic and treatment decisions based on patients' symptoms, signs, and examination results. Adult learning theory also plays an important role in the training of specialist nurses; this theory posits that adult learners are characterized by self-direction, rich life experience, and a focus on practicality. Therefore, in the training of specialist nurses, these characteristics should be fully taken into account, and flexible and diverse teaching methods such as case analysis and group discussions should be adopted to meet the learning needs of adult learners.

2.2. Characteristic theories of surgical critical care nursing education

Damage control theory emphasizes that in surgical critical care nursing, efforts should be made to avoid the exhaustion of patients' physiological potential caused by definitive surgery, and a phased treatment approach should be adopted ^[2]. The concept of enhanced recovery after surgery (ERAS) focuses on promoting patients' rehabilitation by optimizing various perioperative measures, such as reducing preoperative fasting time and encouraging early ambulation. In surgical nursing education, the construction system of this theoretical knowledge is crucial. It enables nursing staff to understand the special needs of critically ill patients, thereby providing more scientific and reasonable nursing care. Standardized patients (SPs) also play a unique role in skill training. By simulating real clinical scenarios, nursing staff can conduct various operational and communication exercises on SPs, improve their clinical skills and response capabilities, and better serve critically ill surgical patients.

3. Analysis of the application status of nursing education models

3.1. Implementation paths of clinical teaching in emergency departments

Domestic Grade A tertiary hospitals adopt diverse teaching models in emergency departments, with the traditional apprenticeship system and microteaching method each having distinct characteristics. The traditional apprenticeship system focuses on the inheritance of clinical experience; under the guidance of preceptors, students directly participate in clinical practice, enabling them to quickly accumulate practical operational experience. However, the teaching effect may vary due to individual differences among preceptors ^[3]. The microteaching method emphasizes the refinement and standardization of the teaching process, decomposing complex teaching content into multiple small teaching units, which helps students learn systematically but may lack the experience of real clinical scenarios. The application of high-fidelity patient simulators (HPS) in emergency department teaching has gradually gained attention. HPS can simulate various critical care scenarios, providing students with a safe and repeatable practice environment to enhance their clinical thinking and emergency response capabilities, but the current application coverage needs to be improved.

3.2. Bottlenecks in surgical critical care nursing training

Patients with multiple traumas present complex and acute conditions, and emergency rescue training has high

requirements for teaching resources. On one hand, clinical case resources are limited, making it difficult to meet the practical needs of a large number of trainees. Additionally, some cases lack systematicness and completeness, which is not conducive to trainees' comprehensive mastery of rescue processes ^[4]. On the other hand, simulation teaching equipment is insufficient or outdated, failing to truly simulate complex trauma scenarios and hindering the cultivation of trainees' practical operational capabilities.

In terms of fostering interprofessional collaboration capabilities, existing systems have certain obstacles. There is a lack of effective communication and collaboration mechanisms between different specialties, leading to potential disconnections in the process of patient treatment. Meanwhile, the assessment and evaluation system is incomplete, with no clear standards for assessing interprofessional collaboration capabilities. This makes it difficult to motivate nurses to actively improve such capabilities, thereby restricting the development of surgical critical care nursing training.

4. In-depth analysis of existing problems in the education system

4.1. Problems in the dimension of curriculum construction

4.1.1. Disconnection between theory and practice

In the nursing education system, there exists a disconnection between theory and practice in curriculum construction. Taking emergency and surgical critical care nursing education as examples, the lagging update of case libraries is one of the key factors. With the rapid development of medicine, clinical realities are constantly changing, but case libraries fail to keep pace timely, resulting in discrepancies between the cases encountered by nursing students and actual clinical scenarios ^[5]. This leads to skill deviations when nursing students apply theoretical knowledge to practice. Meanwhile, due to the outdated cases, students struggle to accurately grasp the key points of transforming clinical thinking, resulting in an insufficient conversion rate of clinical thinking. Such a disconnection between theory and practice seriously affects the quality of nursing education and is not conducive to cultivating professional nursing talents who can meet the actual needs of clinical practice.

4.1.2. Lack of a hierarchical and progressive system

There is a lack of a hierarchical and progressive system in nursing education, which is prominently reflected in the training of nursing interns at different academic levels. The training standards for interns of various academic backgrounds (such as technical secondary school, junior college, undergraduate, and postgraduate levels) are insufficiently matched with the demands of clinical critical care nursing, failing to fully align with the actual work requirements of emergency departments and surgical departments. For instance, in the fields of key skills and professional knowledge related to critical care nursing, existing training programs may be overly general or lack sufficient depth, leaving nursing interns with competency gaps when dealing with complex clinical situations ^[6]. At the same time, the construction of a post-competency model for nursing interns is still incomplete. The existing model fails to fully cover the core competency elements required for critical care nursing, such as emergency response capabilities, multidisciplinary team collaboration skills, and rapid assessment and decision-making abilities for acute conditions. This directly impacts the clinical practice effect and training quality of interns.

4.2. Problems in the allocation of teaching resources

4.2.1. Structural contradictions in teaching staff

The teaching staff in emergency and surgical critical care nursing education face an imbalance in the gradient

distribution of teaching capabilities, as reflected by data on both academic qualifications and clinical experience years. Some teachers, despite holding high academic degrees, lack sufficient clinical experience and practical case expertise, leading them to focus more on theory in teaching without providing adequate practical guidance to students ^[7]. Conversely, some teachers with rich clinical experience may have relatively lower academic qualifications, resulting in deficiencies in the systematic imparting of theoretical knowledge. This imbalance impairs teaching quality and hinders the cultivation of nursing talents with both solid theoretical foundations and proficient practical skills. The allocation of teaching resources has failed to effectively address this contradiction, preventing the teaching staff from fully exerting their potential and restricting the development of emergency and surgical critical care nursing education.

4.2.2. Lagging construction of informationized teaching platforms

In the education system, the lagging construction of informationized teaching platforms is a prominent issue in the allocation of teaching resources. Taking the application of nursing education in emergency and surgical critical care as an example, the use of technologies such as virtual reality (VR) for critical care training encounters numerous obstacles. On one hand, there is a shortage of hardware facilities—for instance, VR devices lack sufficient precision and stability, making it difficult to meet the needs of simulating complex clinical scenarios ^[8]. On the other hand, software development faces challenges, with a lack of high-quality teaching software that can perfectly synergize with hardware. The software content may be insufficiently rich or accurate, failing to truly replicate the practical operational processes and emergent situations in critical care nursing. This lag in the coordinated development of hardware and software seriously undermines the effective application of informationized teaching platforms in nursing education, restricts the improvement of teaching quality, and is not conducive to cultivating critical care nursing talents who can meet the actual demands of clinical practice.

5. Construction of nursing education development strategies

5.1. Optimization paths of the curriculum system

5.1.1. Modular curriculum development plan

Design an ABCDE hierarchical curriculum module based on clinical pathways, which needs to integrate actual clinical needs and nursing education objectives. ABCDE can correspond to different nursing stages or the severity of patients' conditions, respectively, making the curriculum content more targeted and systematic. For example, Module A can focus on basic nursing knowledge and skills in the initial stage of trauma emergency care, such as hemostasis and bandaging ^[9]. As the modules progress, Module C, for instance, can delve into complex nursing operations and key points of condition monitoring in the intensive care stage. Meanwhile, formulating vertical connection standards for trauma emergency care, intensive care, and rehabilitation nursing is crucial. Clarify the connection points of knowledge and skills at each stage to ensure students can smoothly transition from one stage to the next, achieve the coherence and completeness of knowledge, improve the quality of nursing education, and better meet the clinical needs of emergency and surgical critical care nursing.

5.1.2. Interdisciplinary joint training mechanism

Construct an interdisciplinary curriculum system integrating emergency medicine, nursing, and engineering, aiming to cultivate nursing talents with comprehensive capabilities in medical instrument operation and maintenance. This system integrates the core knowledge and skills of the three disciplines, enabling students to

fully understand the medical principles, nursing operations, and the application and maintenance of instruments involved in critical care nursing^[10]. In terms of curriculum design, emphasis is placed on the integration of theory and practice. Through case analysis, simulation operations, and other methods, students can master knowledge and skills in practical scenarios. At the same time, strengthen the construction of the teaching team, encourage teachers to engage in interdisciplinary learning and research, and improve teaching quality. In addition, establish practical teaching bases to provide students with real clinical environments and opportunities to operate instruments, further enhancing their comprehensive capabilities to adapt to the development needs of emergency and surgical critical care nursing.

5.2. Innovative practices in teaching methods

5.2.1. Exploration of blended teaching models

The integration of Massive Open Online Courses (MOOCs) and flipped classrooms brings new opportunities for emergency skills training. MOOCs provide abundant online learning resources, including theoretical knowledge and operational demonstration videos, allowing students to arrange their learning progress independently. Flipped classrooms, on the other hand, utilize class time for practical operations, case discussions, and answering questions. This combination of online and offline methods can effectively improve students' learning enthusiasm and initiative. Meanwhile, establishing a reasonable online-offline class hour allocation model is essential. Class hours should be scientifically distributed according to the difficulty, key points of teaching content, and requirements of practical operations. For example, for some basic theoretical knowledge, online learning time can be appropriately increased; while for key emergency skill operations, sufficient offline practical class hours must be guaranteed to ensure students master them proficiently.

5.2.2. Reform of objective structured clinical examination (OSCE)

In the reform of the Objective Structured Clinical Examination (OSCE), a multi-station assessment system including emergency cart equipment operation and team collaboration should be designed. This multi-station assessment can more comprehensively examine students' comprehensive capabilities in emergency and surgical critical care nursing. At the same time, improve the weight distribution algorithm of assessment indicators, reasonably determine the weights of different assessment indicators, so that the assessment results can more accurately reflect students' actual levels. For example, appropriate weights should be given to the proficiency in emergency cart equipment operation, communication skills, and role assumption in team collaboration, etc. Through such reforms, the scientificity and effectiveness of the OSCE can be improved, better promoting the development of nursing education in the field of emergency and surgical critical care nursing.

5.3. Construction of quality evaluation system

5.3.1. Improvement of the Kirkpatrick evaluation model

When improving the Kirkpatrick evaluation model, the fourth-level outcome evaluation can be refined. Expand it from the traditional, relatively broad scope to dimensions such as patient prognosis indicators and medical cost control. Considering patient prognosis indicators can directly reflect the effect of nursing education in practical clinical applications, such as patients' recovery speed and complication rate. At the same time, the inclusion of the medical cost control dimension is also crucial, as it can measure whether nursing education rationally utilizes medical resources and avoids unnecessary waste while improving nursing quality. On this basis, construct a quantitative evaluation matrix and assign quantitative values to each dimension to more accurately and objectively

assess the effectiveness of nursing education, providing strong data support and decision-making basis for the further development of nursing education.

5.3.2. PDCA cycle quality improvement

To promote the development of nursing education, it is necessary to establish a quality evaluation system and apply the PDCA cycle for improvement. In terms of the construction of the quality evaluation system, multi-dimensional indicators such as the achievement of educational objectives, the improvement of students' capabilities, and the effect of clinical practice should be comprehensively considered. At the same time, establish a dynamic feedback mechanism based on adverse event analysis to promptly identify problems in the educational process. For PDCA cycle quality improvement, first determine the Plan based on the current educational situation and clinical needs; then implement (Do) the educational activities in strict accordance with the plan; next check (Check) the educational effect through the quality evaluation system; finally act (Act) by adjusting and optimizing the educational plan according to the inspection results, continuously improving the quality of nursing education to better apply it in emergency and surgical critical care nursing.

6. Conclusion

Nursing education plays a crucial role in emergency and surgical critical care nursing. The reform of its system is of key significance for improving the level of treatment. By continuously optimizing educational content and methods, it can better cultivate professional talents who meet the needs of critical care nursing. In the future, artificial intelligence-assisted teaching and the application of metaverse technology will become important research directions. These new technologies are expected to bring innovative teaching models and experiences to nursing education, further enhancing educational effectiveness. Meanwhile, people should adhere to a sustainable development path that combines standardization and personalization in nursing education. Standardization ensures the basic quality and norms of nursing education, while personalization can meet the learning needs and characteristics of different students. The two are complementary, jointly promoting the continuous development of nursing education in the field of critical care nursing and providing higher-quality nursing services for patients.

Disclosure statement

The author declares no conflict of interest.

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Yinao Capsules Combined with Memantine Hydrochloride in the Treatment of Alzheimer's Disease in the Elderly

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Abstract: *Objective:* To investigate the clinical efficacy of Yinao capsule combined with memantine hydrochloride in the treatment of Alzheimer's disease (AD) in the elderly, and to analyze its effects on cognitive function and quality of life of patients. *Methods:* A total of 84 elderly AD patients admitted to the hospital from June 2022 to June 2023 were randomly divided into an observation group (42 cases, Yinao capsule combined with memantine hydrochloride) and a control group (42 cases, memantine hydrochloride monotherapy), both of which were treated for 3 months. The Mini-Intelligent Mental State Scale (MMSE) was used to evaluate cognitive function, and the Quality of Life Scale for Alzheimer's Patients (QOL-AD) was used to evaluate the quality of life. *Results:* Before treatment, there was no significant difference in the MMSE AND QOL-AD scores between the two groups ($P>0.05$). After 3 months of treatment, the MMSE AND QOL-AD scores of both groups were significantly higher than those before treatment (both $P<0.001$), and the MMSE (24.70 ± 3.70 points) and QOL-AD (31.60 ± 3.59 points) scores in the observation group were significantly higher than those in the control group (21.24 ± 3.33 points) and (28.44 ± 3.26 points), both $P<0.001$. There were no serious adverse reactions in either group. *Conclusion:* Yinao capsule combined with memantine hydrochloride can significantly improve cognitive function and quality of life in elderly AD patients, and the efficacy is better than memantine hydrochloride monotherapy, and the safety is good.

Keywords: Alzheimer's disease dementia in the elderly; Yinao capsule; Memantine hydrochloride; Cognitive function; Quality of life

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1. Introduction

Alzheimer's disease dementia (AD) is a chronic neurological degenerative disease whose cause has not been fully determined, mainly characterized by progressive memory loss and cognitive dysfunction^[1]. The prevalence of

AD increases significantly with age. The prevalence is approximately 0.20% among 59-year-olds and as high as 35.90% among those over 90, presenting a distinct age gradient ^[2]. It will not only lead to the gradual impairment of patients' ability to perform daily life and social activities, seriously reduce their quality of life, but also bring heavy care pressure and economic burden to the family and society ^[3]. There is currently no curative therapy, and clinical practice mainly relies on drugs (such as cholinesterase inhibitors, NMDA receptor antagonists, etc.) to delay disease progression, improve cognitive function, and daily living ability ^[4].

Memantine hydrochloride is a non-competitive N-methyl D-aspartate (NMDA) receptor antagonist that selectively blocks pathologically overactivated NMDA receptors and reduces glutamate-mediated excitotoxicity, thereby improving cognitive function and psychobehavioral symptoms in patients with moderate to severe AD ^[5]. A large number of clinical trials have shown that memantine significantly improves patients' cognitive scores, ability to perform daily living, and control of behavioral disorders, and is generally well tolerated ^[6]. However, memantine hydrochloride alone also has limitations. First, memantine only targets the glutamatergic system and fails to simultaneously regulate multiple pathological links, such as the cholinergic system, inflammatory response, and oxidative stress involved in the course of AD, resulting in limited clinical efficacy in some patients. Secondly, long-term medication may cause gastrointestinal discomfort (such as nausea, vomiting) and central nervous system side effects (such as dizziness, headache), and some patients may even experience a decrease in efficacy. Therefore, the combination of memantine with cholinesterase inhibitors or other neuroprotective agents is often considered clinically in order to achieve more comprehensive pathological intervention and longer-lasting efficacy ^[5-6].

In the theory of traditional Chinese medicine, AD belongs to the categories of "dementia" and "forgetfulness", and the pathogenesis is based on kidney essence deficiency, insufficient qi and blood, cerebral marrow dystrophy, phlegm turbidity, and blood stasis blocking the brain channel. As a proprietary Chinese medicine developed based on the theory of traditional Chinese medicine, Yinao capsule contains ginseng, codonopsis, Ganoderma lucidum, tortoiseshell gum, poria, and other multi-flavored traditional Chinese medicines, which have the effects of nourishing qi and yin, nourishing the kidney and brain, nourishing the mind, and calming the nerves. Ginsenosides in ginseng and other medicinal materials, Rg1 significantly increased the concentration of extracellular acetylcholine in the hippocampus of rats with an AD model, improving cognitive function ^[7-8]. Rg1 promotes A β degradation by upregulating the PPAR γ /IDE pathway, reducing A β content in the hippocampus, and improving memory ^[9]. In APP/PS1 transgenic mice, Rg1 treatment significantly reduced A β 142 and phosphorylated tau (pTau) levels and restored synaptic plasticity ^[10]. At the same time, Rg1 also showed the effect of inhibiting NLRP1 inflammasomes and reducing inflammatory mediators, further supporting its anti-inflammatory effects ^[11]. Ganoderma lucidum polysaccharide can significantly reduce the expression of pro-inflammatory cytokines such as TNF α and IL6, and improve cognitive impairment by modulating the inflammatory network of the brain-liver axis ^[12]. These mechanisms of action are complementary to the glutamate modulation of memantine hydrochloride, providing a theoretical basis for the combined application of the two in the treatment of AD.

2. Information and methods

2.1. General information

A total of 84 elderly patients with Alzheimer's disease dementia admitted to the hospital from June 2022 to June 2023 were selected as the research subjects. Inclusion criteria: Meet the diagnostic criteria for AD set by the National Institute of Neurological Disorders and Stroke-Alzheimer's and Related Disorders Association (NINDS-

AD/DA); Age ≥ 60 years; Patients and their families are informed and sign the informed consent form. Exclusion Criteria: Patients with severe dementia; Patients with cognitive impairment not caused by AD, such as vascular dementia and frontotemporal lobe dementia; Patients with impaired consciousness, severe physical diseases (such as severe heart, liver, and kidney failure), severe depression, speech disorders, and allergies. This study protocol was approved by the hospital ethics committee. The patients were divided into a control group and an observation group according to the random number table method, with 42 cases in each group. There were 27 males and 15 females in the control group; Age 60–82 years, mean 71.1 ± 1.0 years; The duration of the disease was 0.5–16.1 years, with an average of 4.5 ± 1.1 years. There were 30 males and 12 females in the observation group. Age 61–81 years, mean 70.9 ± 1.1 years; The duration of the disease is 0.5–16.3 years, with an average of 4.6 ± 1.2 years. The general data, such as gender, age, and disease course of the two groups, were compared, and the differences were not statistically significant ($P > 0.05$), which were comparable.

2.2. Treatment

Both groups received basic interventions during treatment, including health publicity and education (guiding family members to master patient care skills) and simple cognitive training (such as memory games and language communication exercises). The control group was treated with memantine hydrochloride tablets (Guangzhou Baiyunshan Pharmaceutical Group Co., Ltd. Baiyunshan Pharmaceutical General Factory, Sinopharm Zhunzi H20090310), and the dose adjustment regimen was: 5 mg/time in week 1, 1 time/d (oral administration before going to bed); 10 mg/time, 1 time/day in week 2; 15 mg/time, 1 time/d in week 3; Maintain 20 mg/time, 1 time/d, for 3 months of continuous treatment at week 4 and beyond. The observation group was treated with Yinao Capsule (Guizhou Sanli Pharmaceutical Co., Ltd., Sinopharm Zhunzi Z52020035, 0.3g/capsule), 3 capsules/time, 3 times/d (oral administration after meals), and continued treatment for 3 months.

2.3. Observation indicators

The cognitive function and quality of life of the patients in the two groups before and after 3 months of treatment were observed, and the occurrence of adverse reactions (such as headache, vomiting, dizziness, etc.) during the treatment period was recorded.

2.4. Evaluation criteria

Cognitive function assessment: The Mini-Mental State Examination Scale (MMSE) was adopted, which covers orientation, memory, attention, calculation, language ability, and other dimensions, with a total score of 30 points. Quality of life assessment: The Quality of Life Scale for Alzheimer's Patients (QOL-AD) was adopted, which contains a total of 13 items in 4 domains, with a total score ranging from 13–52 points, with higher scores indicating a higher quality of life for patients.

2.5. Statistical methods

The data were processed by SPSS 20.0 software, and the measurement data were expressed in Mean \pm SD, and the *t*-test was used for comparison before and after treatment within groups and between groups. Numerical data are expressed as frequencies (%), and the comparison is tested using the χ^2 test. The difference was statistically significant in $P < 0.05$.

3. Comparison of clinical efficacy between the two groups

3.1. Comparison of cognitive function (MMSE score) and quality of life (QOL-AD score) between the two groups before and after treatment

Before treatment, there was no difference in MMSE score (19.09 ± 3.02 points) between the observation group and the control group (19.04 ± 2.97 points) ($P=0.936$). After 3 months of treatment, the MMSE scores of both groups were significantly increased (24.70 ± 3.70 points in the observation group and 21.24 ± 3.33 points in the control group), and the score of the observation group was significantly higher than that of the control group ($P<0.001$). Before treatment, there was no difference in QOL-AD score (23.30 ± 2.58 points) between the observation group and the control group (23.27 ± 2.60 points) ($P=0.953$), and after 3 months of treatment, the QOL-AD score of both groups was significantly increased (observation group 31.60 ± 3.59 points, control group 28.44 ± 3.2 points), and the comparison within the group was $P<0.001$). The score of the observation group was significantly higher than that of the control group ($P<0.001$) (Table 1).

Table 1. MMSE, QOL-AD scores, and P values before treatment and after 3 months in the two groups

Constituencies	MMSE score			QOL-AD score		
	Before treatment	After 3 months of treatment	P -value before and after treatment	Before treatment	After 3 months of treatment	P -value before and after treatment
Observation group ($N=42$).	19.09 ± 3.02	24.70 ± 3.70	<0.001	23.30 ± 2.58	31.60 ± 3.59	<0.001
Control group ($N=42$).	19.04 ± 2.97	21.24 ± 3.33	<0.001	23.27 ± 2.60	28.44 ± 3.26	<0.001
P -value	0.936	<0.001		0.953	<0.001	

3.2. Security

During the treatment period, 1 case in the observation group had a mild headache, 1 case in the control group had nausea, and 1 case had dizziness, all of which were not treated for spontaneous relief, and no serious adverse reactions occurred (Table 2).

Table 2. The occurrence of adverse reactions

Constituencies	Headache	Disgusting	Dizzy	Total incidence (%)
Observation group	1 (2.38)	0 (0.00)	0 (0.00)	2.38
Control group	0 (0.00)	1 (2.38)	1 (2.38)	4.76
P -value	-	-	-	0.557

4. Discussion

The pathological process of AD involves multiple mechanisms, such as neuronal damage, neurotransmitter imbalance, and inflammation, and its core treatment goal is to delay cognitive decline and maintain the patient's quality of life. This study achieved significant results in improving cognitive function and quality of life through the combination of Yinao capsules with memantine hydrochloride.

As an NMDA receptor antagonist, memantine hydrochloride in AD pathology can specifically block neuronal excitotoxicity caused by overactivation of glutamate, reduce synaptic damage and neuronal loss,

and improve cognitive function in patients ^[13]. However, a single drug works only on the glutamate system and has limited intervention in the complex pathological network of AD ^[14]. In the formula of Yinao capsule, ginseng and codonopsis nourish qi and strengthen the spleen to transform qi and blood, Ganoderma lucidum and tortoise shell gum nourish the kidney and strengthen the brain to nourish the brain marrow, and Poria calms the mind and calms the mind to regulates the vitality. Modern pharmacological research has shown that Yinao capsules can synergize through multiple pathways. First, by promoting the synthesis and release of acetylcholine, cholinergic nerve function is enhanced ^[15]. Yinao capsule complements the glutamate regulation of memantine hydrochloride, comprehensively improving the balance of neurotransmitters in the brain. Second, Rgl delays neuronal degeneration by restoring mitochondrial autophagy (PINK1Parkin pathway) by reducing A β plaques and attenuating tau phosphorylation ^[16]. Provides structural support for the “neuroprotective” effects of memantine hydrochloride. At the same time, Rgl can also promote A β degradation by inhibiting the ERK/PPAR γ phosphorylation pathway ^[17]. Third, in the APP/PS1 mouse model, Rgl significantly downregulated the expression of TNF α and IL1 β in the inflammasome of NLRP1 and its downstream, showing strong anti-inflammatory effects ^[18]. In addition, Rgl further inhibits tau phosphorylation and mitigates oxidative stress by modulating the Wnt/GSK3 β / β catenin signaling pathway ^[7].

Ganoderma lucidum in the formula has a “nootropic and calming” effect. Ganoderma lucidum spore extract can inhibit NF- κ B/NLRP3 inflammatory pathway and enhance GABAergic neuronal activity, thereby improving sleep disturbance and restoring cognitive function in rat models with AD ^[19]. In early models of AD, shelled Ganoderma lucidum spores significantly reduced microglial activation and inflammatory factor expression (TNF) in the hippocampus and prefrontal cortex-ATHE-1 β), and elevated BDNF levels, exhibiting antidepressant and anxiolytic effects ^[20]. Molecular docking and kinetic simulations showed that glycyrrhizic acid A and mannitolic acid B in Ganoderma lucidum had a high affinity for MARK4 (microtubule affinity-regulated kinase 4), which could inhibit its activity, thereby blocking the key pathway of abnormal phosphorylation of tau protein ^[21]. In addition, liquid-fermented Ganoderma lucidum (GANO99) can remodel the gut microbial structure of AD transgenic mice, reduce A β plaque deposition, and improve memory behavior ^[21]. Ganoderma lucidum is anti-inflammatory, antioxidant, and anti-inspired A β and anti-tau pathology, making it promising in AD prevention and treatment ^[22].

The above multi-target mechanism is similar to that of memantine hydrochloride. Glutamate regulation is complementary: memantine primarily reduces NMDA receptor-mediated excitotoxicity, while Yinao capsules can repair damaged neurons at the structural level and improve overall neural network function by enhancing cholinergic delivery, scavenging A β , inhibiting tau pathology, and inhibiting inflammation. For this reason, the combination of the two has shown better improvements in cognitive function, daily living ability, and quality of life in this clinical observation. To be a potential strategy to optimize AD treatment options. The quality of life of AD patients is not completely linearly correlated with cognitive function, and factors such as emotional state and behavioral abnormalities can also directly affect their ability to live. The “nootropic and calming” effect of the Yinao capsule can reduce the decline in life ability caused by mental symptoms by regulating central nervous system function and relieving patients’ mental and behavioral symptoms, such as anxiety and paranoia ^[23–26]. This is also an important driver of improved QOL-AD scores.

Clinical manifestation of TCM toxicity reduction and efficiency. In this study, the total incidence of adverse reactions in the observation group was lower than that in the control group; although the difference was not statistically significant, it could be observed from the clinical details. The symptoms of nausea and dizziness

in the control group were related to the gastrointestinal stimulation and central regulatory effects of memantine hydrochloride, while only one mild headache in the observation group had spontaneous relief. The traditional Chinese medicine properties of Yinao capsule play a key role in this: Codonopsis and Poria in its formula have the effect of strengthening the spleen and stomach, and can reduce the direct irritation of memantine hydrochloride to the gastrointestinal tract ^[27–29]. The yin-nourishing and latent yang effects of Ganoderma lucidum and tortoiseshell gum can buffer the regulation fluctuations of memantine hydrochloride on the central nervous system, thereby reducing the risk of adverse reactions such as dizziness ^[29]. This characteristic of “reducing toxicity and increasing efficiency” provides a guarantee for the safety of long-term treatment and is also in line with the treatment of integrated traditional Chinese and Western medicine, “Increasing efficiency without increasing toxicity” clinical expectations.

There are two limitations of this study: first, the sample size is small, and it is a single-center study, and the results may be geographical or population bias; Second, the observation period was only 3 months, and the long-term efficacy and drug tolerability were not evaluated. In the future, the following directions can be further explored: expand the sample size, carry out multicenter, randomized, double-blind trials, and enhance the universality of the results. The follow-up time was extended to analyze the long-term safety and delay of disease progression of combination therapy. Combined with cerebrospinal fluid biomarkers, imaging examinations, and other objective indicators, the molecular mechanism of drug synergy is deeply analyzed.

5. Conclusion

Yinao capsule combined with memantine hydrochloride in the treatment of elderly AD can significantly improve patients' cognitive function and quality of life through multi-target synergy, and has a good safety profile, making it a treatment plan worthy of clinical promotion.

Disclosure statement

The authors declare no conflict of interest.

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Application of the MDT Clinical Teaching Model in Screening for Geriatric Sarcopenia and Nutrition Intervention Education

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Abstract: *Objective:* To investigate the effectiveness of the multidisciplinary team (MDT) clinical teaching model in screening for sarcopenia and nutrition intervention education among the elderly. *Methods:* Sixty undergraduate medical students undergoing clinical internships in the geriatrics department of a hospital from June 2024 to May 2025 were randomly assigned to a control group (n=30) and an observation group (n=30) using a random number table. The control group received conventional bedside teaching, while the observation group underwent MDT-based teaching. Post-internship assessments compared both groups on theoretical knowledge, clinical practice skills, and clinical reasoning. *Results:* The observation group achieved significantly higher scores than the control group in both basic theoretical knowledge (83.40 ± 10.03 vs. 72.24 ± 11.64 , $P < 0.05$) and clinical practice assessment (89.81 ± 5.87 vs. 76.73 ± 6.48 , $P < 0.05$). 2. Scores for the observation group in “comprehensiveness of problem analysis”, “accuracy of evidence-based decision-making”, “multidisciplinary integration ability”, and “risk prediction and complication management ability” were (20.58 ± 1.87), (22.44 ± 1.18), (22.28 ± 1.53), and (23.21 ± 1.46) points, respectively, all significantly higher than the control group's (18.83 ± 1.95), (20.21 ± 1.36), (19.56 ± 1.74), and (21.02 ± 1.37) points, respectively, with statistically significant differences ($P < 0.05$). *Conclusion:* The application of the MDT clinical teaching model in screening for sarcopenia and nutrition intervention education among the elderly demonstrated significant efficacy, effectively enhancing students' understanding of sarcopenia-related knowledge and comprehensive diagnostic and therapeutic capabilities.

Keywords: MDT teaching model; Sarcopenia in the elderly; Screening; Nutritional intervention; Medical education

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1. Introduction

Sarcopenia is a syndrome characterized by progressive decline in muscle mass and function, with a high prevalence among the elderly population ^[1]. Research data indicate that the prevalence of sarcopenia in individuals aged 60 and above ranges from approximately 10% to 20%, rising to as high as 50% in those aged

80 and above ^[2]. Older adult sarcopenia not only leads to reduced muscle strength, slowed walking speed, and impaired balance but also increases the risk of falls and loss of independence, severely impacting quality of life and placing a heavy burden on family caregivers ^[3].

Early screening and effective nutritional interventions are key measures to delay the progression of sarcopenia and improve the quality of life and health status of older adults. Through early screening, individuals at high risk for sarcopenia can be identified promptly and provided with targeted nutritional interventions, thereby slowing disease progression and improving muscle mass and function in patients ^[4]. Therefore, there is an urgent need in geriatric clinical education to enhance students' mastery of multidisciplinary knowledge regarding sarcopenia screening methods and nutritional interventions. However, traditional bedside teaching models often focus primarily on single-discipline knowledge transmission, making it difficult to comprehensively cover the multidisciplinary knowledge system involved in geriatric sarcopenia. This results in students having an incomplete understanding of the disease. Furthermore, the limited scope of bedside teaching scenarios deprives students of opportunities to integrate knowledge and skills within complex real-world clinical settings, hindering the development of practical clinical competence and problem-solving abilities. The multidisciplinary team (MDT) model represents an innovative medical philosophy and practice approach. Introducing MDT into medical education not only addresses the shortcomings of traditional teaching methods but also provides students with more comprehensive and systematic knowledge and skills training. In recent years, this model has gained widespread application and promotion in clinical settings. Research by Tang Yiping et al. revealed that the liver cancer MDT teaching model, through multidisciplinary collaboration, real-case-driven learning, and structured feedback mechanisms, significantly enhances clinical interns' comprehensive clinical abilities and critical thinking skills ^[5]. A clinical trial by Wang Long et al. demonstrated that applying the MDT teaching model in standardized residency training systematically cultivates physicians' clinical reasoning abilities, enabling more comprehensive analysis and decision-making when confronting complex clinical issues ^[6]. This study aims to conduct a clinical trial to thoroughly investigate the effectiveness of the MDT clinical teaching model in screening for sarcopenia and delivering nutritional intervention education among the elderly. The findings are reported as follows.

2. Materials and methods

2.1. General information

Sixty undergraduate medical students undergoing clinical internships in the geriatrics department of a certain hospital from June 2024 to May 2025 were selected. All participants had completed foundational courses in internal medicine and nutrition, possessing a certain level of medical theoretical knowledge. Inclusion criteria: voluntary participation in the study; no record of failing clinical internships. Participants were randomly assigned using a random number table to a control group ($n=30$, 18 males, 12 females, mean age 22.3 ± 1.2 years) and an observation group ($n=30$, 20 males, 10 females, mean age 22.5 ± 1.1 years). Baseline characteristics showed no significant differences between groups ($P > 0.05$), ensuring comparability.

2.2. Methods

2.2.1. Control group

Traditional bedside teaching (TBT) was implemented. Upon admission, geriatric teaching physicians conducted instruction following a "theoretical lecture + bedside demonstration" protocol. Theoretical instruction involved textbook explanations and PowerPoint presentations to teach students about sarcopenia definitions, diagnostic criteria,

and nutritional intervention principles. Bedside teaching utilized typical cases to demonstrate sarcopenia screening and nutritional assessment procedures, with students participating only as observers and asking one-way questions.

2.2.2. Observation group

Implemented an MDT-based teaching model (MDT-T), with specific measures as follows:

Formation of multidisciplinary teaching team: An MDT teaching team comprising physicians from Geriatrics (2), Clinical Nutrition (1), and Rehabilitation Medicine (1) was established. Team members collaboratively developed standardized teaching protocols based on their respective expertise and experience.

Case introduction and group discussion: Carefully selected cases of geriatric sarcopenia complicated by conditions such as diabetes and chronic heart failure were distributed to students in advance. Students conducted group discussions based on the case materials to formulate preliminary treatment plans.

Interdisciplinary deep dive: Geriatrics physicians thoroughly explain sarcopenia diagnostic criteria and introduce common screening tools with application methods. Clinical nutritionists demonstrate how to develop personalized nutrition plans based on patient specifics. Rehabilitation physicians guide resistance training protocols and teach home intervention strategies, ensuring students grasp key rehabilitation principles for sarcopenia patients.

Scenario simulation and feedback: Standardized patients simulate communication scenarios with sarcopenia patients. Students practice doctor-patient communication techniques in groups. Instructors provide individualized feedback on each group's performance, highlighting strengths and areas for improvement to enhance communication skills.

2.3. Observation indicators

Basic theoretical knowledge score: Following the internship, a comprehensive closed-book assessment will evaluate both groups of students on their mastery of geriatric sarcopenia knowledge. The assessment covers five sections: disease recognition, high-risk population identification, pathological mechanisms, evaluation methods, and nutritional intervention principles. Each section is worth 20 points, totaling 100 points.

Clinical practice skills: On-site assessments evaluated students' proficiency in: Standardized geriatric sarcopenia screening procedures; Accuracy of nutritional assessments; Rationality of nutritional intervention plan development; Patient communication skills. Each criterion was scored out of 25 points, totaling 100 points.

Clinical reasoning: The modified Critical Thinking Dimensions Inventory (CTDI-CV) is used to evaluate students' abilities in problem analysis, evidence-based decision-making, multidisciplinary integration, and risk prediction. Each dimension is worth 25 points, with a maximum total score of 100 points.

2.4. Statistical methods

Data analysis was performed using SPSS 26.0. Quantitative data are expressed as mean \pm standard deviation (Mean \pm SD). Intergroup comparisons were conducted using independent samples *t*-tests, while categorical data were analyzed using chi-square (χ^2) tests. A *P* value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of basic theoretical knowledge assessment scores between groups

Students in the observation group demonstrated significantly higher scores than the control group in assessments

of basic theoretical knowledge regarding geriatric sarcopenia, including disease awareness, identification of high-risk populations, pathological mechanisms, assessment methods, and nutritional intervention principles. These differences were statistically significant ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of basic theoretical knowledge assessment scores between groups (Mean \pm SD, points)

Group	Disease awareness	Identification of high-risk populations	Pathological mechanisms	Assessment methods	Nutritional intervention principles	Overall score
Control group (n=30)	14.52 \pm 2.13	14.85 \pm 2.34	13.26 \pm 2.51	15.06 \pm 2.23	14.55 \pm 2.43	72.24 \pm 11.64
Observation group (n=30)	16.24 \pm 1.86	16.51 \pm 2.03	16.81 \pm 2.02	17.04 \pm 1.93	16.80 \pm 2.19	83.40 \pm 10.03
<i>t</i>	3.332	2.935	6.035	3.677	3.767	3.978
<i>P</i>	0.002	0.004	<0.001	0.001	<0.001	<0.001

Students in the observation group demonstrated significantly higher scores than the control group in the following areas: standardization of geriatric sarcopenia screening procedures, accuracy of nutritional assessments, rationality of nutritional intervention plan formulation, and physician-patient communication skills. These differences were statistically significant ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of clinical practice assessment scores between groups (Mean \pm SD, points)

Group	Screening procedure compliance	Accuracy of nutritional assessment	Rationality of the intervention plan	Communication and coordination skills	Overall score
Control group (n=30)	19.29 \pm 1.55	17.86 \pm 1.69	19.52 \pm 1.51	20.06 \pm 1.73	76.73 \pm 6.48
Observation group (n=30)	21.26 \pm 1.67	22.05 \pm 1.73	23.32 \pm 1.34	23.18 \pm 1.13	89.81 \pm 5.87
<i>t</i>	4.736	9.489	10.310	8.270	8.194
<i>P</i>	<0.001	<0.001	<0.001	0.001	<0.001

3.3. Comparison of clinical reasoning scores between the two groups

Students in the observation group scored significantly higher than those in the control group in “Comprehensiveness of Problem Analysis”, “Accuracy of Evidence-Based Decision-Making”, “Multidisciplinary Integration Ability”, and “Risk Prediction and Complication Management Ability”, with statistically significant differences ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of clinical reasoning scores between groups (Mean \pm SD, points)

Group	Comprehensiveness of problem analysis	Accuracy of evidence-based decision-making	Multidisciplinary integration ability	Risk prediction and complication management
Control group (n=30)	18.83 \pm 1.95	20.21 \pm 1.36	19.56 \pm 1.74	21.02 \pm 1.37
Observation group (n=30)	20.58 \pm 1.87	22.44 \pm 1.18	22.28 \pm 1.53	23.21 \pm 1.46
<i>t</i>	3.548	6.684	6.429	5.991
<i>p</i>	0.001	<0.001	<0.001	<0.001

4. Discussion

Amidst China's accelerating demographic aging, the prevalence of sarcopenia among the elderly continues to rise annually. Early screening coupled with effective nutritional interventions—ensuring adequate protein and vitamin D intake—is crucial for slowing sarcopenia progression. This places heightened demands on the clinical capabilities of geriatric practitioners^[7]. They must not only possess keen awareness to identify high-risk populations for sarcopenia and master standardized screening tools and assessment methods, but also provide targeted, feasible nutritional guidance to patients and their families. However, under traditional teaching models, students' understanding of sarcopenia remains confined to a single-discipline perspective, often resulting in fragmented knowledge systems that fail to comprehensively grasp the key points of sarcopenia diagnosis and treatment.

The MDT teaching model offers a comprehensive, systematic learning platform through interdisciplinary theoretical integration and case-based practice. During the theoretical integration phase, students not only learn the basic definitions and diagnostic criteria of sarcopenia but also gain an in-depth understanding of the complex pathophysiological mechanisms of sarcopenia in the elderly^[8]. During the case practice phase, students organically integrate knowledge from different disciplines through participation in real-case discussions and analysis, forming a complete knowledge system. This enables students to understand sarcopenia from multiple angles, thereby enhancing their comprehensive analysis and judgment capabilities regarding the disease^[9].

The study findings revealed that the observation group students achieved significantly higher scores than the control group in basic theoretical knowledge assessments, clinical practice evaluations, and clinical reasoning ability assessments ($P < 0.05$). Analysis indicates this advantage primarily stems from the comprehensive strengths of the geriatric sarcopenia MDT teaching model: (1) The MDT teaching model provides students with a comprehensive and systematic learning framework through interdisciplinary theoretical integration and case-based practice. Under this multidisciplinary integration mechanism, students not only learn the fundamental definitions, diagnostic criteria, and complex pathophysiological mechanisms of sarcopenia, but also organically combine knowledge from different disciplines to form a complete knowledge system. This enhances their comprehensive analytical and judgmental abilities regarding geriatric sarcopenia. (2) The MDT teaching model creates an immersive learning environment through role-playing and real-world scenario practice, enabling students to fully hone their practical skills and collaborative abilities in simulated clinical settings. During role-playing sessions, students assume roles such as geriatricians, nutritionists, and rehabilitation therapists. By simulating actual diagnostic and treatment processes, students not only become familiar with the responsibilities and workflows of each discipline but also learn how to communicate and collaborate effectively with healthcare professionals from other fields^[10]. In real-world practice, students participate in multidisciplinary team (MDT) outpatient rounds, gaining firsthand experience with multidisciplinary collaboration in clinical settings. This deepens their understanding of patient needs and disease progression, enhancing their clinical skills and problem-solving abilities. (3) The MDT model emphasizes comprehensive disease assessment from the perspective of geriatric syndromes. Students learn to analyze problems from multiple disciplinary viewpoints, better understand the connections and interactions between disciplines, and thus grasp the overall process of disease onset and progression. This enhances their clinical reasoning abilities and decision-making skills.

5. Conclusion

In summary, the MDT-based geriatric sarcopenia screening and nutritional intervention education program enables

students to comprehensively master the key points of sarcopenia diagnosis and treatment through interdisciplinary knowledge integration, practical collaboration, and clinical reasoning training. This enhances their overall response capabilities in complex clinical scenarios, providing an effective pathway for cultivating multidisciplinary medical professionals capable of meeting the demands of an aging society.

Disclosure statement

The authors declare no conflict of interest.

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Effect of Magnesium Sulfate Wet Compress Intervention During the Second Stage of Labor on Maternal and Neonatal Outcomes in Vaginal Delivery

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Abstract: *Objective:* To investigate the effects of magnesium sulfate wet compress applied during the second stage of labor in vaginal delivery on maternal and neonatal outcomes, and to provide evidence for perineal protection in midwifery practice. *Methods:* In this retrospective cohort study, 117 women who delivered vaginally between September and October 2025 at the study center were enrolled. According to perineal management during the second stage of labor, participants were assigned to the magnesium sulfate wet compress group or the control group. Maternal outcomes (labor duration, perineal laceration rate, NRS pain score, perineal edema, and postpartum cold compress requirement) and neonatal outcomes (body length, birth weight, Apgar score, and transfer rate) were compared between groups. *Results:* There were no statistically significant differences in baseline characteristics between the two groups ($P > 0.05$). Compared with the control group, parturients in the observation group had significantly lower pain scores at 2 hours postpartum, as well as lower incidences of perineal edema and reduced demand for cold compress therapy; moreover, the rates of perineal laceration and episiotomy were significantly decreased ($P < 0.05$). No statistically significant differences were observed between the two groups with respect to neonatal length, birth weight, Apgar score, or neonatal transfer rate ($P > 0.05$). *Conclusion:* Magnesium sulfate wet compress during the second stage of labor is a safe and feasible intervention that effectively reduces perineal pain, edema, and birth-related perineal trauma without compromising neonatal outcomes. Larger randomized controlled studies are needed to confirm these findings.

Keywords: Magnesium sulfate; Wet compress therapy; Second stage of labor; Vaginal delivery; Perineal protection; Maternal and neonatal outcomes

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1. Introduction

The second stage of labor is a critical period affecting maternal and neonatal safety and comfort during vaginal delivery. As the fetal head descends and uterine contractions intensify, the perineal tissues are continuously stretched and compressed, resulting in impaired local blood circulation and varying degrees of edema and pain ^[1]. Although most cases of perineal edema resolve within 2–3 days postpartum with appropriate treatment and nursing care and have little impact on quality of life, severe edema is more challenging to manage and may cause local circulatory disorders, delayed wound healing, wound dehiscence, and secondary infection, leading to significant discomfort, endocrine disturbances, and possible adverse effects on breastfeeding ^[2–4]. Magnesium sulfate hot wet compress, a traditional physical therapy, reduces edema through its hyperosmotic effect by promoting the exudation of interstitial fluid and can also inhibit sympathetic neurotransmitter release, relax vascular smooth muscle, improve microcirculation, and exert anti-inflammatory, analgesic, and tissue-repair-enhancing effects ^[5]. In recent years, magnesium sulfate wet compress has been increasingly applied in perineal care during childbirth to alleviate congestion, relieve edema, and facilitate tissue recovery ^[6–8]; however, clinical evidence regarding its effectiveness when used specifically during the second stage of labor remains limited. Therefore, this retrospective analysis compared maternal and neonatal outcomes between women who did and did not receive magnesium sulfate wet compress during the second stage of labor, aiming to evaluate its clinical value and provide evidence for perineal protection in midwifery practice.

2. Methods

2.1. Study population

This retrospective cohort study was conducted using data obtained from the electronic medical record system of Zhaoqing Hospital of The Third Affiliated Hospital of Sun Yat-sen University. Clinical data of women who underwent vaginal delivery in the Department of Obstetrics between September and October 2025 were consecutively collected. The inclusion criteria were as follows: (1) term pregnancy with a gestational age of 37–42 weeks; (2) singleton pregnancy with cephalic presentation and vaginal delivery; (3) entry into the second stage of labor with complete labor records; and (4) complete maternal and neonatal clinical data. The exclusion criteria were: (1) presence of severe preeclampsia, heart disease, severe infection, or other pregnancy-related complications; (2) conversion to cesarean section due to fetal distress, labor arrest, or other reasons; (3) history of perineal surgery or vulvar skin disease; and (4) incomplete clinical data or missing key variables. All enrolled cases met the study criteria, and a total of 117 women were included. Personal information of all participants was anonymized to ensure privacy protection and data security.

2.2. Grouping and intervention

According to the perineal management methods used during the second stage of labor, the participants were divided into a magnesium sulfate wet-compress group (observation group) and a non-wet-compress group (control group). In the observation group, after full cervical dilation in the second stage, sterile gauze soaked in 50% magnesium sulfate solution was applied to the perineal area and the external vaginal opening following routine perineal cleaning and disinfection. The control group did not receive magnesium sulfate wet compress during the second stage of labor. All deliveries were attended by qualified midwives, and all women received standard labor management and perineal protection guidance throughout the birthing process, followed by routine postpartum maternal and neonatal care and observation.

2.3. Outcome measures

The primary aim of this study was to evaluate the effect of magnesium sulfate wet compress during the second stage of labor on maternal and neonatal outcomes. The assessed indicators included: (1) Maternal outcomes: duration of the first, second, and third stages of labor; incidence of perineal laceration; degree of perineal edema; pain score at 2 hours postpartum (NRS); incidence of perineal erythema or allergic reactions; and maternal demand for ice application. (2) Neonatal outcomes: neonatal birth weight and length; Apgar scores at 1, 5, and 10 minutes; and neonatal transfer rate. (3) General demographic data: maternal age, height, weight, gestational age, gravidity, and parity, which were recorded to determine the comparability of baseline characteristics between the two groups.

2.4. Statistical analysis

All data were analyzed using SPSS version 25.0. Continuous variables were tested for normality and expressed as mean \pm standard deviation (Mean \pm SD). Between-group comparisons were performed using independent-sample *t*-tests for normally distributed data or the rank-sum test for non-normally distributed data. Categorical variables were presented as frequencies (percentages) and compared using the χ^2 test or Fisher's exact test, as appropriate. A two-tailed significance level of $\alpha = 0.05$ was adopted, and statistical significance was defined as $P < 0.05$.

3. Results

3.1. Comparison of general characteristics

There were no statistically significant differences between the two groups in maternal age, height, weight, gravidity, parity, or gestational age ($P > 0.05$), indicating good comparability of baseline characteristics (**Table 1**).

Table 1. Comparison of general data between the two groups of parturients

Variable	Observation group ($n=32$)	Control group ($n=85$)	<i>t</i>	<i>P</i>
Age (years)	29.81 \pm 4.69	30.11 \pm 3.92	-0.342	0.754
Height (cm)	159.03 \pm 4.71	159.32 \pm 4.67	-0.315	0.754
Weight (kg)	65.65 \pm 9.28	65.56 \pm 8.35	0.326	0.745
Gravidity	1.94 \pm 1.24	1.99 \pm 1.24	-0.338	0.756
Parity	0.56 \pm 0.64	0.49 \pm 0.63	-0.826	0.411
Gestation (weeks)	39.46 \pm 0.89	39.34 \pm 0.91	0.595	0.554

Note: Values are presented as mean (SD). An independent samples *t*-test was used for group comparisons. $P < 0.05$ indicates statistical significance

3.2. Comparison of maternal outcomes

Compared with the control group, the observation group had significantly lower perineal pain scores (NRS) at 2 hours postpartum ($P < 0.05$), suggesting that magnesium sulfate wet compress effectively reduced perineal pain. In addition, the observation group exhibited lower rates of postpartum perineal edema, reduced need for ice application, and lower incidences of perineal laceration and episiotomy ($P < 0.05$), indicating that magnesium sulfate wet compress may help reduce perineal trauma and enhance maternal comfort. No cases of local skin erythema or systemic allergic reactions were observed during the magnesium sulfate application (**Table 2**).

Table 2. Comparison of labor outcomes between groups

Variable	Observation group (n=32)	Control group (n=85)	t/χ^2	P
First stage of labor (h)	6.46 ± 2.97	7.49 ± 3.14	-1.283	0.202
Second stage of labor (h)	0.75 ± 0.57	0.74 ± 0.59	-0.075	0.942
Third stage of labor (h)	0.18 ± 0.17	0.17 ± 0.18	-1.067	0.288
Postpartum 2h NRS score	0.28 ± 0.63	0.79 ± 0.93	-3.366	0.001
Need for cold compress	2 (6.25)	20 (23.53)	4.546	0.033
Perineal edema	7 (21.87)	25 (29.41)	4.194	0.041
Perineal laceration	15 (46.88)	57 (67.06)	4.001	0.045
Episiotomy	4 (12.50)	26 (30.59)	3.989	0.046

Note: Values are presented as mean (SD) or n (%). Independent samples *t*-test and chi-square test were used for group comparisons. *P* < 0.05 indicates statistical significance

3.3. Comparison of neonatal outcomes

There were no significant differences between the two groups in neonatal birth weight, length, Apgar scores at 1, 5, and 10 minutes, or neonatal transfer rate (*P* > 0.05), indicating that magnesium sulfate wet compress had no adverse effects on neonatal outcomes (Table 3).

Table 3. Comparison of neonatal outcomes between groups

Variable	Observation group (n=32)	Control group (n=85)	t/χ^2	P
Neonatal weight (kg)	3.35 ± 0.35	3.28 ± 0.37	0.261	0.795
Neonatal length (cm)	49.41 ± 1.68	49.14 ± 1.62	0.657	0.503
1-min Apgar score	9.59 ± 0.50	9.50 ± 0.49	0.571	0.569
5-min Apgar score	9.91 ± 0.28	9.86 ± 0.35	1.423	0.156
10-min Apgar score	10.00 ± 0.00	10.00 ± 0.00	-	-
Transfer to NICU	5 (15.63)	27 (31.76)	0.002	0.965

Note: NICU: neonatal intensive care unit. Values are presented as mean (SD) or n (%). Independent samples *t*-test and chi-square test were used for group comparisons. *P* < 0.05 indicates statistical significance

4. Discussion

In recent years, with the continuous advancement of medical technology and the increasing awareness of natural childbirth, more women have voluntarily chosen vaginal delivery. However, during labor, factors such as a large fetal head, malposition, or rapid labor progression may lead to perineal tears, which can have significant physical and psychological impacts on mothers^[9–10]. Therefore, to facilitate smooth delivery, episiotomy is frequently employed in clinical practice. Nevertheless, episiotomy is an invasive procedure, and some women may experience postoperative discomfort, including perineal edema and pain, thereby increasing the risk of complications such as urinary retention and infection^[11–12].

Magnesium sulfate solution is a calcium ion antagonist with anti-inflammatory, anti-edematous, and sedative effects. It can alleviate spasms of capillaries and small arterioles and activate both cellular protein kinases and

ATPases, thereby altering cell membrane permeability, stabilizing membrane potentials, and promoting the resolution of mucosal edema. In addition, magnesium sulfate exerts vasodilatory effects and enhances local blood circulation as well as endothelial cell function ^[13]. Because magnesium sulfate is water-soluble, applying it as a wet compress to the perineal incision facilitates transdermal absorption and subsequently contributes to its anti-inflammatory and analgesic effects.

The findings of this study indicate that the application of magnesium sulfate wet compress during the second stage of labor effectively reduces perineal pain, lowers the incidence of perineal laceration and episiotomy, and decreases the need for postpartum ice analgesia. These results suggest that this intervention plays a beneficial role in perineal protection and improving maternal comfort. The underlying mechanisms may be related to the high osmotic pressure and local physiological effects of magnesium sulfate. Through osmotic action, magnesium sulfate facilitates the exudation of interstitial fluid, thereby reducing local edema. Meanwhile, magnesium ions can inhibit the release of norepinephrine from sympathetic nerve endings and relax vascular smooth muscle, leading to improved local microcirculation ^[14]. In addition, magnesium sulfate has inhibitory effects on inflammatory responses, reducing the release of cellular cytokines and alleviating pain and congestion. These synergistic actions help minimize perineal tissue injury and promote wound healing. Regarding neonatal outcomes, no significant differences were observed between the two groups in Apgar scores, umbilical cord blood gas parameters, or neonatal transfer rates, indicating that magnesium sulfate wet compress is merely a localized physical intervention without adverse effects on fetal circulation or the nervous system. This further supports the safety of its clinical application.

This study has several limitations. First, it was a single-center retrospective study with a relatively small sample size, and the findings may have been influenced by incomplete data and potential confounding factors. Second, the study did not perform stratified analyses based on the duration, temperature, or frequency of magnesium sulfate wet compress application; variations in these parameters may affect the intervention's effectiveness. Finally, pain assessment relied primarily on subjective ratings, and future studies could incorporate objective physiological indicators to enhance the accuracy of outcome evaluation.

5. Conclusion

The application of magnesium sulfate wet compress during the second stage of labor can effectively reduce perineal edema and pain, lower the incidence of perineal laceration and episiotomy, and does not adversely affect maternal or neonatal outcomes. This intervention demonstrates good safety and practicality. It is recommended for wider adoption in clinical midwifery practice. Further large-sample, multicenter, randomized controlled studies are warranted to validate its long-term effects and optimize the operational protocol.

Disclosure statement

The authors declare no conflict of interest.

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Application Effect of Team Responsibility System Nursing in the Care of Patients in the Intensive Care Unit

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Abstract: Patients admitted to the Intensive Care Unit (ICU) have the characteristics of rapid and complex changes in their conditions, thus putting forward higher requirements for nursing work. As an important part of the ICU medical team, nurses should actively explore the application of the team responsibility system nursing in daily care. Based on this, this paper briefly analyzes the significance of applying the team responsibility system nursing in the care of ICU patients, and discusses the improvement strategies and application effects of team responsibility system nursing in the care of ICU patients, aiming to provide certain references for the innovation and development of ICU patient care work.

Keywords: Team responsibility system nursing; Intensive Care Unit (ICU); Patient care

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1. Introduction

Patients in the ICU usually have injuries or disorders of multiple organ and system functions, unstable vital signs, and an inability to take care of themselves. Based on doctors' treatment plans and advanced monitoring equipment and technologies, ICU nurses should provide high-quality nursing services to ensure treatment effects, help patients accelerate the rehabilitation process, and reduce the physical and mental pain they suffer. Based on this, in ICU nursing work, the application of the team responsibility system nursing, which clarifies the patients in charge to each team, work responsibilities, and nursing processes, helps each patient receive effective care, thereby improving the pertinence and effectiveness of nursing work.

2. Overview of the team responsibility system nursing

Team responsibility system nursing is a nursing model that adheres to the principle of "patient-centered", forms a structured nursing team, and provides continuous professional care for patients throughout their hospital treatment.

It is also an important form of practicing the modern holistic nursing model ^[1]. Derived from system theory and collaborative governance theory, team responsibility system nursing is different from traditional nursing that “each is responsible for one module” with “rigid connection.” It pays more attention to the integrity, professionalism, and responsibility closed-loop of nursing services, extending nursing responsibility from one nurse to a team, which effectively improves the coordination of nursing decision-making and execution. A common nursing team configuration usually consists of a senior nurse leading three to five responsible nurses and auxiliary staff. Some teams also include professional members such as pharmacists and dietitians to care for patients in a hierarchical collaboration model. While ensuring the continuity and effectiveness of nursing services, it achieves a clear division of labor and definite responsibility ^[2].

3. Significance of applying the team responsibility system nursing in the care of ICU patients

3.1. Strengthen multidisciplinary collaboration and improve the quality of critical care

Patients in the ICU are usually accompanied by multiple organ dysfunction and frequent fluctuations in vital signs, requiring joint intervention of multiple systems such as respiration, circulation, and nutrition. Team responsibility system nursing led by senior nurses can dynamically organize multidisciplinary consultations according to patients' conditions and implement nursing services of “special person responsible and full-course follow-up” ^[3]. For example, responsible nurses can timely detect and quickly respond to potential risks such as abnormal ventilator parameters and hemodynamic fluctuations of patients based on their underlying diseases, treatment plans, and condition changes in daily work, and the medical team or nursing team will carry out targeted treatment and nursing work. This nursing model avoids problems such as scattered multidisciplinary communication and delayed response in traditional nursing, effectively reduces the risk of related complications, and significantly improves the quality of critical care.

3.2. Optimize the critical care team and meet patients' diverse needs

The ICU has extremely high requirements for nurses' professional capabilities and professional quality. The application of the team responsibility system nursing can not only provide high-quality care for patients but also carry out hierarchical teaching based on practice to cultivate more excellent nurses ^[4]. For example, in nursing work, the leader of the nursing team plays a “mentoring” role through case discussions and practical guidance, guiding nurses to improve their core critical care capabilities, such as ventilator operation and ECMO nursing, and promoting the development of the ICU nursing team towards specialization and refinement. In addition, in addition to physiological treatment needs, ICU patients may also have psychological problems such as anxiety and fear due to complex conditions ^[5]. Team responsibility system nursing can formulate personalized nursing plans according to patients' specific conditions: some nurses focus on patients' psychological nursing needs; some nurses are mainly responsible for monitoring patients' complications to promote the rehabilitation process and shorten the length of stay in the ICU.

4. Improvement strategies for the application of the team responsibility system nursing in the care of ICU patients

4.1. Scientifically form nursing teams to ensure a reasonable team structure

The formation of nursing teams is an important prerequisite for implementing the team responsibility system

nursing, which requires ICU directors to make scientific plans based on the number of patients, the severity of their conditions, and the allocation of nursing staff. First, ICU patients can be divided into three nursing levels (high, medium, and low) according to the severity of their conditions. High-risk patients are assigned a senior nurse as the team leader, two responsible nurses, and one specialist nurse; medium-risk patients are assigned a senior nurse, one responsible nurse, and one specialist nurse; low-risk patients are assigned a senior nurse and one responsible nurse^[6]. At the same time, each team can reasonably increase or decrease the number of patients under their care according to the actual rehabilitation progress of the patients in charge, but the number of patients under simultaneous care shall not exceed five. If a patient's condition suddenly changes, the responsible nurse can quickly supplement specialist personnel such as pharmacists and respiratory therapists in accordance with the corresponding "emergency support plan." Second, the age, professional title, and specialty of the nursing team members should also be scientifically configured. For example, the team leader should be a senior nurse with more than five years of ICU nursing experience, a professional title above a supervisor nurse, and good communication and coordination skills. Team members are matched according to age, professional title, and expertise of the department nurses to build a nursing team with a reasonable age and professional structure^[7]. Then, work is carried out in accordance with the written nursing team rules. For example, the team leader organizes case discussions, plan adjustments, and team coordination every day. On the basis of completing basic nursing and condition monitoring, responsible nurses also communicate with patients and their families. Finally, with the in-depth application of information technology in nursing work, nursing teams should upload nursing records on time, such as changes in patients' condition monitoring data and adjustments to respiratory/nutritional support plans, providing data support for treatment and nursing work through information sharing and visualization^[8].

4.2. Strengthen nursing team training to adapt to the needs of critical care

On the one hand, differentiated professional training activities should be designed around the core competency requirements of ICU nursing. For nursing team leaders, "specialized training courses for improving critical care capabilities" should be offered, including but not limited to team coordination, interdisciplinary communication, and emergency decision-making. For responsible nurses, "practical training on critical care capabilities" should be offered, covering ECMO equipment operation, hemodynamic monitoring, etc.^[9]. For example, simulate a scenario where a patient suffers a sudden cardiac arrest to exercise the team leader's team command ability and the responsible nurses' practical skills in emergency situations. At the same time, comprehensive nursing skill assessments should be conducted for nursing teams regularly. Those who fail the assessment need to receive intensive training for at least one week to ensure that the professional ability of each nurse in the nursing team meets the needs of critical care. In addition, a "typical/complex case database" should be established. A case with typical characteristics or special cases is selected regularly, and the nursing team leader organizes the team to conduct an in-depth discussion and review, summarizing nursing experience and improvement plans to enhance the team's ability to deal with complex conditions^[10]. On the other hand, multi-dimensional treatment monitoring standards should be set to evaluate the training effect of nursing teams. The standards can be set from three dimensions: safety, efficiency, and effectiveness. Safety evaluation mainly comes from the incidence of complications and the reporting rate of adverse events of patients; efficiency evaluation assesses the on-time rate of nursing plan execution and the response time of interdisciplinary consultations of the nursing team; effectiveness evaluation consists of the length of stay of patients in the ICU and the satisfaction of patients and their families. Every month, ICU managers conduct a comprehensive evaluation based on the statistical reports of

the online nursing management platform, put forward targeted improvement suggestions, and promote the high-quality development of ICU nursing services.

4.3. Formulate hierarchical nursing plans to promote the humanized development of nursing

In the ICU, each patient has a different age, condition, and psychological state. In the new era, in addition to focusing on patients' treatment effects, nursing work should also provide humanized care and psychological intervention for patients. The formulation of hierarchical nursing plans in the ICU should classify patients according to the severity of their conditions. For example, patients with unstable vital signs and a high risk of serious complications are designated as level 1 nursing, and a complete nursing team is assigned to them ^[11]. Responsible nurses complete nursing work such as maintaining vascular access patency and reasonable infusion speed, as well as regular turning over and strengthening oral care. The nursing team leader supervises the implementation and adjustment of the nursing plan daily. Patients with relatively stable conditions and the goal of functional recovery are designated as level 2 nursing. After responsible nurses complete basic nursing, respiratory therapists and dietitians carry out targeted rehabilitation nursing, such as respiratory function training and nutritional formula optimization. Patients with stable conditions who are about to be transferred out of the ICU are designated as level 3 nursing, focusing on the adaptive transition care for patients to be transferred to the general ward, communicating with patients and their families to help them familiarize themselves with home care knowledge and practices. In addition, conscious patients who stay in the ICU for a long time may experience negative emotions such as anxiety, depression, and panic, which requires the nursing team to strengthen psychological intervention for patients ^[12]. For example, relieve patients' tension through chatting, play soothing music to stabilize their emotions, or allow patients' families to visit and encourage them. At the same time, the nursing team should communicate more with patients' families, update them on the patients' conditions and nursing status, so that families can further understand the nursing work of the team, and work together to create conditions conducive to patients' rehabilitation.

4.4. Introduce information technology platforms to promote intelligent nursing management

With the rapid development of smart medical care, information technology platforms should also be introduced into ICU patient care work to promote intelligent nursing management. First, the ICU should take the patient's hospital number as the core to establish a multi-system data sharing platform. Nurses and doctors can real-time monitor patients' vital sign indicators on the platform system and retrieve patients' electronic medical records and examination data at any time as needed. For example, electrocardiogram monitors collect real-time data such as patients' heart rate, blood pressure, and blood oxygen saturation, and automatically upload them to the corresponding system platform. Patients' blood test results issued by the laboratory, such as WBC count and blood glucose, are also uploaded in a timely manner; when the pharmacy dispenses drugs, the specific parameters of the corresponding drugs are uploaded to the system platform to facilitate the nursing team leader and responsible nurses to verify medication. This paperless nursing management not only helps reduce the risk of environmental pollution in the ICU but also reduces patient information errors caused by manual entry or system switching ^[13]. At the same time, nursing teams can carry out online case discussions and interdisciplinary consultations through the "team communication module" of the system platform. For example, responsible nurses upload patients' condition

changes and parameter screenshots on the platform to consult the nursing team leader or doctors for treatment plans, providing scientific and efficient nursing services for patients. For patients with more complex condition changes, the nursing team leader can initiate “online consultations” on the system platform, which effectively saves the time for doctors to travel to the ICU.

5. Application effect of the team responsibility system nursing in the care of ICU patients

5.1. Significant improvement in nursing quality and safety

Team responsibility system nursing can define nursing responsibilities, optimize nursing processes, strengthen the collaboration ability of the nursing team, and significantly improve the nursing quality and safety of the ICU. The nursing team can monitor patients’ conditions from a comprehensive and in-depth perspective, thereby timely discovering potential risks that patients may face, implementing corresponding intervention measures, and reducing the probability of patients developing complications. At the same time, standardized nursing processes and strict quality control can reduce errors and omissions in clinical nursing, improve the completeness and accuracy of nursing records, and provide high-quality nursing services and rehabilitation guarantees for patients ^[14]. For example, in the care of critically ill infected patients, the nursing team timely detects signs of worsening infection by tracking and monitoring patients’ body temperature, blood indicators, vital signs, and other indicators. Then, the nursing team and doctors jointly adjust the nursing plan, thereby effectively blocking severe infections and further improving clinical treatment effects.

5.2. Comprehensive growth of nurses’ comprehensive quality

Under the team responsibility system nursing model, nurses have more opportunities to participate in the overall care of patients, such as case discussions, team collaboration, and the formulation of personalized nursing plans, accumulating experience and skills in practice. For example, the nursing team leader leads responsible nurses to carry out bedside teaching, demonstrating how to dynamically adjust respiratory support parameters based on blood gas analysis results to better care for patients with acute respiratory distress syndrome ^[15]. At the same time, clear job responsibilities and teaching mechanisms help stimulate the enthusiasm and initiative of young nurses, enhance their sense of professional value and identity, thereby promoting the continuous improvement of the professional level of the ICU nursing team, and ultimately building an excellent ICU nursing talent team with exquisite professionalism, efficient collaboration, and innovative development.

6. Conclusion

In summary, the application of the team responsibility system nursing in the care of ICU patients has a positive effect on improving nursing quality and the satisfaction of patients and their families. In daily nursing work, ICU nurses provide comprehensive and meticulous nursing services for patients through the implementation of strategies such as scientifically forming nursing teams, strengthening nursing team training, and formulating hierarchical nursing plans, ensuring treatment effects and stabilizing patients’ conditions.

Disclosure statement

The authors declare no conflict of interest.

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Summary of the Best Evidence for Wound Care Management in Pediatric Burn Patients

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Abstract: *Objective:* To retrieve and extract evidence related to wound care management in pediatric burn patients, summarize the best evidence, and provide evidence-based practice for clinical nursing management in pediatric burn patients. *Methods:* Evidence-based questions were identified, and domestic and international databases, as well as wound management websites, were systematically searched for guidelines, clinical decisions, evidence summaries, systematic reviews, expert consensus, and randomized controlled trials on wound care management in pediatric burn patients. The search period spanned from the establishment of the databases to December 31, 2024. Two researchers conducted literature screening, quality evaluation, and evidence summarization. *Results:* A total of 19 articles were included, comprising 4 clinical decisions, 6 guidelines, 5 expert consensus documents, and 4 systematic reviews. This study summarized 37 pieces of best evidence from six aspects: wound assessment, wound management, wound treatment, selection of topical dressings and medications, fluid resuscitation, and identification and management of infections. *Conclusion:* This study summarizes the best evidence for wound care management in children with burns, providing evidence-based support for clinical wound care management. It is recommended that healthcare professionals apply and translate the evidence in conjunction with actual clinical circumstances to conduct effective wound care management and improve the quality of life for children with burns.

Keywords: Children; Burns; Wounds; Evidence summary; Evidence-based nursing

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1. Introduction

Burns are one of the common accidental injuries among children, with a consistently high incidence globally. In 2021, the global incidence rate of burns among children and adolescents was 1,316 cases per 100,000 people ^[1]. Between 2016 and 2020, 11,080 children with burns were admitted to hospitals in Mexico, with those under 5 years old accounting for 55.8% ^[2]. Effective wound care management by healthcare professionals

is crucial for burn wound healing, preventing infections, and reducing complications ^[3]. Moreover, due to physiological characteristics such as a weak skin barrier and an immature immune system in children, wound care for pediatric burn patients presents greater challenges compared to adults ^[4,5].

In recent years, with the advancement of burn treatment research, significant progress has been made in wound care management for pediatric burn patients. The development and application of novel dressings have shortened the recovery time for pediatric wounds, while the use of negative pressure wound therapy has reduced dressing change frequency and infection rates ^[6,7]. Additionally, there has been a proliferation of clinical decision-making tools, guidelines, and expert consensus related to pediatric burns ^[3,8,9]. This study aims to systematically search for evidence, evaluate the quality of literature, extract and grade evidence, and summarize the best evidence for wound care management in pediatric burn patients. The goal is to provide scientific and practical guidance to clinical healthcare professionals, standardize nursing practices, and improve the quality of care for pediatric burn patients.

2. Data and methods

This study has been registered at the Evidence-Based Nursing Center of Fudan University (ES20246711).

2.1. Defining the evidence-based question

The clinical question “How to conduct effective and comprehensive wound care management for pediatric burn patients” was established, utilizing the PICO model to structure the evidence-based inquiry. The target population (Population, P) for evidence application: pediatric burn patients under 18 years old; Intervention measures (Intervention, I): measures related to burn wound care management; Evidence implementers (Professional, P): healthcare professionals; Outcome indicators (Outcome, O): wound healing/improvement in pediatric burn patients, incidence of infection, wound healing time; Evidence application settings (Setting, S): healthcare institutions; Types of evidence (Type of evidence, T): guidelines, clinical decisions, evidence summaries, systematic reviews, expert consensus, randomized controlled trials.

2.2. Literature search strategy

Based on the “6S” pyramid model of evidence-based resources, a top-down search was conducted across various databases and platforms, including UpToDate, BMJ Best Practice, the International Guideline Collaboration Network, the National Guideline Clearinghouse (USA), the National Institute for Health and Care Excellence (UK), the Registered Nurses’ Association of Ontario (Canada), the Canadian Medical Association Clinical Practice Guidelines website, Medlive, the World Health Organization website, the National Health Commission of the People’s Republic of China, the European Wound Management Association, the Association for the Advancement of Wound Care (USA), the Wound, Ostomy and Continence Nurses Society (USA), the World Union of Wound Healing Societies, the Joanna Briggs Institute Evidence-Based Health Care Data Center, the Cochrane Library, CINAHL, Web of Science, PubMed, Embase, China National Knowledge Infrastructure, Wanfang Medical Network, the Chinese Biomedical Literature Database, and the VIP Database. English search terms used included “Infant Newborn/Child/Infant/Adolescent”, “Burns”, “Wounds and Injuries”, “Nursing/Disease Management/Therapeutics/Symptom Assessment”, and “Guideline/Clinical Practice Guideline/Best Practice/Clinical Decision/Expert Consensus/Evidence Summary/Systematic Review/Randomized Controlled

Trial”.

The Chinese search terms include “infant/child patient/child”, “burn/scald/burn”, “wound/burn wound”, “care/assessment/management/treatment/intervention”, and “guideline/clinical decision-making/evidence summary/systematic review/expert consensus/randomized controlled trial”. Taking PubMed in English databases as an example, the search formula is shown in **Figure 1**.

Taking CNKI (China National Knowledge Infrastructure) in Chinese databases as an example, the search formula is: (SU=infant + child patient + child) AND (SU=burn + scald + burn) AND (SU=wound + burn wound) AND (SU=care + assessment + management + treatment + intervention) AND (SU=guideline + clinical decision-making + evidence summary + systematic review + expert consensus + randomized controlled trial).

```
#1 ("Infant, Newborn"[Mesh] OR "Child"[Mesh] OR "Infant"[Mesh] OR "Adolescent"[Mesh] )
#2 (Infants, Newborn[Title/Abstract] OR Newborn Infant[Title/Abstract] OR Newborn Infants[Title/Abstract] OR Neonate[Title/Abstract] OR Neonates[Title/Abstract] OR
Newborns[Title/Abstract] OR Newborn[Title/Abstract] OR Infants[Title/Abstract] OR Children[Title/Abstract] OR Adolescents[Title/Abstract] OR Adolescence[Title/Abstract] OR
Adolescents, Female[Title/Abstract] OR Adolescent, Female[Title/Abstract] OR Female Adolescent[Title/Abstract] OR Female Adolescents[Title/Abstract] OR Adolescents,
Male[Title/Abstract] OR Adolescent, Male[Title/Abstract] OR Male Adolescent[Title/Abstract] OR Male Adolescents[Title/Abstract] OR Youth[Title/Abstract] OR Youths[Title/Abstract]
OR Teens[Title/Abstract] OR Teen[Title/Abstract] OR Teenagers[Title/Abstract] OR Teenager[Title/Abstract])
#3 ("Burns"[Mesh]
#4 (Burn*[Title/Abstract] OR Smoke Inhalation Injury[Title/Abstract])
#5 ("Wounds and Injuries"[Mesh]
#6 (Wound*[Title/Abstract] OR Injuries[Title/Abstract] AND Wounds[Title/Abstract] OR Injuries, Wounds[Title/Abstract] OR Wounds[Title/Abstract] OR Injury[Title/Abstract] OR
Injury[Title/Abstract] OR Wounds[Title/Abstract] OR Wounds, Injury[Title/Abstract] OR Wounds[Title/Abstract] OR Wound[Title/Abstract])
#7 ("Nursing"[Mesh] OR "Disease Management"[Mesh] OR "Therapeutics"[Mesh] OR "Symptom Assessment"[Mesh])
#8(Nursings[Title/Abstract] OR Disease Managements[Title/Abstract] OR Management, Disease[Title/Abstract] OR Managements, Disease[Title/Abstract] OR
Management*[Title/Abstract] OR Therapeutic[Title/Abstract] OR Therapy[Title/Abstract] OR Therapies[Title/Abstract] OR Treatment[Title/Abstract] OR Treatments[Title/Abstract] OR
Therap*[Title/Abstract] OR Assessments, Symptom[Title/Abstract] OR Assessment, Symptom[Title/Abstract] OR Symptom Assessments[Title/Abstract] OR Symptom
Evaluation[Title/Abstract] OR Evaluations, Symptom[Title/Abstract] OR Evaluation, Symptom[Title/Abstract] OR Symptom Evaluations[Title/Abstract] OR Assessment*[Title/Abstract]
OR Evaluation*[Title/Abstract] OR Intervention[Title/Abstract])
#9 ("Guideline"[Title/Abstract] OR "Clinical Practice Guideline"[Title/Abstract] OR "Best Practice"[Title/Abstract] OR "Clinical Decision"[Title/Abstract] OR "expert
consensus"[Title/Abstract] OR "Evidence Summary"[Title/Abstract] OR "systematic review"[Title/Abstract] OR "Randomized Controlled Trial"[Title/Abstract] )
#10 #1 OR #2
#11 #3 OR #4
#12 #5 OR #6
#13 #7 OR #8
#14 #10 AND #11 AND #12 AND #13 AND #9
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Figure 1. English search formula.

2.3. Inclusion and exclusion criteria for literature

Inclusion criteria are as follows:

- (1) The study subjects are pediatric burn patients aged ≤ 18 years;
- (2) Burn wound care management measures;
- (3) Wound healing/improvement status in children with burns, incidence of infection, and wound healing time;
- (4) The literature types are guidelines, clinical decision-making documents, evidence summaries, systematic reviews, expert consensuses, and randomized controlled trials.

Exclusion criteria are as follows:

- (1) Literature for which the full text cannot be obtained;
- (2) Duplicate publications;
- (3) Literature with unavailable or incomplete data;
- (4) Literature not published in Chinese or English;
- (5) Literature of low quality.

2.4. Literature quality assessment and assessment process

Two researchers who had received systematic training in evidence-based courses independently evaluated the included literature in a double-blind manner, strictly adhering to the literature quality assessment criteria. In cases of conflicting assessment opinions, a third authoritative researcher would discuss and make a decision. The clinical guidelines were evaluated using the Appraisal of Guidelines for Research and Evaluation II (AGREE II) ^[10]. For primary studies, systematic reviews, evidence summaries, and expert consensus, the corresponding assessment criteria (2016 version) from the Joanna Briggs Institute (JBI) Evidence-Based Health Care Center in Australia were used to evaluate the literature quality ^[11].

2.5. Evidence extraction and grading

In this study, two researchers first independently summarized the relevant information from the included literature using a self-made evidence information extraction form. The information included intervention content, outcome indicators, source literature, time, etc. After completing the extraction, they conducted a cross-check. When integrating the evidence, consistent evidence was first combined. For contradictory evidence, priority was given to authoritative literature that was of a high level, high quality, and newly published ^[12]. For evidence extracted from guidelines and systematic reviews, the original research literature was traced back, and the evidence was graded from level 1 to level 5 using the JBI Evidence Pre-grading System (2014 version) ^[13]. Finally, the extracted information was summarized as the best evidence.

3. Results

3.1. Literature screening

A preliminary search yielded 1,860 articles, with 21 remaining after initial screening. The literature screening process is illustrated in **Figure 2**. Upon evaluating the quality of the literature, two systematic reviews were deemed to be of low quality and were excluded ^[14,15]. The literature screening process is depicted. Ultimately, 19 articles were included, encompassing 4 clinical decisions, 6 guidelines, 5 expert consensuses, and 4 systematic reviews ^[3,8,9,16–32]. The basic characteristics of the included literature are presented in **Table 1**.

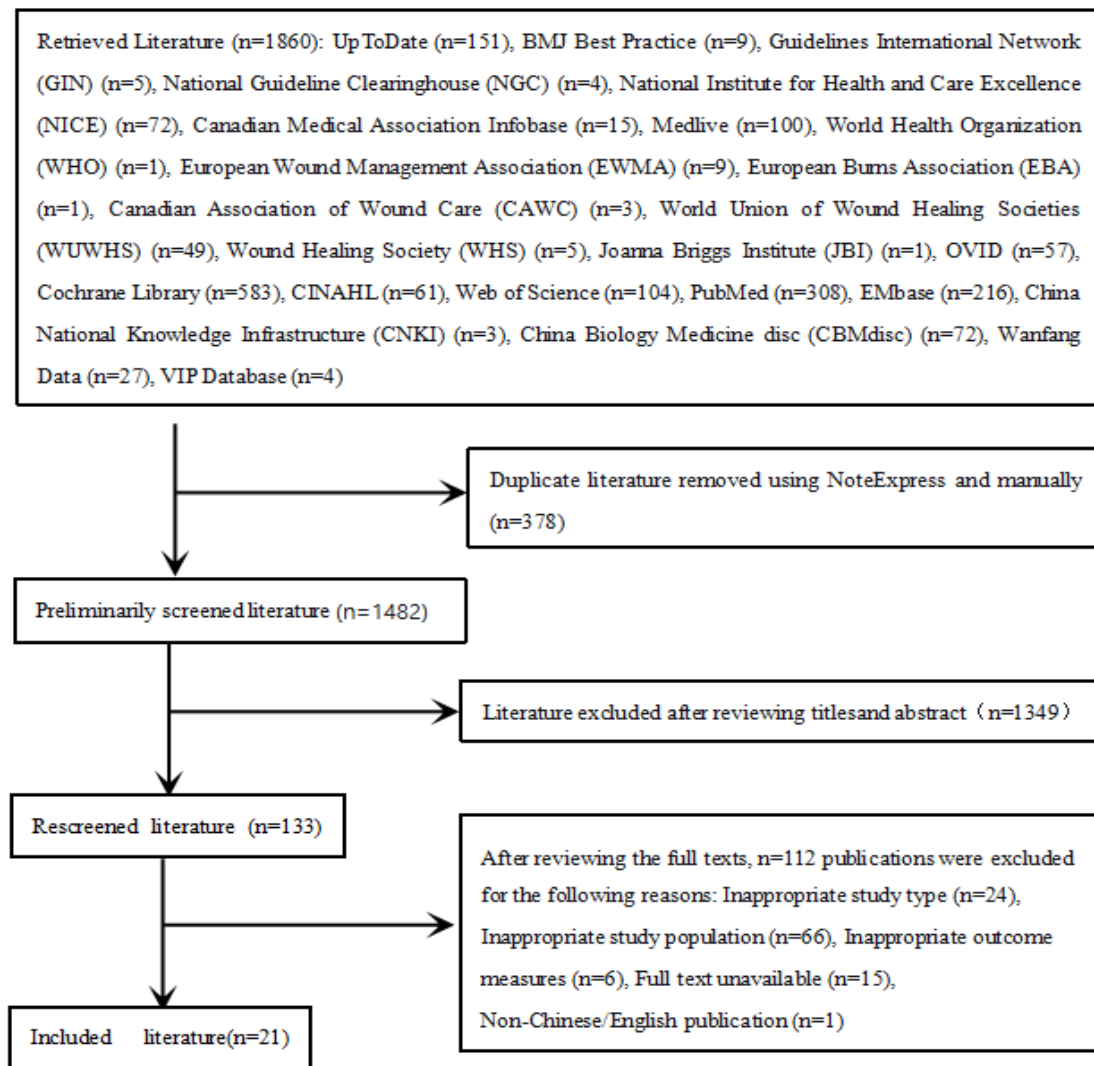


Figure 2. Flowchart of literature screening.

Table 1. Basic characteristics of included literature ($n = 19$)

No.	Literature	Source	Type	Topic
1	Mark 2024 ^[8]	UpToDate	Clinical Decision Support	Emergency Management of Moderate and Severe Thermal Burns in Children
2	Gerd 2024 ^[16]	UpToDate	Clinical Decision Support	Burn Wound Infection and Sepsis
3	Shelley 2024 ^[17]	UpToDate	Clinical Decision Support	Management of Burn Pain and Pruritus
4	Mayer 2024 ^[18]	UpToDate	Clinical Decision Support	Topical Agents and Dressings for Local Burn Wound Care
5	Yoshino et al. 2016 ^[9]	PubMed	Guideline	Burn Guideline
6	ISBI Practice Guidelines Committee 2016 ^[20]	PubMed	Guideline	ISBI Practice Guidelines for Burn Care
7	Allorto et al. 2016 ^[20]	PubMed	Guideline	ISBI Practice Guidelines for Burn Care, Part II

Table 1 (Continued)

No.	Literature	Source	Type	Topic
8	Atiyeh et al. 2017 ^[21]	WUWHS	Guideline	Effective Skin and Wound Management of Uncomplicated Burns
9	European Burns Association 2017 ^[22]	European Burns Association	Guideline	European Practice Guidelines for Burn Care
10	Hirche et al. 2020 ^[23]	PubMed	Guideline	Bromelain-based Enzymatic Debridement (NexoBrid®) for Burn Eschar Removal: European Consensus Guidelines
11	Chinese Society of Burn Surgery, CMA 2021 ^[24]	Wanfang Med Online	Expert Consensus	National Expert Consensus on the Clinical Application of Eschar Grinding in Burn Wounds
12	Chinese Society of Burn Surgery, CMA 2024 ^[25]	Wanfang Med Online	Expert Consensus	Expert Consensus on Grade II Burn Wound Treatment I: Pre-hospital Emergency Care and Non-surgical Treatment
13	Chinese Society of Burn Surgery, CMA 2024 ^[26]	Wanfang Med Online	Expert Consensus	Expert Consensus on Grade II Burn Wound Treatment II: Surgical Treatment and Infection Prevention
14	Chinese Society of Burn Surgery, CMA 2023 ^[3]	Wanfang Med Online	Expert Consensus	Expert Consensus on the Management of Deep Grade II Burn Wounds in Children
15	Chinese Society of Burn Surgery, CMA 2017 ^[27]	Wanfang Med Online	Expert Consensus	National Expert Consensus on the Application of Negative Pressure Wound Therapy in Burn Surgery
16	Lou et al. 2024 ^[29]	Wanfang Med Online	Systematic Review	Systematic Review of the Efficacy and Safety of Negative Pressure Wound Therapy in Pediatric Burns
17	Breederveld et al. 2014 ^[28]	Cochrane Library	Systematic Review	Systematic Review of Recombinant Human Growth Hormone for Treating Burns
18	Hu et al. 2024 ^[30]	Web of Science	Systematic Review	Systematic Review and Meta-Analysis of the Efficacy and Safety of Recombinant Human GM-CSF Hydrogel for Treating Grade II or III Burn Wounds in Children
19	Therese et al. 2022 ^[31]	PubMed	Systematic Review	Duration of Cooling with Water for Thermal Burns: A Systematic Review

3.2. Results of literature quality evaluation

A total of 6 guidelines were included, and the specific results of the AGREE II quality evaluation for the included guidelines are detailed in **Table 2**.

Table 2. Results of methodological quality evaluation of included guidelines (n = 6)

Included guideline	Domain-specific standardized score (%)						Number of domains		Recommendation grade
	Scope & purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence	≥ 60%	≥ 30%	
Yoshino ^[9]	95.23	47.61	92.85	95.23	46.42	100	4	6	B
Isbi Practice Guidelines Committee ^[19]	94.44	94.44	77.08	100	83.33	100	6	6	A
Allorto et al. ^[20]	94.44	94.44	77.08	100	83.33	100	6	6	A
Atiyeh et al. ^[21]	66.67	33.33	54.16	100	60.87	83.33	3	6	B
Europeans Burns Association ^[22]	100	72.22	62.50	100	78.26	91.67	5	6	A
Hirche ^[23]	88.89	72.22	64.58	100	87.50	100	6	6	A

A total of 5 expert consensus were included ^[3,25–28]. The quality of the expert consensus was evaluated using the 2016 evaluation tool from the JBI Evidence-Based Health Care Center. Among them, one consensus was rated as “No” for the item “Are there any inconsistencies between the proposed viewpoints and previous literature?”, while the rest were rated as “Yes” and were all included ^[25].

A total of four systematic reviews were included and evaluated using the 2016 version of the authenticity evaluation tool for systematic review papers from the Joanna Briggs Institute (JBI) Evidence-Based Health Care Center in Australia ^[29–32]. For two of the articles, the evaluation for the item “whether recommendations for policy and/or practice are made based on reported data” was “no,” while all other items were rated as “yes” ^[30,32].

3.3. Summary of best evidence

This study extracted 37 pieces of evidence from six aspects: wound assessment, wound management, wound treatment, topical dressings and medications, fluid resuscitation therapy, and infection identification and management, as shown in **Table 3**.

Table 3. Summary of evidence for wound care management in pediatric burn patients

Evidence theme	Evidence description	Level
Wound Assessment	1. Determine burn extent (percentage of Total Body Surface Area, TBSA) and depth (superficial, partial-thickness, full-thickness). Widely used methods include the Rule of Nines, Lund-Browder chart, and palm method ^[19,21,23,26] . Smartphone/tablet apps can improve speed and accuracy ^[8,26] .	5b
	2. Document the burn wound photographically with appropriate consent ^[8] .	5c
	3. Burns require an initial assessment, a secondary assessment, and ongoing dynamic assessment for partial-thickness burns ^[3,26] .	5c
Wound Management	4. Initial resuscitation: Remove hot, smoldering, or chemically exposed clothing to prevent further injury ^[3,8] . Toxic chemicals must be completely removed ^[20] .	5b
	5. Immediate cooling of the burn area with water for at least 20 minutes (water temperature not below 8°C) is recommended. Do not use ice or ice water directly. Monitor for hypothermia. Benefits of cooling beyond 30 minutes are unclear ^[8,20,32] .	2a
	6. For chemical burns: Remove contaminated clothing and materials, irrigate thoroughly with copious water for 45 minutes ^[8,20] .	4c
	7. During transport of severe burns to a burn center, cover wounds with a dry sterile dressing; avoid topical medications ^[8] .	5c
	8. Cleanse burns with mild soap and water or gentle washing with a damp dressing ^[21] . Initial debridement can be done with gauze soaked in sterile saline ^[8] .	5c
	9. Antiseptics may impair healing and are generally avoided ^[8] . For partial-thickness burns, low-toxicity agents like chlorhexidine or hypochlorous acid solutions are recommended ^[26] .	5b
	10. Debridement of non-viable tissue (including ruptured blisters) reduces infection risk ^[3,8,23,26] . For clean deep partial-thickness burns in children, blister fluid can be aspirated initially, and the blister roof preserved for 3-5 days ^[3] . Blister roofs should be removed in low-temperature scald burns ^[26] .	5b
	11. Enzymatic debridement agents (e.g., collagenase, bromelain) can be used based on wound condition ^[24,27] .	5c
	12. Debridement and dressing changes are painful and should be performed with adequate analgesia ^[3] .	5b
	13. Administer a tetanus booster if the last dose was > 5 years ago and the burn is partial or full-thickness. Give tetanus immunoglobulin if primary immunization is incomplete ^[8,19] .	4c

Table 3 (Continued)

Evidence theme	Evidence description	Level
Wound Treatment	14. Management of deep burns includes skin grafting, tangential excision, etc. ^[25,27] . Aggressive skin grafting is not recommended for deep partial-thickness burns in infants (< 3 years) ^[27] .	4c
	15. Perform escharotomy for circumferential burns to relieve constriction or pressure ^[8,21] .	4c
	16. Negative Pressure Wound Therapy (NPWT) reduces adverse events. Polyurethane foam is preferred for pediatric burns, changed every 2–3 days. Continuous mode is preferred. Negative pressure should not exceed arterial systolic pressure: < 2 years: -10 to -3.3 kPa; 2–12 years: -10 to -6.6 kPa; 13–18 years: -13.3 to -10 kPa ^[28,30] .	1b
	17. Recombinant human growth hormone may accelerate wound healing in pediatric burns ^[29] .	1b
	18. For pruritus: First-line treatment includes oral antihistamines (e.g., diphenhydramine). Other options include H1/H2 blockers, cyproheptadine, hydroxyzine, tricyclic antidepressants (doxepin). Avoid lanolin-rich products ^[17,21] .	4c
	19. Topical therapies for pruritus include aloe vera, petrolatum-based creams, cocoa butter, mineral oil, hydrogel dressings, topical corticosteroids, topical doxepin, silicone gel sheets, pressure garments, massage ^[17] .	4c
Topical Dressings & Agents	20. Laser therapy may have a positive effect on pruritus ^[17] .	2c
	21. Cover burns adequately with a primary gauze dressing, especially in emergency settings. Apply after topical antibiotic: first layer (non-adherent gauze), second layer (soft, dry gauze), outer layer (elastic bandage roll) ^[8] .	5c
	22. Biologic/synthetic dressings can reduce dressing change frequency, alleviate pain, prevent infection, and promote healing ^[8] . Other materials include film, foam, alginate, hydrocolloid, hydrogel, silicone-coated polyurethane, cellulose, or silk dressings ^[16,18,19] . Silver compounds/dressings are effective topical antimicrobials ^[20] .	1b
	23. Dressing change frequency should be adjusted based on exudate but not too frequent to interfere with re-epithelialization ^[18] .	5c
	24. Common topical antimicrobials include: antibiotic ointments, silver sulfadiazine (SSD), bismuth-impregnated petrolatum gauze, mafenide, chlorhexidine. SSD (alone or with cerium) and povidone-iodine are contraindicated in neonates with burns ^[18] .	5c
	25. Recombinant human GM-CSF hydrogel effectively promotes healing of partial or full-thickness burns in children ^[31] .	1b
Fluid Resuscitation	26. Choice of agent/dressing depends on wound characteristics, healing stage, change frequency, clinician experience, local resources, and cost ^[18,23] .	5c
	27. Fluid resuscitation is essential in severe burns, requiring accurate TBSA assessment ^[8,23] . Initiate for burns ≥ 10% TBSA in children ^[19,21] .	5c
	28. Initiate resuscitation using the Parkland formula ^[19,21] . Modified Parkland: 4 mL/(kg × %TBSA) + 24-hour maintenance fluid, where TBSA includes only partial and full-thickness burns ^[8] .	5c
	29. Use isotonic crystalloids for the first 24 hours. For children < 20 kg, include 5% dextrose in maintenance fluids to prevent hypoglycemia ^[8] .	4c
	30. Administer half the calculated volume over the first 8 hours post-burn, and the remaining half over the next 16 hours ^[23] .	4c
	31. Monitor urine output to guide resuscitation: 1–2 mL/kg/hour for weight < 30 kg; 0.5–1 mL/kg/hour for weight ≥ 30 kg ^[8,19,21] .	4c
Infection Recognition & Management	32. Rapid clinical deterioration (increased pain, change in wound appearance, intolerance to enteral feeding, systemic signs) may indicate burn wound infection/sepsis ^[16,27] .	5b
	33. Signs of fungal infection: early eschar separation (possibly due to fat liquefaction), rapid spread of subcutaneous edema with central ischemic necrosis ^[8] .	5c
	34. Inflammatory markers and wound microbiology results were incorporated into the diagnostic assessment ^[16,20,27] .	5b
	35. Systemic antibiotic therapy for burn wound infection should be guided by quantitative culture and sensitivity results ^[19,23,25] .	4c
	36. Management includes wound care (cleansing, dressing), antimicrobial therapy (topical ± systemic), and wound excision/debridement, depending on burn type ^[3,20,27] .	5b
	37. Implement strict hand hygiene, patient-isolation, and patient-provider isolation measures to prevent cross-infection ^[20,27] .	4c

4. Discussion

4.1. Dynamic assessment of wounds in pediatric burn patients should be conducted

In this study, the evidence described in items 1 to 3 regarding wound assessment is derived from clinical decision-making and expert consensus, emphasizing the importance of wound assessment. Therefore, it is essential to clarify the area and depth of the wound through assessment in pediatric patients. The study recommends using the Lund-Browder chart to evaluate the percentage of burn area relative to the total body surface area, supplemented by smartphone and tablet applications to assist in area calculation ^[26].

The application of electronic devices enables the initial wound to be documented in the form of photographs, providing an image basis for the subsequent dynamic assessment of the wound ^[8]. After burns, due to the continuous action of heat, the wound area and depth of pediatric burn patients undergo dynamic changes. Therefore, burn wound assessment includes initial assessment, re-assessment, and dynamic assessment ^[8,26,27]. Hence, in clinical practice, the evidence-based summary assessment methods can be referred to for pediatric wound assessment, providing a basis for the treatment of pediatric wounds and the selection of medications and dressings.

4.2. Early management of burn wounds should be based on their characteristics

Evidence 4–13 describes the methods for wound management in pediatric burn patients. Timely and effective management after burns in children is beneficial for reducing the transplantation rate of wounds and promoting wound recovery. In the emergency management of wounds in pediatric burn patients, to prevent further injury, heat sources, charred or clothing exposed to chemicals should be removed, and toxic substances should be cleared ^[3,8,20].

Regarding the timing of applying cold therapy after burns, current evidence suggests that cold should be applied immediately after burns, with the burned area flushed with cold water for at least 20 minutes or cooled with a cooling gauze applied to the wound. During the application of cold, body temperature changes need to be monitored ^[8,20,32]. Effective application of cold can reduce the proportion of skin grafting in pediatric wounds ^[32]. However, the benefits of cold therapy for burn wounds when applied for more than 30 minutes remain to be studied. Since burns mainly occur in home environments and emergency management is primarily carried out by caregivers of pediatric burn patients, the decision to use cold water for wound management is also influenced by the caregivers' level of knowledge ^[33]. For chemical burns, all contaminated clothing and materials should be removed and disposed of, and chemical burns require a longer washing time than thermal injuries ^[8,20].

Appropriate methods for wound cleaning and debridement should be selected based on the condition of the wound. Debridement of the wound surface is often accompanied by severe pain, so it is essential to choose an appropriate method for managing wound pain, such as sedation during dressing changes ^[3]. In addition to the application of analgesic techniques in burned children, the use of virtual reality technology during wound dressing changes can also effectively alleviate pain ^[34]. Timely and effective wound management facilitates wound healing, reduces the risk of wound infection, and prevents the wound from deepening.

4.3. Precise grading treatment based on burn severity

Evidence 14–20 elaborate on the wound treatment for burned children. Due to variations in burn severity, the treatment approaches for wounds differ. Treatment should be tailored to the characteristics of the wound to promote its recovery. For superficial burns, dressing changes are sufficient, while the management of deep burns

is more complex. Given the heterogeneity of the wound surface in children, techniques such as escharectomy and skin grafting may be necessary during debridement and dressing changes to promote wound healing [25,27]. Burn wounds are often accompanied by inflammatory exudation and the formation of a large amount of necrotic tissue, which can easily lead to wound infection. Negative pressure wound therapy can shorten the wound healing time, and the selection of negative pressure should be based on the child's age [28]. Children with severe thermal injuries often suffer from hypermetabolic syndrome, and recombinant human growth hormone can inhibit the catabolism of burned tissue and shorten the healing time of burn wounds [29]. Severe itching is common during the healing process in burned children, and systemic pharmacological treatment and local physical therapy can be chosen to alleviate itching [17].

4.4. Appropriate dressings and medications help reduce the frequency of dressing changes and promote healing

Evidence items 21–26 describe the selection of topical dressings and medications for burn wounds in pediatric patients. After debridement or surgery for burns, wound dressing changes are necessary for pediatric patients. Basic wound care for children includes covering the wound with gauze and the use of antibiotics [8]. Meanwhile, the use of biological and synthetic dressings helps reduce the frequency of dressing changes in pediatric patients, so the choice of dressing for dressing changes in children should be based on the nature of the wound and its specific requirements [9]. Frequent dressing changes may interfere with the epithelialization process of the wound, so the frequency of dressing changes should be dynamically adjusted in clinical practice based on the amount of wound exudate in pediatric patients [8]. Due to the open nature of the wound, topical antibiotics are required to prevent bacterial colonization and maintain a moist burn environment. Therefore, the selection of topical medications should be based on wound characteristics, healthcare provider experience, local resources, and cost considerations [18].

4.5. Fluid therapy facilitates wound recovery in pediatric burn patients.

Evidence items 27–31 discuss the use of fluid resuscitation after burns. After a burn, pediatric patients experience fluid loss, and early fluid replacement is beneficial for wound recovery. The wound area should be assessed to determine whether fluid resuscitation is necessary for the pediatric patient, with resuscitation required for burns covering more than 10% of the body surface area [8]. The Parkland formula is commonly used to calculate fluid resuscitation volumes in pediatric burn patients, taking into account only second-degree and higher burn areas [8]. During the fluid replacement process for pediatric patients, crystalloid solutions are administered within 24 hours. For pediatric patients with low body weight, a 5% glucose solution is used for fluid replacement to prevent hypoglycemia [8]. Urine output serves as an important indicator of whether fluid replacement in pediatric patients is adequate, and the amount of urine output should be monitored based on the patient's weight [8,19,21].

4.6. Appropriate identification and management of wound infections are necessary

Evidence items 32–37 provide an overview of the management of infected wounds in burn patients. During the course of a burn injury, infection is the most common cause of complications and death, making infection management of burn wounds particularly crucial [16]. Rapid clinical changes in burn patients, such as visible changes in the wound, wound pain, and systemic signs, indicate the presence of infection [27]. The diagnosis

of infection in pediatric burn patients requires examination of inflammatory markers and wound etiology. The wound should be cleaned and dressed, and sensitive medications should be selected for treatment based on the examination results. Severe wounds should undergo wound excision^[3]. Healthcare personnel should practice proper hand hygiene to prevent cross-infection of wounds^[3].

5. Conclusion

This paper summarizes 37 pieces of best evidence on wound care management for pediatric burn patients from six aspects: wound assessment, wound management, wound surface treatment, topical dressings and medications, fluid therapy, and infection identification and management. The aim is to provide evidence-based practical guidance for clinical healthcare professionals in managing wounds in pediatric burn patients. The evidence in this study is solely based on existing available research findings, with some evidence being of relatively low quality and most of it sourced from English literature. Therefore, during clinical practice, it is recommended that healthcare professionals reasonably adapt and apply the best evidence, taking into account the individual differences among pediatric burn patients, the availability of medical resources, and the characteristics of clinical environments both domestically and internationally.

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Disclosure statement

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Summary of Best Evidence for Disease Management of Primary Nephrotic Syndrome in Children

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Abstract: *Objective:* To retrieve, evaluate and summarize the best evidence for disease management in children with primary nephrotic syndrome. *Methods:* The relevant literatures on the management of primary nephrotic syndrome in children were systematically searched in comprehensive databases, relevant guidelines websites and professional society websites at home and abroad. The search time was from the establishment of the database to January 2025. Two researchers independently completed the quality evaluation, evidence extraction and integration of the literature. *Results:* A total of 16 articles were included, including 4 evidence-based guidelines, 5 expert consensuses, 1 systematic review, and 6 clinical decisions. A total of 34 best evidences were summarized and integrated, including management objectives, medication management, urine monitoring, diet management, infection prevention, lifestyle and recurrence assessment. *Conclusion:* This study summarizes the best evidence of disease management in children with primary nephrotic syndrome, and provides evidence-based basis for clinical medical staff to implement disease management and health education for children. Clinical medical staff should fully combine the clinical situation and the actual situation of the child when selecting evidence, transform it and apply it to clinical practice.

Keywords: Children; Primary nephrotic syndrome; Management; Best evidence summary; Evidence-based nursing

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1. Introduction

Primary nephrotic syndrome (PNS) in children is one of the most prevalent glomerular diseases among children, accounting for 90% to 95% of pediatric nephrotic syndrome cases^[1]. According to statistics, the global incidence rate of PNS in children is approximately (1.2 to 16.9) per 100,000, with an annual increase of 28,000 to 56,000 new cases in China^[2,3]. Glucocorticoid therapy has long been the first-line treatment for this condition, but it is characterized by a long treatment cycle, a tendency to become protracted, and a high risk of recurrence^[4,5]. This also makes it one of the primary causes of chronic renal failure in children^[6].

Implementing effective disease management measures can help improve the quality of life for affected children, enhance long-term disease outcomes, and reduce the recurrence rate. While current guidelines and research have outlined treatment and management approaches for pediatric nephrotic syndrome, there is a lack of standardized, family-centered management plans specifically tailored to children with primary nephrotic syndrome. This study summarizes the best evidence for disease management in pediatric primary nephrotic syndrome through systematic retrieval, screening, quality assessment, extraction, and grading, aiming to provide evidence-based support for healthcare professionals in developing family-centered disease management plans.

2. Materials and methods

This study has been registered with the Evidence-Based Nursing Center at Fudan University (ES20246713).

2.1. Establishing evidence-based questions

Evidence-based questions were constructed following the PIPOST model of the Evidence-Based Nursing Center at Fudan University^[7]. The details are as follows:

- (1) Target population (Population, P): Pediatric patients with PNS (Primary Nephrotic Syndrome);
- (2) Interventions (Intervention, I): Measures related to disease management applied to pediatric patients with PNS;
- (3) Implementers of evidence application (Professional, P): Healthcare professionals or family caregivers;
- (4) Outcome indicators (Outcome, O): Caregiving ability, unplanned readmission, infection rate, medication adherence, follow-up appointment adherence, satisfaction, etc.;
- (5) Settings for evidence application (Setting, S): Hospitals, medical institutions, etc.;
- (6) Study design or type (Study Design, T): Clinical practice guidelines, clinical decision-making, recommended practices, systematic reviews, evidence summaries, expert consensus, randomized controlled trials.

2.2. Evidence retrieval

Following the “5S” pyramid model, the search was conducted from top to bottom^[8]. The Chinese search terms were “children/pediatric patients/infants”, “nephrotic syndrome/ nephritic syndrome/ nephropathy”, “diagnosis and treatment/ management/ therapy/ intervention/ nursing”, and “guideline/ practice/ evidence summary/ systematic review/clinical decision-making/expert consensus/meta-analysis”. The corresponding English search terms were “child/ children/ pediatric/ infant/ adolescent”, “nephrotic syndrome/ nephritic syndrome/ nephropathy”, “diagnosis/ treatment/ therapy/ management/ nursing/ nursing care/ nursing intervention”, and “guideline/ practice/ systematic review/ consensus/ evidence summary/ meta-analysis”.

The databases searched included CNKI, VIP, Wanfang Data, Chinese Biomedical Literature Database (CBM), PubMed, Web of Science, CINAHL, Cochrane Library, Joanna Briggs Institute (JBI) Evidence-Based Practice Database, Ovid, and Karger Medical Electronic Resource Database. Relevant guideline and professional society websites included UpToDate Clinical Advisor, BMJ Best Practice, National Institute for Health and Care Excellence (NICE), Chinese Society of Nephrology (CMA), International Society of Nephrology (ISN), International Pediatric Nephrology Association (IPNA), Medlive Clinical Guidelines, Guidelines International Network (GIN), MedSci, Scottish Intercollegiate Guidelines Network (SIGN), Registered Nurses’ Association

of Ontario (RNAO), New Zealand Guidelines Group (NZGG), Chinese Medical Knowledge Base (Selected Guidelines Database), American Society of Nephrology (ASN), and Chinese Medical Journal Full-text Database (Guidelines Module). The search period spanned from the establishment of each database to January 2025. Chinese and English search strategies are shown in **Figure 1**.

<p>English database retrieval formula -- taking PubMed as an example</p> <p>#1 (((child[MeSH Terms]) OR (children[MeSH Terms])) OR (pediatric[MeSH Terms]) OR (infant[MeSH Terms])) OR (adolescent[MeSH Terms])</p> <p>#2 ((nephrotic syndrome[MeSH Terms]) OR (nephritic syndrome[MeSH Terms])) OR (nephropathy[MeSH Terms])</p> <p>#3 ((((((diagnosis[Title/Abstract]) OR (treatment[Title/Abstract])) OR (therapy[Title/Abstract])) OR (management[Title/Abstract])) OR (nursing[Title/Abstract])) OR (nursing care[Title/Abstract])) OR (nursing intervention[Title/Abstract]))</p> <p>#4 (((((guideline[Title]) OR (practice[Title])) OR (systematic review[Title])) OR (consensus[Title])) OR (evidence summary[Title])) OR (meta-analysis[Title]))</p> <p>#5 (((#1) AND (#2)) AND (#3)) AND (#4)</p> <p>Search query for Chinese databases—taking CNKI as an example:</p> <p>#1 Subject = Children + Pediatric Patients + Infants</p> <p>#2 Subject = Nephrotic Syndrome + Kidney Disease</p> <p>#3 Title/Abstract/Keywords = Diagnosis and Treatment + Management + Therapy + Intervention + Nursing</p> <p>#4 Title/Abstract/Keywords = Guidelines + Practice + Expert Consensus + Systematic Review + Evidence Summary + Clinical Decision-Making + Meta-Analysis</p> <p>#5 #1 AND #2 AND #3 AND #4</p>

Figure 1. Search formulas for PubMed and CNKI.

2.3. Literature inclusion and exclusion criteria

The inclusion criteria are as follows:

- (1) Research content of the literature: measures related to disease management in children with PNS;
- (2) Types of literature: guidelines, best practices, clinical decisions, expert consensus, systematic reviews, evidence summaries, randomized controlled trials;
- (3) Outcome indicators: caregiving capacity, recurrence rate/unplanned readmission, infection rate, medication adherence, follow-up compliance, satisfaction, etc.;
- (4) Time frame: literature published from the establishment of the database to January 2025, language: Chinese or English.

The exclusion criteria are as follows:

- (1) Literature with incomplete data, duplicate publications, abstracts, or unavailable full texts;
- (2) Literature that fails to meet the quality evaluation criteria.

2.4. Literature quality evaluation criteria

The quality of included guidelines will be evaluated using the Appraisal of Guidelines for Research and Evaluation II (AGREE II) ^[9]. Expert consensus will be evaluated using the JBI Evidence-Based Health Care Center's authenticity evaluation tool for opinion and consensus articles (2016 version) ^[10]. Systematic reviews and randomized controlled trials will be evaluated using the corresponding evaluation tools from the Australian JBI Evidence-Based Health Care Center (2016); clinical decisions, best practices, and evidence summaries will be traced back to the original literature and evaluated for quality using the corresponding evaluation tools ^[11,12].

2.5. Literature quality evaluation process

Two members of the research team, who have undergone systematic training in evidence-based nursing, independently evaluate the literature according to the literature quality evaluation criteria and conduct cross-

reviews. In cases of inconsistent or divergent evaluation opinions, a decision is made through consultation with a third team member.

2.6. Evidence extraction and summarization

Two researchers extract evidence based on the research topic and objectives. After evidence extraction, all team members participate in discussions to summarize the evidence. The principles for evidence summarization are as follows:

- (1) When the content is consistent, select evidence that is more concise and better aligned with professional expressions;
- (2) If the content is complementary, merge the evidence;
- (3) When there are conflicting conclusions from evidence from different sources, prioritize evidence-based evidence, high-quality evidence, and recently published evidence.

The grading of evidence adopts the “JBI Evidence Pre-grading and Evidence Recommendation Level System (2014 Edition)”^[13]. By tracing back to the original literature of the evidence, the evidence level is determined, encompassing a total of five levels, which decrease sequentially from 1 to 5. Additionally, under the guidance of the JBI FAME structure and in combination with the aforementioned recommendation level system (2014 Edition), the recommendation level of the included evidence-based guidelines is determined, with Level A representing strong recommendations and Level B representing weak recommendations.

3. Results

3.1. General characteristics of included literature

A preliminary search yielded 2,191 articles. After removing duplicates and excluding articles that did not meet the inclusion criteria by reviewing their titles, abstracts, and full texts, a final set of 16 articles was included, comprising 4 evidence-based guidelines, 5 expert consensuses, 1 systematic review, and 6 clinical decisions^[5,14–28]. The general characteristics of the included literature are presented in **Table 1**, and the literature screening process is illustrated in **Figure 2**.

Table 1. General characteristics of included literature

No.	Literature	Database/ source	Type	Topic
1	Trautmann et al. 2022 ^[14]	CINAHL	Evidence-based Guideline	IPNA Recommendations for Diagnosis and Management of Steroid-Sensitive Nephrotic Syndrome in Children
2	Chinese Medical Association Pediatrics Branch Nephrology Group 2016 ^[5]	VIP	Evidence-based Guideline	Evidence-based Guidelines for Diagnosis and Treatment of Steroid-Sensitive, Relapsing/Dependent Nephrotic Syndrome in Children
3	Kaku et al. 2015 ^[15]	PubMed	Evidence-based Guideline	General Treatment of Nephrotic Syndrome in Children
4	KDIGO 2012 ^[16]	PubMed	Evidence-based Guideline	Management and Treatment of Glomerular Diseases
5	Ehren et al. 2021 ^[17]	CINAHL	Expert Consensus	German Expert Consensus on Diagnosis and Treatment of Steroid-Sensitive Nephrotic Syndrome in Children

Table 1 (Continued)

No.	Literature	Database/ source	Type	Topic
6	Li Xiaozhong et al. 2019 ^[18]	CNKI	Expert Consensus	Expert Consensus on Vaccination for Children with Renal Diseases
7	Pasini et al. 2017 ^[19]	Yimaitong	Expert Consensus	Management of Nephrotic Syndrome in Children
8	Sinha et al. 2021 ^[20]	PubMed	Expert Consensus	Management Recommendations for Steroid-Sensitive Nephrotic Syndrome in Children
9	Sun Jinqiao et al. 2019 ^[21]	CNKI	Expert Consensus	Expert Consensus on Vaccination for Children on Immunosuppressive Therapy
10	Mi Xiufang et al. 2019 ^[22]	CNKI	Systematic Review	Efficacy of Calcium and Vitamin D in Preventing Steroid-Induced Bone Loss in Children with Nephrotic Syndrome
11	Boyer 2023 ^[23]	UpToDate	Clinical Decision Support	Evaluation of Proteinuria in Children
12	Niaudet 2023 ^[24]	UpToDate	Clinical Decision Support	Symptomatic Management of Nephrotic Syndrome in Children
13	Valentini 2022 ^[25]	UpToDate	Clinical Decision Support	Evaluation and Treatment of Edema in Children
14	Niaudet 2024 ^[26]	UpToDate	Clinical Decision Support	Treatment of Idiopathic Nephrotic Syndrome in Children
15	UpToDate 2025 ^[27]	UpToDate	Clinical Decision Support	Health Education for Patients with Nephrotic Syndrome
16	UpToDate 2025 ^[28]	UpToDate	Clinical Decision Support	Health Education on Low-Sodium Diet for Children

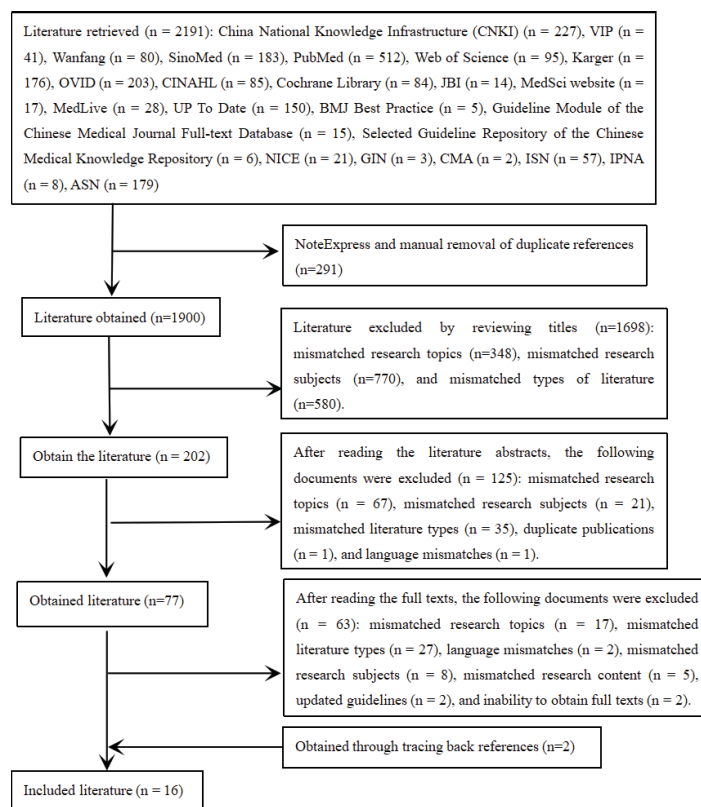


Figure 2. Flowchart of literature screening process.

3.2. Results of literature quality assessment

3.2.1. Quality assessment of guidelines

Four guidelines were included, all of which received high-quality assessments and were thus included. The standardized percentage scores and recommendation levels for each field are provided in **Table 2**.

Table 2. Quality assessment results of included guidelines (n = 4)

Included guidelines	Domain score percentage (%)						Number of domains		Recommendation level
	Scope & purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence	≥ 60%	≥ 30%	
Trautmann et al. ^[14]	100	100	70.83	90.48	66.67	100	6	6	A
Chinese Medical Association Pediatrics Branch Nephrology Group ^[5]	94.44	63.89	79.17	97.22	62.50	100	6	6	A
Kaku et al. ^[15]	100	97.22	81.25	100	52.08	95.83	5	6	B
KDIGO ^[16]	100	58.34	69.79	100	81.25	100	5	6	B

3.2.2. Quality assessment of expert consensuses

Five expert consensuses were included, all of which received favorable quality assessments and were thus approved for inclusion. The assessment results are shown in **Table 3**.

Table 3. Quality assessment results of included expert consensuses (n = 5)

Literature	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Ehren et al. ^[17]	Yes	Yes	Yes	Yes	Yes	Yes
Li et al. ^[18]	Yes	Yes	Unclear	Yes	Yes	Yes
Sun et al. ^[21]	Yes	Yes	Unclear	Yes	Yes	Yes
Pasini et al. ^[19]	Yes	Yes	Yes	Yes	Yes	Yes
Sinha et al. ^[20]	Yes	Yes	Unclear	Yes	Yes	Yes

3.2.3. Quality assessment of systematic reviews

A total of one systematic review was included ^[22]. In its quality assessment, item 7, “Were measures taken to minimize errors during data extraction?” was rated as “No”; item 11, “Were appropriate suggestions made regarding specific directions for future research?” was rated as “Unclear”; all other items were rated as “Yes”. The quality assessment was favorable, and the review was approved for inclusion.

3.2.4. Quality evaluation of clinical decisions

A total of six clinical decisions were included, all sourced from the UpToDate clinical decision-making system ^[23–28]. This system is an internationally recognized authoritative evidence-generating institution, with its evidence content confirmed through international peer review, ensuring high evidence quality. Therefore, all decisions were approved for inclusion.

3.3. Evidence description and summary

This study summarized seven themes: management objectives, medication management, urine testing, dietary management, infection prevention, lifestyle, and recurrence assessment, culminating in a total of 34 pieces of best evidence (**Table 4**).

Table 4. Summary of best evidence for disease management in pediatric patients with PNS

Evidence theme	Evidence content	Level
Management Goals	1. Achieve relapse-free status, minimize adverse effects, and improve quality of life ^[14] .	1a
	2. Prevent or minimize complications of the underlying NS ^[2] .	1a
Medication Management	3. Common adverse effects: Obesity/weight gain, hypertension, diabetes, behavioral/mental disorders, sleep disruption, growth impairment, Cushingoid appearance, striae, glaucoma, cataracts, bone pain, femoral head necrosis ^[14] .	1a
	4. Regular monitoring recommended: Blood pressure, height, weight (quarterly) ^[14,23] .	1b
	5. Regular ophthalmologic examinations recommended during steroid therapy ^[14,15] .	2d
	6. Prophylactic use of calcium and vitamin D to prevent bone loss during PDN therapy ^[14,22] .	1a
	7. Guide parents to keep a medication record [20].	5b
Urine Monitoring	8. Random urine samples (preferably first morning or 24-hour specimens) recommended for assessing proteinuria ^[14] .	1a
	9. Educate parents/caregivers: Use dipstick test to monitor urine protein levels ^[1-3,6-7] .	5b
	10. Continue monitoring proteinuria after effective PDN treatment to detect early relapse, initiate timely treatment, and prevent significant edema and complications ^[23] .	1b
	11. Monitoring frequency/timing: (1) Daily home dipstick testing until remission after discharge ^[14,23] . (2) Home dipstick testing at least twice weekly in the first year, then individualized ^[14,19] . (3) Daily testing if dipstick shows 1+ protein or more, during fever/infection, or if relapse is suspected ^[14,19] .	5b
	12. Advise children to urinate before bed and remain recumbent before collecting the first morning sample ^[23] .	5c
	13. Do not use dipstick tests for at least 24 hours after contrast imaging ^[23] .	5c
Dietary Management	14. Low-salt diet recommended during edema ^[14,15,19,24,25,27,28] , daily sodium intake limited to 2-3 mEq/kg body weight, up to 90 mEq/day (2000 mg) for older children ^[14,25] ; fluid restriction should be based on effective circulating volume ^[14,15,19,23,25,28] .	5b
	15. Ensure healthy nutrition during PDN therapy, avoiding high-fat/high-calorie foods. Caloric intake should be age-appropriate ^[14,15] .	1b
	16. Dietary measures limiting excessive caloric intake (including low-fat diet) help prevent significant weight gain. Therefore, guiding families on reasonable diet is important for obesity prevention ^[15,24] .	5a
	17. For PNS children with normal renal function, protein intake should be based on the nutritional requirements of healthy peers ^[15] . Protein intake should reach 130%-140% of the Recommended Daily Allowance ^[23] .	2b
	18. Ensure adequate dietary calcium; children with insufficient intake should receive oral calcium supplements ^[14] .	1a
	19. Where possible, involve a dietitian to advise children and families on appropriate low-salt, low-fat diet during relapse ^[14] .	1a

Table 4 (Continued)

Evidence theme	Evidence content	Level
Infection Prevention	20. Routine prophylactic antibiotics are not recommended ^[1] .	1a
	21. Inform families about the increased infection risk due to immunosuppressive therapy ^[3] .	5b
	22. In case of suspected bacterial infection, seek immediate medical care for timely antibiotic therapy ^[14,19] .	5b
	23. Vaccination is the primary means of infection prevention ^[24] .	1b
	24. Children on immunosuppressive therapy can receive inactivated vaccines ^[13] and are recommended to complete age-appropriate inactivated vaccinations ^[14,15,20,24] .	5b
	25. Administration of live attenuated vaccines should follow national guidelines ^[1,13] . It is advised to postpone live attenuated vaccines during high-dose immunosuppressive therapy ^[19,21] .	5b
	26. Live vaccines are contraindicated during immunosuppressive therapy ^[14,15] .	1a
	27. Annual influenza vaccination is recommended for the child and close household contacts ^[1,6,9,16] . Unimmunized children should receive pneumococcal vaccines ^[2,15,16] .	4b
	28. Timely vaccination of healthy household contacts, especially against varicella and influenza, is recommended to minimize the child's infection risk ^[4,6,15] .	1b
Lifestyle	29. Avoid direct contact of the child with GI, urinary, or respiratory secretions of household members who have received a live vaccine within the prior 3-6 weeks ^[16] .	1a
	30. Avoid excessive restriction of physical activity to prevent thrombosis, bone loss, and obesity ^[14,24] .	4a
	31. Restrict activity during acute phase if there is abnormal blood pressure and/or severe pulmonary edema ^[15] .	4d
Relapse Assessment	32. Adequate sun protection is recommended for children on long-term immunosuppressants ^[14,17] , including reducing UV exposure, avoiding sunbathing, covering skin, and using high-SPF sunscreen ^[14] .	5b
	33. Relapse is defined in a previously fully remitted patient as dipstick urine protein $\geq 3+$ (or uPCR ≥ 200 mg/mmol / 2 mg/mg) for 3 consecutive days, with or without edema ^[5,14] .	1b
	34. Signs of potential relapse requiring evaluation include fever $\geq 38^{\circ}\text{C}$, decreased urination frequency, and worsening swelling ^[27] .	5c

Note: NS refers to Nephrotic Syndrome, PNS refers to Primary Nephrotic Syndrome, and PDN refers to Prednisone or Prednisolone.

4. Discussion

4.1. Family-centered approach: Leveraging the vital role of family caregivers

Due to the unique characteristics of children with PNS, such as their young age and limited self-care abilities, they primarily rely on family caregivers for disease management. Multiple items in the compiled evidence explicitly highlight the crucial role of family caregivers in managing the child's illness. For instance, evidence item 7 recommends instructing family caregivers to keep medication records during the child's pharmacological treatment; evidence item 9 suggests educating the child and their parents or caregivers and guiding them to monitor the child's urinary protein levels using dipstick tests; evidence item 19 proposes that not only should children be educated on dietary management, but family members also play a pivotal role in dietary adjustments; evidence item 21 advises informing family members that the child's risk of infection increases due to immunosuppressive therapy, necessitating the cooperation of family caregivers to implement measures to prevent infections ^[14,19,20,13].

In summary, family caregivers play a vital role in medication management, urine monitoring, dietary management, and infection prevention for the child. Evidence items 1 and 2 summarize that effective disease

management can prevent relapse, minimize adverse reactions, reduce complications caused by underlying nephrotic syndrome (NS), and improve the child's quality of life ^[14,23]. Therefore, in future clinical practice, healthcare professionals can fully leverage the initiative of family caregivers of pediatric patients, encouraging their participation in the child's disease management to improve the child's long-term prognosis and enhance their quality of life.

4.2. Strengthening medication management is crucial for pharmacological treatment

Evidence items 3 to 7 summarize the content related to medication management in children with PNS. Guidelines and clinical decisions outline common adverse reactions during corticosteroid therapy and corresponding measures ^[14,15,23]. For adverse reactions such as obesity or weight gain, hypertension, and growth disorders, children require regular monitoring of blood pressure, height, and weight. During corticosteroid therapy, children also face risks of glaucoma and cataracts, necessitating regular ophthalmologic examinations to promptly assess ocular conditions. Research also indicates that children undergoing prednisone (PDN) therapy can prophylactically use calcium and vitamin D to prevent drug-induced bone loss ^[22]. Additionally, expert consensus recommends that healthcare professionals should guide parents in keeping medication records ^[20]. Collectively, regular monitoring and examination of relevant indicators are key to prevention in the medication management of children with PNS; prophylactic use of relevant medications and the involvement of family caregivers are important components of management.

4.3. Emphasizing urine monitoring for timely identification of relapse

Evidence items 8 to 13 summarize the methods and specific content of urine monitoring in children with PNS. The degree of proteinuria is closely related to the onset and prognosis of the disease in children and is considered one of the important predictors of relapse ^[29]. Other studies have shown that continuous monitoring of urinary protein facilitates early detection of relapse and initiation of treatment, thereby preventing significant edema and minimizing related complications ^[23]. Currently, clinicians primarily rely on urine test results reported by pediatric patients and their caregivers during medical visits to assess the prognosis of these patients after discharge. However, research has found issues such as poor monitoring compliance and untimely medical visits ^[30]. Therefore, strengthening health education on urine monitoring for pediatric patients and their family caregivers to enhance their awareness and compliance is of great significance for the disease prognosis of these patients.

Guidelines recommend prioritizing the use of first morning urine or 24-hour urine specimens for assessing proteinuria, followed by random urine samples ^[14]. Family caregivers can be encouraged to actively participate in the urine monitoring and management of pediatric patients. It is recommended that healthcare professionals provide health education to pediatric patients and their family caregivers, instructing them on how to use test strips to monitor the urinary protein levels of pediatric patients, and informing them about the timing, frequency, and precautions of urine monitoring ^[14,19,20,23]. Simultaneously, pediatric patients and their family caregivers should be instructed on how to identify disease recurrence. The guidelines recommend that when a pediatric patient who has previously achieved complete remission exhibits a random urine or first morning urine test strip result of $\geq 3+$ for three consecutive days, or a urine protein/creatinine ratio of ≥ 200 mg/mmol (2 mg/mg), with or without edema, it indicates recurrence, and they should seek medical attention promptly. If symptoms of infection, a decrease in urination frequency compared to usual, or increased swelling occur, it may also indicate recurrence, and medical attention should also be sought promptly ^[5,14,27].

4.4. Emphasizing the supportive role of diet and lifestyle in pediatric patients

Articles 14 to 19 and 30 to 32 summarize the management of diet and lifestyle for pediatric patients with PNS. During periods of edema, a low-salt diet is recommended with daily intake adjusted according to body weight and limited to 2-3 mEq/kg, with a maximum of 90 mEq (2000 mg) for older children ^[14,15,19,24,25,27,28]. However, fluid intake restriction should be determined based on effective circulating blood volume ^[14,15,19,23,25,28]. Regarding caloric intake, guidelines recommend maintaining healthy nutrition during PDN treatment, avoiding high-fat and/or high-calorie foods ^[14,15]. Caloric intake should be tailored to the patient's age, and dietary measures to limit excessive calorie intake can help prevent significant weight gain in children.

Studies have shown that guiding families on proper dietary arrangements is crucial for preventing obesity ^[24]. When feasible, it is recommended that a dietitian provide advice to children and their families who require a moderately low-fat and low-salt diet during relapse ^[14]. In terms of protein intake, guidelines suggest that protein consumption in PNS children with normal renal function should be based on the nutritional needs of healthy children of the same age, reaching 130% to 140% of the daily recommended intake ^[15,23]. Additionally, regarding lifestyle, reasonable exercise can prevent complications such as thrombosis, decreased bone mass, and obesity, but children with abnormal blood pressure and/or severe pulmonary edema during the acute phase should limit physical activity ^[14,15,24]. Children receiving long-term immunosuppressive therapy should also be adequately protected from sun exposure ^[14,17].

4.5. Popularize knowledge about vaccination and strengthen the prevention of infections

Evidence from Articles 20 to 29 summarizes content related to infection prevention and management in children with PNS. Due to the long-term use of corticosteroids and other immunosuppressive agents in children with PNS, their immune function is prone to decline, making them susceptible to infections. Infections are not only a major complication of childhood PNS but also one of the risk factors for PNS relapse, posing a persistent challenge in PNS treatment ^[31–33]. Guidelines and expert consensus recommend that children and their families should be informed of the increased risk of infection during treatment and instructed on how to take effective measures to prevent infections ^[14,19].

In cases of suspected bacterial infection, immediate medical attention is advised to initiate antibiotic therapy promptly; however, routine prophylactic use of antibiotics is not recommended. Studies indicate that vaccination is a primary means of preventing infections ^[24]. However, live vaccine administration is contraindicated under immunosuppressive therapy ^[16,17]. Children receiving immunosuppressive therapy can receive inactivated vaccines, and it is recommended that they complete inactivated vaccine vaccinations according to age-appropriate standards ^[14,15,20,21,24]. The administration of live attenuated vaccines should adhere to the corresponding principles outlined in national vaccination guidelines, and it is recommended that children undergoing high-dose immunosuppressive therapy delay vaccination ^[14,19,21].

Timely vaccination of family members who have long-term contact with pediatric patients is also crucial to minimize the risk of infecting the children, particularly with vaccines for varicella and influenza ^[15,16,20]. It is recommended that both pediatric patients and their family members with long-term contact receive annual influenza vaccinations, and that pediatric patients who have not been immunized should also receive pneumococcal vaccines ^[5,14,16,20,23,24]. Additionally, guidelines recommend that pediatric patients should avoid direct contact with gastrointestinal, urinary, or respiratory secretions from family members who have received live vaccines within the past 3 to 6 weeks ^[16].

5. Conclusion

This study summarized the disease management aspects for pediatric patients with PNS across seven dimensions, including management objectives, medication management, urine testing, dietary management, infection prevention, and lifestyle. In the future, based on the evidence summarized and in conjunction with actual clinical conditions, disease management measures for pediatric patients with primary nephrotic syndrome will be developed to provide evidence-based support for clinical healthcare professionals in implementing disease management and health education for pediatric patients. However, this study has certain limitations, including a limited variety of included literature types and a lack of high-quality randomized controlled trials. Future research could expand search resources and enrich the types of literature. Clinical healthcare professionals should fully consider clinical conditions and the actual situations of pediatric patients when selecting evidence, transforming it, and applying it to clinical practice.

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Disclosure statement

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Research on the Exploration and Implementation Methods of Ideological and Political Education Elements in Internal Medicine Nursing Teaching from the Perspective of Teachers' and Students' Sense of Gain

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Abstract: In the context of education in the new era, integrating ideological and political education into the curriculum has become a crucial approach to fulfilling the fundamental task of fostering virtue and nurturing talent. Internal medicine nursing, as a core course in the nursing program, holds significant importance in incorporating ideological and political elements into its teaching process to cultivate nursing professionals who possess both professional competence and humanistic care. The sense of gain among teachers and students serves as a core indicator for evaluating the effectiveness of implementing ideological and political education in the curriculum, directly reflecting the educational quality and instructional value of ideological and political education. This paper systematically reviews the dimensions and core content of exploring ideological and political elements in internal medicine nursing teaching, conducts an in-depth analysis of the implementation methods for ideological and political education in internal medicine nursing teaching based on enhancing the sense of gain for both teachers and students, discusses the existing problems in current practice, and provides an outlook on future development trends. The aim is to offer theoretical references and practical insights for optimizing the ideological and political teaching model in internal medicine nursing courses and enhancing the sense of gain for both teachers and students.

Keywords: Internal medicine nursing; Curriculum-based ideological and political education; Sense of gain for teachers and students; Implementation methods; Teaching exploration

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1. Introduction

With the rapid development of the medical and health sector, the demand for nursing professionals has shifted from purely technical talent to composite talent that combines “technical skills, humanistic qualities, and a sense of responsibility”^[1]. Curriculum-based ideological and political education, as an educational model that integrates ideological and political education throughout the entire process of professional course teaching, achieves the organic unity of knowledge transmission, ability cultivation, and value guidance^[2]. The internal medicine nursing curriculum covers nursing knowledge and skills for various systemic diseases, including circulatory, respiratory, and digestive systems, and its teaching content is closely integrated with clinical practice, containing rich entry points for ideological and political education. It serves as an important vehicle for implementing curriculum-based ideological and political education.

The sense of gain for teachers and students refers to the comprehensive experience of cognitive enhancement, ability improvement, emotional resonance, and value identification that both teachers and students acquire through the interaction of teaching and learning in the process of curriculum-based ideological and political education^[3]. For teachers, a sense of gain is manifested in the renewal of teaching philosophies, the enhancement of teaching abilities, and the realization of the value of educating people. For students, it is reflected in the consolidation of professional knowledge, the cultivation of professional qualities, and the establishment of correct worldviews, outlooks on life, and values. Currently, research on ideological and political education in internal medicine nursing teaching primarily focuses on the excavation of ideological and political elements and the construction of implementation pathways.

However, insufficient attention has been paid to the sense of gain among teachers and students, leading to issues of “emphasizing form over effectiveness” in some ideological and political teaching practices. Therefore, systematically organizing the exploration achievements and implementation methods of ideological and political elements in internal medicine nursing teaching, with a focus on enhancing the sense of gain among teachers and students, holds significant theoretical and practical importance for promoting the high-quality development of ideological and political education in internal medicine nursing courses and cultivating qualified nursing professionals.

2. Exploration dimensions and core content of ideological and political elements in internal medicine nursing teaching

2.1. Professional ethics dimension

Professional ethics represent the core quality of nursing professionals and constitute one of the central aspects of ideological and political education in internal medicine nursing teaching^[4]. This dimension primarily focuses on cultivating students’ professional ethics, sense of responsibility, dedication, and professional norms. In internal medicine nursing instruction, ideological and political elements can be integrated through clinical case studies. For instance, when explaining the care of critically ill patients, analyzing the emergency response of healthcare workers during public health emergencies can guide students to establish a professional belief in “prioritizing life and saving the injured and sick.” When discussing the care of patients with chronic diseases, emphasizing patience, meticulousness, and responsibility in long-term care can foster students’ dedication and professional mission^[5]. Additionally, incorporating core nursing regulations and medical dispute cases can help students recognize the importance of strictly adhering to professional norms and maintaining ethical standards, thereby enhancing their professional ethics.

2.2. Humanistic care dimension

The essence of nursing work lies in caring for and attending to individuals, with humanistic care representing the core value pursuit of the nursing profession. In internal medicine nursing teaching, the exploration of ideological and political elements related to humanistic care primarily revolves around respecting patients, showing compassion for them, and engaging in effective communication with them ^[6]. For example, when explaining the care for elderly patients, instructors can integrate the physiological and psychological characteristics of elderly patients to guide students in understanding the feelings of loneliness and helplessness experienced by elderly patients, thereby cultivating students' empathy and caring awareness. When discussing the care for patients with infectious diseases, instructors can guide students to respect the personality and rights of patients, eliminate discrimination against those with infectious diseases, and practice the concept of humanistic care ^[7]. Furthermore, by introducing heartwarming cases in nursing services, such as healthcare professionals providing personalized care for patients and helping them resolve practical difficulties, students can gain a profound understanding of the importance of humanistic care in nursing work and enhance their humanistic qualities ^[8].

2.3. Scientific spirit dimension

Internal medicine nursing, as a discipline, possesses strong scientific and practical attributes. Cultivation of students' scientific spirit is one of the important objectives in internal medicine nursing education. The ideological and political elements related to scientific spirit mainly include a rigorous and truth-seeking academic attitude, an innovative and exploratory spirit, and the concept of evidence-based nursing ^[9]. In the teaching process, instructors can integrate the development history of internal medicine nursing, such as breakthroughs in the diagnosis and treatment of major diseases and the evolution of nursing models, to guide students in recognizing the arduousness and importance of scientific exploration and cultivate their innovative consciousness and spirit of exploration. When explaining content such as nursing assessment and the formulation of nursing measures, emphasis should be placed on the evidence-based nursing concept, guiding students to respect science and facts and develop a rigorous and pragmatic attitude towards academic pursuits. Through experimental teaching, clinical internships, and other segments, students' observational, analytical, and problem-solving abilities can be cultivated, thereby strengthening their scientific literacy.

2.4. Patriotism and sense of national identity dimension

Patriotism and a sense of national identity are crucial components of ideological and political education and are also key to cultivating the social responsibility of nursing professionals ^[10]. In internal medicine nursing education, the exploration of ideological and political elements related to patriotism and national identity can be carried out in conjunction with China's achievements in the pharmaceutical and healthcare sector and responses to public health emergencies. For example, when explaining the nursing of respiratory diseases, instructors can combine China's significant achievements in combating the COVID-19 pandemic to introduce the advanced deeds of healthcare workers who bravely went to the frontlines and selflessly contributed, guiding students to establish patriotism and a sense of social responsibility ^[11]. When explaining the nursing care of chronic diseases such as cardiovascular diseases and diabetes, the current status and achievements of China's chronic disease prevention and control efforts should be incorporated to make students recognize the crucial role of nursing in safeguarding national health and advancing the Healthy China strategy, thereby stimulating their professional pride and sense of mission.

3. Implementation methods of ideological and political education in internal medicine nursing teaching based on teacher-student sense of gain

3.1. Case-based teaching method

The case-based teaching method serves as an effective vehicle for deeply integrating ideological and political elements with professional knowledge. By selecting clinical cases with ideological and political connotations, it guides students to achieve an organic unity of knowledge acquisition and value guidance in the process of analyzing cases and solving problems^[12]. During implementation, teachers need to carefully screen cases to ensure they possess both professional and ideological and political qualities, such as selecting advanced cases of medical and nursing staff in the treatment of major diseases, nursing cases that embody humanistic care, and typical cases that uphold professional ethics.

In classroom teaching, through group discussions, case analyses, summary evaluations, and other activities, students are guided to deeply contemplate the professional issues and ideological and political connotations within the cases, enabling them to master nursing knowledge and skills while establishing correct professional values^[13]. For teachers, the process of case selection, design, and implementation can enhance their ability to design ideological and political education in course teaching and improve their teaching proficiency, thereby increasing their sense of teaching gain^[14]. For students, the case-based teaching method can enhance the interest and relevance of learning, helping them better understand professional knowledge and ideological and political connotations, and thereby increasing their sense of learning gain.

3.2. Scenario simulation method

The scenario simulation method is a teaching approach that involves constructing simulated clinical nursing scenarios, having students assume different roles, and participating in the nursing practice process. This method can provide students with an immersive learning experience, helping them translate theoretical knowledge into practical skills while enhancing their emotional experience and value identification^[15]. In the ideological and political education of internal medicine nursing courses, various simulated scenarios can be constructed, such as emergency rescue scenarios for critically ill patients, health education scenarios for patients with chronic diseases, and scenarios involving communication conflicts with patients.

These scenarios incorporate ideological and political elements such as professional ethics, humanistic care, and teamwork^[16]. For example, when simulating an emergency rescue scenario for critically ill patients, students can be assigned roles as healthcare professionals to experience the tense atmosphere and sense of responsibility during the rescue process, thereby cultivating their emergency response capabilities and teamwork spirit. In simulating health education scenarios for patients with chronic diseases, students are guided to pay attention to the psychological needs of patients and practice the concept of humanistic care. The implementation of the scenario simulation method requires teachers to carefully design scenarios, guide students in role-playing, and conduct summaries and evaluations, which can enhance teachers' practical teaching abilities and their ability to integrate ideological and political education into the curriculum. For students, the immersive learning experience can enhance their learning initiative and sense of participation, improve their practical skills and professional qualities, and increase their sense of learning achievement.

3.3. Blended online-offline teaching approach

With the rapid development of information technology, the blended online-offline teaching approach has emerged as a crucial model for ideological and political education within courses^[17]. This method can transcend

the constraints of traditional teaching in terms of time and space, expand the teaching sphere, enrich teaching resources, and enhance students' learning experiences. In the ideological and political education of internal medicine nursing courses, the online component can leverage platforms such as Xuexi Tong, MOOCs, and micro-lessons to upload ideological and political educational resources, such as videos of exemplary deeds by medical staff, nursing ethics case studies, and interpretations of industry policies, guiding students in autonomous learning.

Through online discussion forums, questionnaires, and other means, teachers can gain insights into students' learning needs and ideological trends, providing targeted guidance for offline instruction. The offline component, on the other hand, focuses on explaining key and difficult knowledge points, conducting case analyses, and engaging in scenario simulations, achieving a seamless integration of online autonomous learning with offline interactive teaching. Additionally, online platforms can be utilized for teaching evaluations, providing timely feedback on students' learning outcomes and enhancing teaching efficiency. For teachers, the blended online-offline teaching approach promotes the renewal of their teaching philosophies and the enhancement of their teaching skills, fostering a sense of accomplishment in teaching^[18]. For students, the abundance of teaching resources and flexible learning methods enhance their autonomy and convenience in learning, enriching their learning experiences and sense of achievement.

3.4. Practical experience method

The practical experience method involves organizing students to participate in practical activities such as clinical internships, voluntary services, and community nursing, enabling them to perceive the value of nursing work through practice and deepen their value recognition and sense of responsibility^[19].

In the ideological and political education of internal medicine nursing courses, the practical experience method serves as a crucial bridge connecting classroom teaching with clinical practice. For instance, organizing students to conduct clinical internships in the internal medicine wards of hospitals allows them to personally experience the working conditions of medical staff and learn their professional dedication and humanistic care concepts. Organizing students to participate in voluntary services for community chronic disease management, providing health consultations and education to community residents, helps students recognize the important role of nursing work in safeguarding residents' health. Conducting nursing ethics practical activities, such as involving students in discussions of medical dispute cases and simulations of ethical decision-making, enhances their professional ethics and ethical judgment abilities.

The implementation of the practical experience method requires teachers to strengthen cooperation with clinical institutions and communities, carefully design practical activities, and effectively conduct guidance and evaluation. This can enhance teachers' practical teaching organization skills and their ability to foster ideological and political education in courses. For students, practical experience enables them to integrate knowledge learned in the classroom with practical applications, deepen their understanding and recognition of the nursing profession, strengthen their sense of social responsibility and professional mission, and enhance their sense of learning and career fulfillment^[20].

4. Conclusion

The integration of ideological and political education into internal medicine nursing teaching is an important approach to cultivating compound nursing talents, and the sense of gain among teachers and students serves

as a core indicator for measuring the effectiveness of implementing ideological and political education in the curriculum. Currently, the exploration of ideological and political elements in internal medicine nursing teaching has covered four dimensions: professional ethics, humanistic care, scientific spirit, and patriotism, resulting in various implementation methods such as case-based teaching and situational simulation. However, practical challenges persist, including inadequate integration of ideological and political elements, insufficient innovation in teaching methods, and an imperfect evaluation system, which hinder the enhancement of the sense of gain among teachers and students. In the future, it is necessary to continuously optimize the teaching model of ideological and political education in internal medicine nursing courses by deepening the exploration of ideological and political elements, innovating teaching methods, improving the evaluation system, and enhancing teachers' capabilities. This will promote the deep integration of ideological and political elements with professional teaching, achieving a win-win situation of improving teachers' teaching abilities and students' all-round development. It is believed that with the continuous deepening of relevant research and ongoing exploration in teaching practice, the quality of ideological and political education in internal medicine nursing courses will continuously improve, significantly enhancing the sense of gain among teachers and students, and laying a solid foundation for cultivating more outstanding nursing talents with both professional competence and humanistic qualities.

Disclosure statement

The authors declare no conflict of interest.

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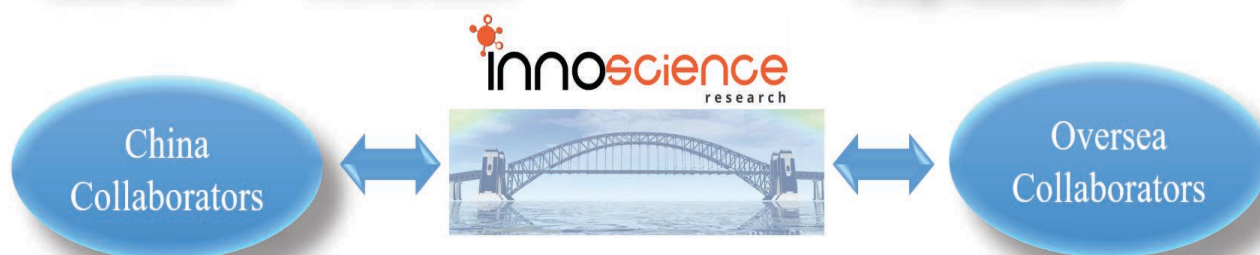
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