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Effects of vigilant leadership on nursing team performance mediated by team reflexivity and moderated by perceived overqualification

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[Abstract] Purpose: This study aims to explore the effect of vigilant leadership on nur sing team performance, and to examine the mediating role of team reflexivity and the moderating role of head nurses' perceived overqualification.

Methods:A questionnaire survey was conducted among all head nurses from three pu blic hospitals in Shenzhen, and 116 valid samples were obtained. Variables including v igilant leadership, perceived overqualification, team reflexivity, and team performance w ere measured, with demographic variables such as gender, age, educational backgroun d, professional title, Years of nursing experience, and Head Nurse Tenure (years) set as control variables. Correlation analysis, hierarchical regression, and the Bootstrap m ethod were used to test the mediating and moderating effects.

Results:Vigilant leadership had a significant positive effect on nursing team performanc e (β=0.328, P<0.001). Team reflexivity played a full mediating role between the above two,with an indirect effect value of 0.2522.Perceived overqualification exerted a signific ant negative moderating effect on the path of "vigilant leadership→team reflexivity" (β=-0.157, P<0.05). Simple slope analysis further revealed that high perceived overqualifica tion significantly weakened the positive impact of vigilant leadership on team reflexivity.

Conclusion:Vigilant leadership improved nursing team performance by promoting team reflexivity, and head nurses' high perceived overqualification can weaken the positive

effect of vigilant leadership on team reflexivity. The findings of this study provide theoretical support and practical implications for the optimization of nursing leadership, the configuration of head nurse positions, and the improvement of nursing team performance.

Keywords：vigilant leadership; team reflexivity; perceived overqualification; nursing team performance

In nursing practice, healthcare professionals often work in environments characterized by high uncertainty and risk. This requires nursing managers not only to maintain efficient and stable nursing quality but also to keenly identify potential crisis signals in complex and changing clinical scenarios. Against this backdrop, vigilant leadership—defined as a leadership style that maintains constant alertness, anticipates potential risks, and guides teams to proactively respond—has become increasingly valuable[1].Vigilant leaders can help teams detect weak early warning signals and identify potential threats and opportunities before crises erupt[2], thereby avoiding catastrophic consequences caused by ignoring such signals.Additionally, vigilant leaders can more effectively monitor decision-making processes, provide targeted suggestions[3], and rationally allocate and guide organizational members' attention[4], ensuring that nursing teams remain focused and efficient on critical issues.Thus, exploring the impact of vigilant leadership in nursing management is of great significance.

Nursing team performance is a core metric for measuring clinical service quality and ensuring patient safety, directly related to patient recovery outcomes, medical experience, and the overall operational efficiency of hospitals[5].While sufficient human resources and complete equipment are prerequisites for good performance, interpersonal and cognitive factors such as team members' psychological states and collaboration models are key drivers of performance differences among departments with similar resource allocations.The high-risk nature of nursing work amplifies the role of psychological climate and leadership behavior. Previous studies have shown that team psychological safety can promote learning behaviors such as team reflexivity to improve performance[6-7], and transformational leadership can positively affect performance through team efficacy[8].Information sharing and core role configuration are also significant factors influencing nursing team performance[9-10].

he impact of leadership style on performance does not follow a simple direct path, but is transmitted through the complex mechanism of team reflexivity. It refers to a cognitive and behavioral process in which team members collectively review goals, strategies and work procedures, and dynamically adjust their behaviors accordingly. As a key learning and planning activity, it is carried out by the team during the transition phase [11-12].Effective team reflexivity can optimize division of labor and collaboration, and improve task adaptability and execution efficiency by summarizing past experiences[13]; in contrast, ineffective reflexivity without guidance may lead to excessive internal friction or decision delays[14].As a risk-averse leadership style, vigilant leadership can stimulate team members' crisis awareness, guide them to actively engage in team reflexivity, accurately identify hidden dangers and shortcomings in nursing processes, and ultimately enhance overall team performance. Based on the Team Process Theory, team reflexivity, as a crucial cognitive team process, may serve as the key mediating path to explain how vigilant leadership improves team adaptability and effectiveness.

However, not all teams implementing vigilant leadership can achieve high-level team refl exivity, which may be related to head nurses' perceived overqualification.Based on relative d eprivation theory[15], an individual's attitudes and behaviors are influenced by the gap in res ources or status between themselves and reference groups.When head nurses perceive that their qualifications exceed the requirements of their current positions but fail to receive mat ching recognition and rewards, they may experience relative deprivation, which in turn affect s the effectiveness of their leadership behaviors and team interaction patterns[16-17].Specificall y, high perceived overqualification may lead to a psychological gap of "underutilization of tal ents," reducing head nurses' motivation to translate crisis awareness into constructive guidan ce[18].This psychological imbalance may prevent them from providing effective support and po sitive guidance when promoting vigilant leadership and calling for team reflexivity, even trans mitting negative emotions that trigger defensive attitudes among team members, ultimately r educing the depth and efficiency of team reflexivity[19].Conversely, low perceived overqualifica tion reduces relative deprivation, allowing head nurses to focus on professional responsibilitie s[20], practice vigilant leadership behaviors, and promote high-quality team reflexivity by guidi ng teams to identify potential risks and review workflows[17].As a common employee cognitio n, perceived overqualification may significantly moderate the "leadership behavior-team proce

ss-performance outcome" chain in light of the Relative Deprivation Theory.

In summary, this study aims to construct a moderated mediation model of "vigilant lea dership → team reflexivity → team performance" (as shown in Figure 1 below). The purpos e is to reveal the internal mechanism through which vigilant leadership influences nursing te am performance via team reflexivity, and to examine the boundary condition role played by head nurses' perceived overqualification in this mechanism.

Figure 1: The Moderated Mediation Model

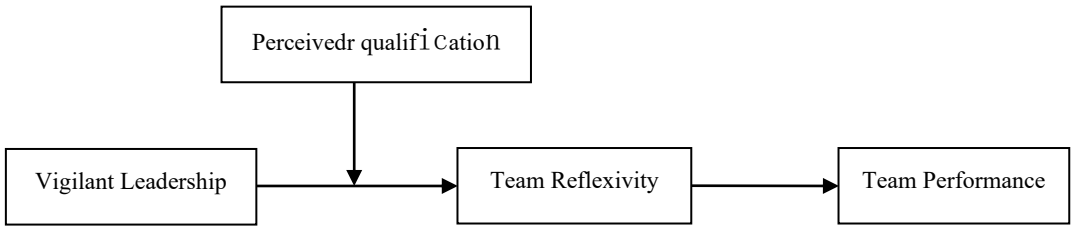


Figure 1. Research Model

1Materials and Methods

1.1 Study Participants and Data Collection

In November 2025, with the approval of the nursing department management of three public hospitals in Shenzhen, an electronic questionnaire survey was conducted among all he ad nurses in these hospitals.The questionnaire was designed using “Wenjuanxing” (a profes sional online survey platform) and submitted to the Department of Science and Education fo r ethical review (No.LL-KT-2026024). The nursing department distributed the questionnaire lin k to all head nurses，all participants gave their informed consent. A total of 125 questionnai res were collected one week later. After excluding invalid responses (e.g.,incomplete answers, failure to pass the attention check question), 116 valid questionnaires were obtained, with an effective response rate of 92.8%.Inclusion criteria: (1) Informed consent to participate in the study; (2) Passed the attention check question.

1.2 Measures

1.2.1 Demographic Variables

A self-designed questionnaire collected head nurses’ basic information, including gender (0=female, 1=male), age (years), educational background (1=junior high school, 2=senior high

school/vocational school, 3=college, 4=undergraduate, 5=graduate), professional title (1=nurse, 2=senior nurse, 3=charge nurse, 4=associate chief nurse, 5=chief nurse), and nursing years (years).

1.2.2 Vigilant Leadership Scale

The scale developed by Gao et al.[1]was used to assess managers' vigilant leadership levels.It consists of 10 items (e.g., "I inform nurses of potential problems our team may face," "I encourage nurses to anticipate potential threats to our team").Responses were rated on a 7-point Likert scale (1=strongly disagree to 7=strongly agree), with higher scores indicating higher levels of vigilant leadership. The Cronbach's α coefficient for this scale in the study was 0.89.

1.2.3 Perceived Overqualification Scale

The scale developed by Hu et al.[17]was used to measure individuals' perceived overqualification.It includes 4 items (e.g.,"My educational background is higher than required for my current job," "My abilities are not fully utilized in my work").Responses were rated on a 7-point Likert scale (1=strongly disagree to 7=strongly agree), with higher scores indicating higher perceived overqualification.The Cronbach's α coefficient for this scale in the study was 0.87.

1.2.4 Team Reflexivity Scale

The scale developed by De Jong & Elfring [12] was used to measure the level of team reflexivity in nursing teams. It includes 5 items (e.g., "Our team often reviews the feasibility of our goals," "Our team frequently discusses ways to improve cooperation efficiency"). Responses were rated on a 7-point Likert scale (1=strongly disagree to 7=strongly agree), with higher scores indicating higher levels of team reflexivity. The Cronbach's α coefficient for this scale in the study was 0.86.

1.2.5 Nursing Team Performance Scale

The scale developed by Carson et al.[21] was used to measure the overall performance of nursing teams. It includes 7 items (e.g., "The workload completed by our team meets my expectations," "Our team always completes tasks with high quality"). Responses were rated on a 7-point Likert scale (1=strongly disagree to 7=strongly agree), with higher scores indicating better team performance. The Cronbach's α coefficient for this scale in the study was 0.

93.

1.2.6 Control Variables

Control variables: Demographic variables including gender, age, educational background, professional title,Years of nursing experience, and Head Nurse Tenure (years)， may exert an impact on vigilant leadership and team performance. Therefore, these variables were treated as control variables during data analysis.

1.3 Statistical Analysis

SPSS20.0 and the Process macro (Model 4 and Model 7) were used for data analysis. Descriptive statistics (frequency, percentage, mean±standard deviation) were used to summarize the data. Pearson correlation analysis was used to test the relationships between variables. Hierarchical regression analysis was used to test the mediating and moderating effects. The Bootstrap method (5000 resamples) was used to verify the significance of the mediating effect.A two-tailed $p<0.05$ was considered statistically significant.

2Results

2.1 Demographic Characteristics of Participants

A total of 116 head nurses were enrolled in this study. Among the respondents , 112 were female (96.6%) and 4 were male (3.4%); regarding age distribution, 27 (23.3%) were 30-39 years old, 76 (65.5%) were 40-49 years old, and 13 (11.2%) were 50-59 years old. In terms of educational background, 1 participant (0.9%) had a senior high school/vocational school degree, 109 (94.0%) had a college degree, and 6 (5.2%) had an undergraduate degree. From the perspective of nursing work experience, 41 (35.3%) had 10-19 years of service, 56 (48.3%) had 20-29 years, and 19 (16.4%) had 30-39 years. Regarding the tenure as head nurses, 80 (69.0%) had less than 10 years of experience, 32 (27.6%) had 10-19 years, 3 (2.6%) had 20-29 years, and 1 (0.9%) had 30-39 years(as shown in Table 1 below).

Table 1: Demographic Characteristics of Participants (n=116)

Characteristics	Categories	Number (n)	Percentage (%)
Gender	Female	112	96.6%
	Male	4	3.4%
Age (years)	30-39	27	23.3%
	40-49	76	65.5%
	≥50	13	11.2%
Marital Status	Unmarried/Divorced	10	8.6%

	Married	106	91.4%
Educational Background	Senior High School/Vocational School	1	0.9%
	College	109	94%
	Undergraduate	6	5.2%
Years of nursing experience	10-19	41	35.3%
	20-29	56	48.3%
	≥30	19	16.4%
Head Nurse Tenure (years)	<10	80	69.0%
	10-19	32	27.6%
	20-29	3	2.6%
	30-39	1	0.9%

2.2 Descriptive Statistics and Correlation Analysis

Descriptive statistics showed that the mean scores were: vigilant leadership (6.226±0.988), perceived overqualification (4.705±0.728), team reflexivity (6.248±0.773), and nursing team performance (5.879±0.790).Correlation analysis revealed that vigilant leadership was significantly positively correlated with team reflexivity (r=0.583, p<0.01) and nursing team performance (r=0.346, p<0.01); team reflexivity was significantly positively correlated with nursing team performance (r=0.571, p<0.01) (Table 2).

Table 2: Descriptive Statistics and Correlation Analysis (n=116)

	Variables	*Mean*	*sd*	1	2	3	4
1	Vigilant Leadership	6.226	0.988	1.000			
2	Perceived Overqualification	4.705	0.728	0.067	1.000		
3	Team Reflexivity	6.248	0.773	0.583**	0.053	1.000	
4	Nursing Team Performance	5.879	0.790	0.346**	0.095	0.571**	1.000

2.3 Testing the Mediating Effect of Team Reflection on the Relationship Between Vigilant Leadership and Team Performance

This study first adopted regression analysis via SPSS software, with gender, age, educational background, professional title, and years of nursing experience as control variables, vigilant leadership as the independent variable (X), team performance as the dependent variable (Y), and team reflection as the mediating variable (M), to examine the mediating effect of team reflection in the association between vigilant leadership and team performance.

Hierarchical regression analysis was conducted on the variables: control variables and the independent variable (vigilant leadership) were successively incorporated into the regression model (see Model 1 and Model 2 in Table 3), with team reflection specified as the dependent variable. Subsequently, the mediating variable team reflection was introduced into Model 5, where team performance was set as the dependent variable, yielding the regression results for the mediating effect (see Table 3).Based on the criteria for mediating effect proposed by Baron & Kenny et al. [22], the specific analysis is as follows:

(1) The independent variable exerts a significant impact on the dependent variable. Preliminary results demonstrated that vigilant leadership had a significantly positive effect on team performance (β=0.328, p<0.001), satisfying the first criterion for mediating effect identification.

(2) The independent variable is significantly associated with the mediating variable. As shown in Model 2 of Table 3, vigilant leadership could positively predict team reflection among nursing teams (β=0.467, p<0.001), thus verifying the second criterion.

(3) The mediating variable has a significant effect on the dependent variable. Results of Model 5 indicated that team reflection exerted a significantly positive influence on nursing team performance (β=0.540, p<0.001), which meets the third criterion.

In addition, Model 5 revealed that after incorporating team reflection as the mediating variable into the model, the regression coefficient of vigilant leadership on nursing team performance decreased from 0.328 to 0.075 and became statistically insignificant. This finding suggests that team reflection plays a full mediating role in the relationship between vigilant leadership and team performance.

Table 3: Hierarchical Regression Analysis for Mediating Effect

	Team Reflexivity				Team Performance					
	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Constant Term	3.948*	1.522	1.552	1.274	3.654*	1.510	1.942	1.423	1.134	1.260
Gender	-0.328	0.417	-0.213	0.339	0.238	0.414	0.318	.0.378	0.434	0.333
Age	0.053	0.046	0.040	0.037	0.062	0.045	0.053	0.041	0.031	0.037
Education	0.327	0.314	0.144	0.256	-0.145	0.311	-0.273	0.285	-0.351	0.251
Years of nursing experience	-.036	.039	--0.009	0.032	-0.020	0.038	-0.001	0.035	0.003	0.031

Head Nurse Tenure	0.000	0.019	-0.010	0.016	-0.016	0.019	-0.023	0.018	-0.017	0.016
Vigilant Leadership			0.467***	0.061			0.328***	0.069	0.075	0.075
Team Reflexivity									0.540***	.0.095
F	0.556		8.974***		1.698		5.004***		9.745***	
ΔR^2	0.030		0.338***		0.085		0.159***		0.177***	

Note: *p<0.05, ***p<0.001;

To further verify the mediating effect, this study performed the analysis using the PROCESS macro in SPSS, with Model 4 selected, the number of Bootstrap resamples set to 5000, and the confidence interval (CI) set at 95%. The results (see Table 2) showed that the mediating effect value of team reflection was 0.2522, with the 95% CI excluding 0, which indicates that the mediating effect is statistically significant. Meanwhile, after controlling for the mediating variable, the direct effect value of vigilant leadership on nursing team performance was 0.0754, with the 95% CI including 0(as shown in Table 4 below), suggesting that the direct effect of vigilant leadership on nursing team performance is not significant.Therefore, team reflection plays a full mediating role in the relationship between vigilant leadership and nursing team performance.

Table 4: Hierarchical Regression Analysis for Moderating Effect

Effect Type	Effect Type	BootstrapStandard Error	Bootstrap	95%CI
			Lower Bound	Upper Bound
Upper Bound	0.2522	0.0633	0.1449	0.3945
Direct Effect	0.0754	0.0749	-0.0728	0.2244
Direct Effect	0.3276	0.0689	0.1920	0.4651

2.4 Moderating Effect of Perceived Overqualification

During the hierarchical regression analysis, the control variables (gender, age, marital status, educational background, professional title, years of nursing experience, and years of serving as head nurse） were first entered into the regression model (Model 1). Subsequently, the independent variable vigilant leadership and the moderating variable overqualification were standardized and sequentially incorporated into the model, followed by the introduction of their interaction term. The dependent variable was specified as team reflection, and the regression results are presented in Table 3.

The findings demonstrated that after the inclusion of the interaction term between vigilant leadership and overqualification in the second layer of the model, this interaction term significantly predicted team reflection scores (β=-0.158, P<0.05), with a significant change in the coefficient of determination (ΔR^2=0.362, P<0.001)(as shown in Table 5 below). These results indicate that nurses' perceived overqualification plays a negative moderating role in the relationship between vigilant leadership and nursing team reflection.

Table 5: Analysis of adjustment effect regression results (n=116)

	Team Reflection			
	Model 1		Model 2	
	B	*SE*	*B*	*SE*
Constant	6.248***	.073	6.259***	.059
Gender	-.064	.077	-.057	.063
Age	.277	.233	.201	.188
Marital Status	-.033	.075	-.023	.061
Educational Background	.077	.077	.041	.062
Years of nursing experience	.006	.106	-.040	.085
Head Nurse Tenure	-.228	.240	-.058	.196
Vigilant Leadership			.440***	.061
Overqualification			.045	.064
Vigilant Leadership × Overqualification			-.158*	.077
F	0.500		6.794***	
ΔR^2	0.031		0.362***	

Note: *p<0.05, ***p<0.001;

To clarify the moderating effect more explicitly, simple slope analysis was further conducted in this study. By dividing the sample based on the mean level of head nurses' overqualification, the subgroups with scores above and below the mean were analyzed separatel.

As shown in Figure 2,

{2}

when head nurses' overqualification level was high: the positive effect of vigilant leadership on team reflection was significantly weakened (y=6.214+0.282x, p<0.001). In this scenario, since head nurses perceived their capabilities as far exceeding job requirements, they tended to believe they could control all risks and solve problems independently. This "in-control" mindset led them to view collective team reflection as unnecessary, and even when they exhibited vigilance, they preferred individual thinking over organizing group discussions—thus li

miting their initiative to lead team reflection.

In contrast, when head nurses' overqualification level was low: the positive effect of vigilant leadership on team reflection was highly significant and showed a substantial upward trend ($y=6.304+0.598x$, $p<0.001$). Here, head nurses recognized that their ability to handle complex risks was not infallible. To ensure work rigor, they demonstrated stronger willingness to proactively lead and facilitate collective work reviews and vulnerability identification within the team. In this context, the head nurses' vigilance was translated into proactive management behavior, and their led collective reflection processes significantly enhanced the team's reflection level.

Figure 2: Moderating Effect of Perceived Overqualification on the Relationship between Vigilant Leadership and Team Reflexivity



3. Discussion

3.1 Current Situation

The results of this study show that the score of nursing team performance was (5.879±0.790) points, which was higher than the survey result of (4.33±0.59) points reported by Ma Yonghong et al. [23] on nursing teams in five "Grade A tertiary" hospitals in Sichuan Province。

This may be related to the selection of research objects and differences in medical environments. This study focused on tertiary public hospitals in Shenzhen, which may have more advantages in policy support, resource allocation and management standardization.

Compared with the measurement result of vigilant leadership among 509 senior managers in the automotive supply chain industry by Zhao Chen et al.[24] (6.06±0.68), the vigilant leadership score of head nurses measured in this study was slightly higher, at 6.226±0.988. This may be attributed to industry differences and varying occupational environmental pressures. Unlike the automotive supply chain industry, the medical industry is closely related to life safety, requiring head nurses to possess higher risk early warning capabilities and vigilance. Secondly, clinical nursing often faces uncertainties such as staffing shortages and nurse-patient conflicts, which prompt leaders to develop a stronger sense of crisis.

In terms of perceived overqualification, the survey result of head nurses in this study was 4.705±0.728, which was significantly higher than the survey result of perceived overqualification among enterprise employees by Xiang Changchun et al.[25](3.415±0.845) and the survey result among teachers in a private university by Chen Lanlan et al.[26](3.36±0.77).This may be because clinical nursing management, while emphasizing proceduralization, often restricts the decision-making power of senior nursing professionals, resulting in "functional redundancy" of their rich professional skills in routine affairs, thereby leading to a high level of perceived overqualification.

The survey result of team reflection in this study was 6.248±0.773, which was significantly higher than the survey result among enterprise employees by Wang Duanxu et al.[27](2.282±0.991). Compared with enterprise work, medical and nursing work is characterized by high risk and high sense of responsibility, which is related to patients' life safety. This extremely low error tolerance forces nursing teams to conduct frequent and in-depth summaries and reflectionsafter nursing operations or safety incidents to prevent the recurrence of errors.

3.2 The Positive Effect of Vigilant Leadership on Nursing Team Performance

This study found that vigilant leadership has a significant positive effect on nursing team performance, which is consistent with the findings of Gao et al. [1] and Gao Zhonghua et al.[28]in cross-industry studies. In the high-risk nursing environment, vigilant leaders can sensitively identify potential risks (e.g., nursing errors, patient safety hazards) and guide teams to take preventive measures in advance. By encouraging team members to participate in risk discussions and learn from the experiences and lessons of other teams, vigilant leaders can enhance the team’s overall risk response capabilities and form a "team defense focus"[25] t

hereby improving task execution efficiency and service quality. Additionally, vigilant leaders can effectively allocate attention resources, help teams focus on key tasks, and avoid resource waste caused by ignoring potential problems, which is crucial for maintaining stable and efficient nursing team performance[29].

3.3 The Mediating Role of Team Reflection between Precautionary Leadership and Team Performance

The results of this study show that team reflection plays a significant mediating role between head nurses' precautionary leadership and nursing team performance. This finding indicates that precautionary leadership does not directly affect team performance; instead, it enhances the overall nursing team performance by motivating head nurses to guide the entire team to conduct work-oriented team reflection and optimize past work performance. As a crucial process of in-depth information processing, team reflection enables team members to timely identify errors and potential risks in work, and make adaptive adjustments to work plans through the cycle of "reflection-planning-action". The error correction ability and action adjustments derived from such reflection can effectively optimize resource allocation and resolve complex problems, thereby significantly improving the team's task performance and innovative output. Therefore, while demonstrating a sense of precaution, managers should establish a normalized mechanism for review and reflection, guiding the team to transform psychological pressure into constructive reflective behaviors to ensure the continuous improvement of team performance.

3.4 The Moderating Role of Head Nurses' Overqualification between Precautionary Leadership and Team Reflection

The research results reveal that head nurses' overqualification exerts a key moderating effect on the relationship between precautionary leadership and team reflection. In the context of high overqualification, head nurses often perceive that their professional competence and experience far exceed the job requirements. The psychological gap caused by this sense of "being underutilized" fosters a sense of self-control, leading them to believe that their individual capabilities are sufficient to address and mitigate all potential risks. Thus, although such head nurses still possess a "sense of precaution", they tend to rely more on personal judgment to resolve crises rather than driving the team to engage in collective reflection. F

rom their perspective, taking individual control of the situation is more efficient than investi ng energy in organizing team discussions. This tendency of "individual replacing the team" si gnificantly weakens the facilitating effect of precautionary leadership on team reflection.

In contrast, in the context of low overqualification, head nurses' competence is highly a ligned with job requirements. When facing potential medical risks and crises, they are fully aware that relying solely on personal efforts cannot guarantee foolproof outcomes. Therefore, this moderate sense of crisis drives head nurses to more actively assume the role of leade rs, guiding the team to conduct in-depth analysis of work objectives, processes and impleme ntation procedures. They will proactively translate their sense of precaution into specific ma nagement behaviors, guiding, organizing and motivating team members to jointly identify vul nerabilities. This collective reflection guidance based on the cognition of "risk sharing" substa ntially amplifies the facilitating effect of precautionary leadership on team reflection.

At the practical management level, this implies that nursing administrators should priorit ize person-job fit when selecting head nurses, avoiding the situation where excessive overqu alification leads to head nurses' arbitrary decision-making and neglect of their role in guidin g team reflection. For head nurses who are indeed highly overqualified, hospital managemen t should strengthen guidance to make them recognize the importance of leading the team t o collectively respond to risks. It is necessary to encourage them to convert their advanced individual capabilities into management effectiveness for guiding team reflection, rather than merely relying on personal competence to control the overall situation, so as to ensure th e long-term safety of the department.

3.5 Implications for Clinical Nursing

This study ，through a moderated mediation model, reveals that vigilant leadership enha nces nursing team performance, with head nurses' perceived overqualification serving as a cr ucial boundary condition in this process. The results indicate that for head nurses with a hi gh level of perceived overqualification, vigilant leadership style can more effectively boost pe rformance by facilitating team reflexivity. This may be attributed to the fact that they percei ve leaders' "vigilance" as a challenge stressor rather than a hindrance stressor, thereby moti vating more proactive leadership behaviors.

On the one hand, hospital administrators should attach importance to cultivating a sens

e of vigilance and translate it into effective team learning. Hospitals can launch specialized t raining programs on vigilant leadership for head nurses, and enhance their abilities to accur ately identify nursing risks and scientifically guide team reflexivity through risk case discussio ns and simulated emergency drills. In addition, regular cross-departmental risk exchange mee tings should be organized to help head nurses turn their sense of vigilance into practical te am management actions.

On the other hand, hospital administrators should establish a competency matching mec hanism for head nurse positions, and assign posts accurately based on their educational bac kgrounds, professional skills and practical experience. They should identify and make good us e of head nurses with perceived overqualification, and convert their excess qualifications into leadership advantages through empowerment, participation in decision-making and other ap proaches, so as to reduce their sense of overqualification.

Therefore, on the one hand, hospitals can launch specialized training programs on preca utionary leadership for head nurses. Through risk case discussions and simulated emergency drills, hospitals can improve head nurses' ability to accurately identify nursing risks and scien tifically guide team reflection. In addition, regular cross-departmental risk exchange meetings should be organized to help head nurses translate their sense of precaution into practical t eam management actions.On the other hand, hospitals should establish a competence match ing mechanism for head nurse positions, accurately assigning roles based on their academic qualifications, skills and experience. For overqualified head nurses, hospitals should provide " management advancement channels",such as assigning them to take charge of nursing qualit y improvement projects or mentor newly appointed head nurses,so as to convert redundant competence into job value and reduce the perception of overqualification.

4 Conclusions

The results of this study indicate that the team performance of nursing teams in three public hospitals in Shenzhen is favorable, yet there remains room for further improvement. Meanwhile, it confirms that team reflection plays a mediating role between head nurses' p recautionary leadership and nursing team performance, and head nurses' overqualification lev

el exerts a moderating effect on the relationship between precautionary leadership and team reflective behaviors. This provides new theoretical basis and insights for hospital management to appoint suitable head nurses, stimulate active reflection of nursing teams, improve nursing quality and enhance team performance.

This study has certain limitations. First, the sample representativeness is limited. Only 116 head nurses from three public hospitals in Shenzhen were selected as the research sample. The sample is geographically concentrated and does not include private hospitals, community medical institutions and other types of healthcare settings. The relatively small sample size may restrict the generalizability of the conclusions. Second, the data source is single. All variables rely solely on head nurses' self-reports, lacking objective indicators such as peer evaluations from nurses, assessments by nursing departments and patient satisfaction. This is prone to common method bias, which affects the objectivity of the results. Third, the cross-sectional survey design fails to capture the dynamic changes in the relationships between variables, making it difficult to clarify the causal sequence.

Future research can be refined from three aspects. First, expand the sample scope by including nursing teams from medical institutions of different types in various regions and increasing the sample size to improve the generalizability of the conclusions. Second, enrich data sources by combining self-reports, peer evaluations and objective performance indicators, and adopt a longitudinal follow-up design to enhance the credibility of results and the power of causal inference. Third, expand the research model by introducing new variables such as psychological safety and perceived organizational support, and combine qualitative methods such as in-depth interviews to explore the applicability of the model in different department scenarios, so as to provide more precise theoretical support and operational guidance for nursing management practices.

Credit authorship contribution statement

Chunfeng Xing: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Project administration.

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Yaxin Liu: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing.

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Ethics Approval and Consent to Participate

This study was conducted in accordance with the Ethical Review Measures for Life Science and Medical Research Involving Human Subjects issued by the National Health Commission of the People's Republic of China and other three ministries and commissions, the Declaration of Helsinki of the World Medical Association (WMA), and other relevant ethical laws, regulations and principles. The study was reviewed and approved by the Ethics Committee of Shenzhen University of Advanced Technology General Hospital, which confirmed that the study complies with ethical norms, and authorized the research team to carry out the study in accordance with the approved documents. The approval number is No. LL-KT-2026024.Written informed consent was obtained from all participants prior to data collection. All participants voluntarily took part in this study.

Declaration of competing interest

The authors declare there is no conflict of interest.

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Clinical Trial Registration

Not applicable.

Consent to publish

Identifiable personal information, clinical photos, and patient privacy data：Not applicable.

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