Research on the Impact Mechanism of Leadership Development on Surgeons' Innovation Behavior: Based on The Mediating Role of Psychological Empowerment

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Received May 16, 2025; **Revised** June 8, 2025; **Accepted** July 23, 2025

Abstract

The primary objective of this study is to explore how leadership development fosters innovation behavior among surgeons through psychological empowerment. Data was gathered from 452 surgeons in China. The proposed hypothesis was tested using the AMOS structural equation model. Our findings reveal a significant correlation between leadership development, psychological empowerment, and surgeons' innovation behavior. Furthermore, our results suggest that psychological empowerment partially mediates the relationship between leadership development and surgeons' innovation behavior. Consequently, our research indicates that hospital leaders should prioritize enhancing the leadership development of surgeons and bolstering their sense of psychological empowerment to promote their innovation behavior. This approach can encourage active innovation in surgical diagnosis and treatment, ultimately leading to improved patient satisfaction.

Keywords: Leadership Development; Surgeons; Innovation Behavior; Psychological Empowerment; Mediating Role

Introduction

Leadership development has a profound impact on the field of innovation (Benitez et al., 2022). Through systematic training and enhancement, leadership development helps individuals refine their leadership capabilities, including strategic cognition, team management, and decision-making

processes. It strengthens leaders' confidence in facing challenges, encouraging them to proactively embrace change and foster continuous improvement and innovation within organizations (Jun & Lee, 2023).

For surgeons, leadership development plays an especially critical role. In the complex and high–stakes environment of the operating room, surgeons require not only exceptional technical expertise but also outstanding leadership skills to guide teams in high–pressure situations, ensuring both surgical safety and success (Soenens et al., 2023). In recent years, leading hospitals in China have increasingly emphasized the cultivation of leadership among physicians. For instance, Peking Union Medical College Hospital (PUMC), one of China's top–tier medical institutions and a leader in both medical education and clinical practice, has implemented a dedicated "Excellent Physician Leadership Development Program." This initiative targets young and mid–career core doctors, particularly surgeons who play pivotal roles in the operating room and in interdisciplinary teams (Yang, 2019).

At present, there exists a significant paucity of scholarly inquiry, especially empirical investigations, pertaining to the domains of leadership and innovation among surgeons (Geerts et al., 2020). This scarcity underscores the significance of conducting more comprehensive research in this domain. Grasping the relationship between leadership development and innovation behavior among surgeons is pivotal for fostering innovation within this field.

While the concept of leadership development has been extensively studied in general organizational settings (Day et al., 2014), its application and effectiveness in surgical contexts remain underexplored. The operating room represents a unique environment where decisions are time–sensitive, risks are high, and collaborative leadership is critical (Weissman et al., 2020). Therefore, leadership development for surgeons must be contextualized, emphasizing domain–specific competencies such as strategic thinking in clinical scenarios, effective interdisciplinary communication, the ability to motivate under pressure, and continuous skills training.

Furthermore, the integration of psychological empowerment as a mediating mechanism offers valuable insights into how leadership development influences innovative behavior. Empowered individuals often display higher self–efficacy, meaning, autonomy, and impact at work (Spreitzer, 1995), which are crucial traits for innovation, especially in high–stakes medical environments. Studies in other healthcare domains have demonstrated that leadership initiatives which enhance

empowerment significantly improve proactive behaviors and innovative capacity (Mohammed & Al–Abrrow, 2024), suggesting potential applicability to surgical teams.

From a macro perspective, this study also supports national strategic goals such as the “Healthy China 2030” initiative, which calls for innovations in healthcare service delivery, workforce training, and clinical quality improvement (State Council of China, 2016). Strengthening leadership development among surgeons is not only relevant to individual career growth and patient safety but also essential to improving the innovation performance of China’s healthcare system as a whole.

Therefore, exploring the mechanisms by which leadership development fosters innovation among Chinese surgeons from a leadership perspective holds significant theoretical and practical value in enhancing surgical treatment standards and capabilities, and aligns with the implementation of the "Healthy China" strategy.

Research Objectives

To investigate the interrelationships among leadership development, psychological empowerment, and surgeons’ innovative behavior within hospital settings in China, with a particular focus on examining how leadership development influences innovation among surgeons.

Literature review

1. Literature on leadership development and innovative behavior

Day and Dragoni (2015) describe leadership development as a process involving training to enhance the skills, knowledge, and behaviors of individuals and teams to improve their ability to lead and influence others effectively. This definition emphasizes continuous learning and growth, highlighting skills such as strategic thinking, communication, and motivation. Based on theories such as the Transformative leadership theory, the leader–member exchange theory, and the leadership practice checklist theory, this study determines that leadership development encompasses four dimensions: strategic thinking, communication, motivation, and training.

Lee & Kim (2021) studied and employed a quantitative research methodology using a survey to collect data from 405 full–time employees, examining the impact of leadership communication at the supervisory and senior levels on organizational internal communication, as well as the mediating role of

employees' feedback–seeking behavior. The results indicate that symmetrical internal communication and leadership communication encourage employees to seek more feedback, thereby enhancing their creativity.

Qalati et al. (2023) conducted an empirical investigation into the factors influencing employees' eco–friendly innovation capabilities and behaviors. The study found that participatory decision–making and intrinsic employee motivation significantly enhance employees' ability to engage in eco–innovation. Based on these, the following hypothesis is proposed:

H1: Leadership development positively impacts innovation behavior.

2. Literature on leadership development and psychological empowerment

Abbas and Khali (2016) conducted an empirical study involving 239 healthcare workers to examine the mediating role of leaders' strategic thinking skills in the relationship between empowering leadership and work engagement. The results indicated that leaders' strategic thinking skills positively influenced psychological empowerment by enhancing healthcare workers' sense of mission.

Ibrahim et al. (2024) found that transformational leadership significantly enhances psychological empowerment among nurses, supporting the view that leadership development initiatives foster empowerment. Their research findings substantiate a favorable and direct correlation between the attributes of leadership and the psychological empowerment experienced by employees. Consequently, this paper puts forth the following hypothesis:

H2: Leadership development positively impacts psychological empowerment.

3. Literature on psychological empowerment and innovation behavior

Psychological empowerment can promote individual positive behavior. Ergun et al. (2025) conducted a study that elucidates how psychological empowerment markedly improves innovative work behavior; however, this enhancement necessitates the backing of supplementary organizational resources such as perceived organizational support and engagement. Employees with high psychological empowerment were part of high–IWB clusters, especially when paired with strong work engagement and organizational support.

Abubakar & Sanda (2024) mentioned psychological empowerment as a major predictor of positive organizational behavior. Considering this, if doctors also give psychological empowerment, then they can foster innovation behavior as well. In this context, self–determination theory asserts that social

environmental variables and individual trait characteristics synergistically foster intrinsic motivation and facilitate the internalization of extrinsic motivation by satisfying the three fundamental psychological needs of autonomy, competence, and relatedness, consequently augmenting individual work performance and psychological well–being. Consequently, this paper puts forth the following hypothesis:

H3: Psychological empowerment positively impacts the surgeons' innovation behavior.

4.Literature on the mediating role of psychological empowerment

Stanescu et al. (2021) examined the correlation between transformational leadership and the innovative work behavior (IWB) of employees, demonstrating that psychological empowerment serves as a mediating factor in this correlation. It highlights that leaders who enhance psychological empowerment significantly foster IWB among their followers.

Wang Kun et al. (2023) examined the "mediating role of psychological empowerment on the structural empowerment and innovation behavior of pediatric nurses". This study investigated the mediating role of psychological empowerment between structural empowerment and innovation behavior among pediatric nurses. The findings revealed a positive correlation between structural empowerment, psychological empowerment, and innovation behavior among pediatric nurses. Psychological empowerment serves as a mediator between structural empowerment and innovation behavior among pediatric nurses. Consequently, this paper proposes the following hypothesis:

H4: Psychological empowerment mediates the relationship between leadership development and surgeons' innovation behavior.

Conceptual Framework

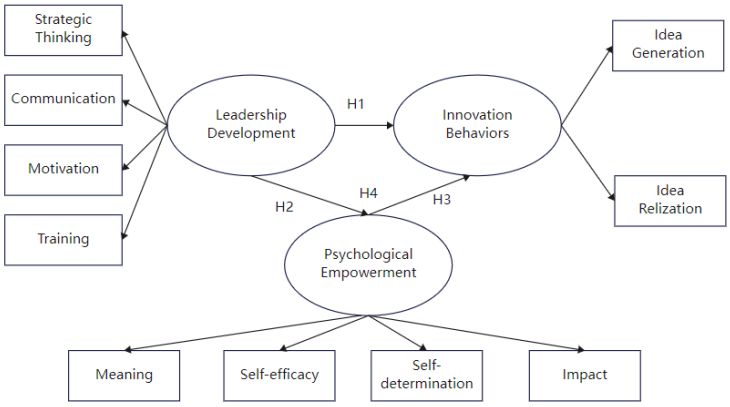

Figure 1 Conceptual Framework (source: Created by researchers, 2024)

The conceptual framework of this study (see Figure 1) is developed to elucidate the mechanisms through which leadership development influences surgeons' innovation behaviors, with psychological empowerment serving as a mediating variable. This framework is grounded in leadership development theory and empowerment theory (Spreitzer, 1995; Day et al., 2014), and it reflects a multidimensional understanding of both leadership capabilities and innovation processes in high-stakes clinical settings.

Definition and Structure of Key Constructs

Strategic Thinking: Means the surgeon's ability to think holistically, understand healthcare dynamics, set long-term goals, anticipate changing trends, and drive change in a complex and uncertain healthcare environment.

Communication: Means the ability of the surgeon to promote information sharing, opinion exchange and problem solving among team members through clear and effective language expression and active listening during the operation and related activities.

Motivation: Means the surgeon's ability to motivate and enthuse team members through clear division of labor, goal setting, task organization, and ongoing feedback.

Training: Means the process by which surgeons continue to improve their clinical and leadership skills through participation in a variety of leadership programs, skills training, and reflective learning.

Meaning: Means the degree of personal value, goal congruence, and intrinsic importance surgeons feel in their work.

Self-efficacy: Means the degree to which a surgeon trusts in his or her own abilities and is self-efficacious in accomplishing the tasks of the job.

Self-determination: Means the surgeon's experience of autonomy and sense of control in his or her work, as reflected in the independence and autonomy he or she possesses in the way work tasks are handled, decisions are made, and goals are achieved.

Impact: Means the surgeon's sense of influence and control over decisions and work outcomes within the department.

Idea Generation: Means the ability of a surgeon to proactively explore opportunities to improve surgical techniques, processes, or postoperative care in the course of their work and to come up with innovative ideas and solutions.

Idea Realization: Means the ability of a surgeon to evaluate, promote, and implement new techniques or treatments in practice.

Research Methodology

This study will employ a stratified sampling method based on provincial divisions. A proportional sampling strategy will be adopted to ensure that the sample reflects the distribution of the population across different provinces. In addition, targeted sampling techniques will be utilized to select participants who are most relevant to the research objectives.

1. Sample Selection

The target population consists of surgeons working in hospitals across China, as recorded in the China Health Statistical Yearbook 2022. The total population includes 437,335 surgeons, distributed across 31 provinces. Based on the number of surgeons in China and considering the overall limited population, the sample size can be calculated as 399 using Taro Yamane's formula (1967) at a 95% confidence level.

Based on the number of the population, the stratified sampling technique will be used to select the sample of this research by province. The provinces of a minimum of 10,000 surgeons will be considered and only 18 provinces will be used and become the majority of the population (84.44%) and the representative of the whole population. Next, this study would adopt a proportion sampling strategy for questionnaire distribution by provinces. Ultimately, the purposive sampling method will be employed to identify the sample for this research endeavor in order to fulfill the study's objectives. Specifically, only surgeons with more than 3 years of experience in surgery will be selected to do the questionnaire.

2. Data Collection

To obtain 399 valid questionnaires, the number of questionnaires distributed should exceed the sample size. Through stratified sampling, proportional sampling, and target sampling methods, data collection involved distributing 523 questionnaires online, with 461 questionnaires returned, representing a response rate of 88%. Of the 461 returned questionnaires, 9 were excluded due to substantial missing data or incomplete responses that compromised their validity for analysis. These questionnaires lacked answers to key sections, such as leadership development items or psychological empowerment dimensions, which are essential to testing the proposed hypotheses. Including such incomplete data would have reduced the reliability and internal consistency of the measurement model and threatened the validity of the structural equation modeling results. Therefore, only 452 fully completed questionnaires were retained for further analysis.

Research Results

1. Reliability and Validity

Leadership development. Given the scarcity of empirical research and similar scales on leadership development, this study developed a leadership development scale tailored to the actual situation of Chinese surgeons. The scale encompasses four dimensions: strategic thinking (5 questions), communication (5 questions), motivation (5 questions), and training (5 questions), utilizing a Likert 5-point rating method (ranging from 1 "strongly disagree" to 5 "strongly agree"). The reliability and validity data for the scale are presented in the table below:

Table 1 Reliability and Validity of Leadership Development

Variables	Components	Corrected Item Total Correlation (CITC)	Cronbach's Alpha (> 0.7)	Average Variance Extracted (AVE≧0.5)	Construct Reliability (CR≧0.7)
Strategic Thinking (ST)	1	0.733	0.894	0.628	0.894
	2	0.712			
	3	0.753			
	4	0.764			
	5	0.734			
Communication (CO)	1	0.766	0.916	0.688	0.917
	2	0.799			
	3	0.761			
	4	0.830			
	5	0.772			
Motivation (MO)	1	0.758	0.911	0.673	0.911
	2	0.758			
	3	0.789			
	4	0.792			
	5	0.774			
Training (TR)	1	0.785	0.925	0.712	0.925
	2	0.763			
	3	0.789			
	4	0.826			
	5	0.854			

Psychological Empowerment. Drawing upon the 12–question psychological empowerment questionnaire developed by Spreitzer [9], we adapted it to the Chinese context based on the actual situation of Chinese surgeons. The scale employs a Likert 5–point scoring method (from 1 "strongly disagree" to 5 "strongly agree"), consisting of four dimensions (each subscale includes 5 questions): meaning, self–determination, self–efficacy, and influence. The reliability and validity data for the scale are presented in the table below:

Table 2 Reliability and Validity of Psychological Empowerment

Variables	Components	Corrected Item Total Correlation (CITC)	Cronbach's Alpha (> 0.7)	Average Variance Extracted (AVE≧0.5)	Construct Reliability (CR≧0.7)
Meaning (ME)	1	0.821	0.944	0.771	0.944
	2	0.876			
	3	0.850			
	4	0.823			
	5	0.865			
Self-Determination (SD)	1	0.778	0.912	0.677	0.912
	2	0.777			
	3	0.821			
	4	0.758			
	5	0.750			
Self-Efficacy (SE)	1	0.820	0.933	0.734	0.932
	2	0.861			
	3	0.820			
	4	0.791			
	5	0.821			
Impact (IM)	1	0.813	0.925	0.711	0.925
	2	0.801			
	3	0.784			
	4	0.795			
	5	0.824			

Innovation behavior. Referring to the innovation behavior scale developed by Chinese scholars Yang Ying and colleagues, and tailored to the specific needs of Chinese surgeons, we developed the Surgeons' Innovation behavior Scale. This scale utilizes a Likert 5–point scoring method (from 1 "strongly

disagree" to 5 "strongly agree"), encompassing two dimensions (each subscale comprises 5 questions): idea generation and idea realization. The reliability and validity data for the scale are presented in the table below:

Table 3 Reliability and Validity of Innovation Behavior

Variables	Components	Corrected Item Total Correlation (CITC)	Cronbach's Alpha (> 0.7)	Average Variance Extracted (AVE≧0.5)	Construct Reliability (CR≧0.7)
Ider Generation (IG)	1	0.834	0.935	0.744	0.936
	2	0.826			
	3	0.843			
	4	0.836			
	5	0.802			
Idea Realization (IR)	1	0.804	0.940	0.759	0.940
	2	0.886			
	3	0.846			
	4	0.820			
	5	0.835			

Table 4 Discriminant validity

Construct	1	2	3
Leadership development	0.675	--	--
Psychological empowerment	0.206	0.723	--
Innovation behavior	0.059	0.319	0.751

From the data in Tables 1, 2 and 3, The Corrected Item–Total Correlation values for all 50 question items of the questionnaire are greater than or equal to 0.5, indicating that the question items are highly correlated with the total score and are of very good quality. The Cronbach's α coefficient and composite reliability of the scales utilized in this study exceed 0.9, surpassing the acceptance threshold of 0.70, thereby demonstrating robust reliability. The mean variance extraction (MVE) values range from 0.62 to 0.77, all exceeding the acceptable level of 0.5. The correlation coefficients between the revised items and the total score fall between 0.71 and 0.87, exceeding the acceptance criterion of 0.5. Furthermore, the AVE values for each construct are higher than the square of the correlation coefficients with other constructs (refer to Table 4), fulfilling the criteria for discriminant validity. These findings

suggest that the developed scale possesses satisfactory reliability and validity, making it suitable for further analysis.

2. Common method bias test

Since all questions in the same questionnaire of this research method were filled out by the same respondent, to prevent common method bias, we conducted a certain degree of control over both questionnaire distribution and statistical testing. On one hand, during questionnaire design, we omitted information about variable names and research objectives to prevent respondents from subjectively guessing and potentially influencing their true feelings. During the survey, we informed respondents about the anonymity and confidentiality of the collected data, aiming to minimize personal biases and ensure the authenticity of the data collected. On the other hand, we employed Harman's single–factor detection method to statistically assess the presence of common method bias. We conducted exploratory factor analysis on all scales included in the questionnaire. The first principal component, obtained without rotation, accounted for 32.803% of the variance, which is below 40%. This suggests that a single factor cannot explain the majority of the variation. Therefore, the impact of common method bias in this study remains within an acceptable range. In conclusion, the issue of common method bias in this study has been effectively controlled, allowing for further investigation.

3. Preliminary analysis

In this study, we utilized AMOS23 software to determine the fit of our sample data with the proposed theoretical model through Confirmatory Factor Analysis (CFA). The CFA results (Table 5) indicated that the expected three–factor measurement model (leadership development, psychological empowerment, and innovation behavior, see Model 1 in Table 5) exhibited a better fit to the sample data and was more acceptable compared to any other alternative measurement models ($\chi 2/df$ = 1.599, RMSEA =0.036, CFI = 0.963, TLI = 0.961, SRMR = 0.0484). Based on the recommendations of Hu and Bentler (1999) regarding appropriate CFA fit indices, we infer that method variance is not a major issue in our data, and all variables in our study can be clearly distinguished by participants.

Table 5 Alternative model test results

NO.	Model	χ2	df	χ2/df	RMSEA	TLI	CFI	SRMR
1	Three-factor model: LD,PE,IB	1858.267	1162	1.599	0.036	0.961	0.963	0.0484
2	Two-factor model(1): LD,PE+IB	1922.949	1164	1.652	0.038	0.958	0.960	0.0600
3	Two-factor model(2): LD+PE,IB	2323.890	1164	1.996	0.047	0.936	0.939	0.1129
4	One-factor model: LD+PE+IB	13077.8	1175	11.13	0.15	0.347	0.373	0.1557

Notes: N=452; LD=leadership development; PE=psychological empowerment; IB=innovation behavior.

χ2/df <3; RMSEA < 0.08; TLI > 0.9; CFI > 0.9; SRMR < 0.08

4. Path coefficient

Table 6 Results of Structural Equation Modeling

Path relationship			Estimate	SE	CR	p	Estimates of Standardized Regression Weights
LD	⟶	PE	0.489	0.066	7.442	***	0.454
PE	⟶	IB	0.515	0.070	7.384	***	0.565
LD	⟶	IB	0.238	0.063	3.796	***	0.243

Note: * p<0.05 ** p<0.01 *** p<0.001

Table 6 shows that the standardized path coefficients of Leadership Development on Psychological Empowerment, Psychological Empowerment on Innovation Behavior, and Leadership Development on Innovation Behavior are 0.454, 0.565, and 0.243 respectively, with p values all less than 0.001. This indicates that Leadership Development has a significant positive impact on Psychological Empowerment, and both Leadership Development and Psychological Empowerment have significant positive impacts on Innovation Behavior. These results also suggest that Psychological Empowerment plays a partial mediating role in the relationship between Leadership Development and Innovation Behavior.

5. Analysis of the mediating effect

Table 7 Results of Mediation.

Hypotheses	Relationship	β	SE	t value	CI		Decision
					5.00%	95.00%	
H4	LD⟶PE⟶IB	0.252	0.048	5.25	0.17	0.36	Supported

Table 7 presents the results of the mediation analysis. The hypothesized indirect effect of leadership development on innovative behavior via psychological empowerment (H4: LD ⟶ PE ⟶ IB) was found to be significant, with a standardized path coefficient (β) of 0.252, a standard error (SE) of 0.048, and a t–value of 5.25. The 95% confidence interval ranged from 0.17 to 0.36, excluding zero, indicating a statistically significant mediation effect. Therefore, hypothesis H4 was supported.

Discussion

1. Direct Effect of Leadership Development on Innovation Behavior (H1)

The results demonstrate a significant positive relationship between leadership development and innovation behavior (β = 0.243, $p < 0.001$), confirming Hypothesis 1. This finding corroborates previous empirical work (Tikas, 2024; Goldman & Scott, 2016), which emphasized the role of strategic leadership practices in promoting innovative thinking and action. In the context of surgery, this suggests that leadership development—encompassing strategic thinking, communication, motivation, and training—enhances a surgeon's ability to identify opportunities for improvement and act on them in high–stakes clinical environments.

Notably, this finding supports the view that leadership is not just about managing tasks but about enabling change. As Nurhidayati and Sabrina (2023) and Li et al. (2024) have shown, communication and motivation stimulate innovation by fostering a psychologically safe environment conducive to idea generation and implementation.

2. Direct Effect of Leadership Development on Psychological Empowerment (H2)

Leadership development was also found to significantly predict psychological empowerment (β = 0.454, $p < 0.001$), confirming Hypothesis 2. This aligns with Abbas and Khal (2016), who found that strategic thinking fosters a sense of mission and confidence in healthcare professionals. Moreover, communication and training activities have been found to enhance psychological empowerment by

promoting clarity, competence, and role significance (Saira et al., 2021; Wang et al., 2022; Schermuly et al., 2022).

Theoretically, this result reinforces the resource–based view (RBV) of leadership, in which leadership development is treated as a critical organizational capability that builds internal psychological resources among staff, thus preparing them for complex innovation tasks.

3. Direct Effect of Psychological Empowerment on Innovation Behavior (H3)

The strong positive effect of psychological empowerment on innovation behavior (β = 0.565, $p < 0.001$) confirms Hypothesis 3 and is consistent with the findings of Zhang et al. (2022) and James et al. (2023). Empowered individuals feel more autonomous, competent, and impactful in their roles, making them more likely to engage in creative problem–solving and innovation.

This aligns with Self–Determination Theory (Deci & Ryan, 1985), which posits that intrinsic motivation—fueled by autonomy, competence, and relatedness—serves as a core driver of proactive and innovative behaviors. In high–pressure environments such as surgical units, psychological empowerment can provide the intrinsic regulatory energy required to transcend routine operations and experiment with novel techniques or interdisciplinary approaches.

4. Mediating Role of Psychological Empowerment (H4)

The indirect effect of leadership development on innovation behavior through psychological empowerment was significant (effect = 0.252, 95% CI = [0.17, 0.36]), validating Hypothesis 4. This mediation suggests that psychological empowerment functions as a crucial psychological mechanism through which leadership development exerts its influence on innovation behavior.

This result is consistent with prior studies (Alshawabkeh et al., 2024; Stanescu et al., 2021), which found psychological empowerment to mediate the relationship between leadership practices and innovative outcomes. It suggests that enhancing individual perceptions of meaning, competence, self–determination, and impact serves as a conduit for leadership to translate into innovation.

Importantly, this mediating pathway provides empirical support for integrating Self–Determination Theory and the empowerment model in leadership and innovation research. It highlights that leadership interventions alone may not be sufficient unless they are internalized by individuals as sources of psychological strength.

Research Findings

This study develops a multidimensional theoretical model of surgeons' leadership development, grounded in frameworks such as transformational leadership theory and leader–member exchange theory. Moreover, it identifies the critical mediating role of psychological empowerment, thereby enriching and refining the theoretical framework linking leadership development to surgeons' innovative behavior, while also providing empirical support for this relationship.

Conclusion

This study explores the relationship between leadership development and innovation behavior among surgeons in China, with a particular focus on the mediating role of psychological empowerment. Based on empirical data collected through validated survey instruments, the following systematic conclusions are drawn:

1. Leadership development significantly promotes surgeons' innovation behavior.

Empirical results indicate that leadership development, encompassing four core dimensions strategic thinking, communication, motivation, and training has a direct and statistically significant positive effect on surgeons' innovation behavior. This suggests that investing in leadership capabilities can foster a more proactive, adaptable, and innovative surgical workforce, which is particularly critical in complex and high–risk clinical environments.

2. Leadership development significantly enhances psychological empowerment.

The study confirms that leadership development positively influences psychological empowerment, reflected in surgeons' increased sense of meaning, self–efficacy, autonomy, and perceived impact. This implies that effective leadership interventions can build essential psychological resources that support personal initiative and resilience in clinical practice.

3. Psychological empowerment significantly contributes to surgeons' innovation behavior.

The results demonstrate that psychologically empowered surgeons are more likely to engage in innovative behaviors. This highlights the motivational role of internal psychological states in driving professional innovation, aligning with the principles of Self–Determination Theory, which emphasizes the importance of autonomy and competence in motivating behavior.

4. Psychological empowerment partially mediates the relationship between leadership

development and innovation behavior.

Mediation analysis reveals that psychological empowerment serves as a significant intermediary mechanism through which leadership development exerts its influence on innovation behavior. This indicates that while leadership development directly encourages innovation, its impact is further amplified when it enhances individuals' psychological states, confirming the indirect effect pathway.

Recommendations

This study examined the impact of leadership development on the innovation behavior of surgeons, revealing that psychological empowerment serves as a partial mediator in this relationship. The findings yield several practical implications that can guide hospital administrators, policymakers, and clinical educators in advancing surgical innovation through leadership strategies. These implications are organized into three major domains: leadership capacity building, psychological empowerment, and systematic innovation cultivation.

1. Strengthening Leadership Capabilities to Drive Surgical Innovation

Given the significant positive effect of leadership development on surgeons' innovation behavior, it is critical for hospitals to embed leadership training into their innovation strategy. Specifically, the study identified strategic thinking and training as the most influential dimensions of leadership development. This suggests that surgeons who are equipped with vision–oriented, systematic, and adaptive thinking are more capable of identifying innovation opportunities and leading change in complex clinical environments. To effectively enhance surgeons' leadership capabilities, hospitals should adopt a multifaceted and strategically aligned approach. This includes establishing a leadership development framework centered on "strategic leadership and collaborative empowerment," fully integrated with institutional innovation agendas. Practical leadership skills should be cultivated through scenario–based and simulation training, enabling surgeons to make sound decisions under uncertainty and high–risk clinical environments. In addition, the use of artificial intelligence and personalized learning platforms can tailor development pathways based on individual surgeons' clinical roles and leadership readiness. Moreover, comprehensive interdisciplinary communication training encompassing patient centered dialogue, intra team coordination, and interdepartmental collaboration should be emphasized to ensure the successful translation of innovation. Together, these strategies foster a cohort of innovation oriented

surgical leaders capable of driving clinical advancement and improving overall hospital performance.

2. Promoting Psychological Empowerment as an Innovation Catalyst

The mediating effect of psychological empowerment emphasizes its central role in mobilizing surgeons' intrinsic motivation and innovative behaviors. Hospitals must, therefore, foster an empowerment–oriented environment where surgeons perceive higher levels of autonomy, competence, and impact. To effectively operationalize psychological empowerment among surgeons, hospitals should implement a comprehensive system encompassing institutional support, capacity enhancement, and value recognition. Institutional empowerment can be achieved through shared governance structures, transparent performance appraisal mechanisms, and inclusive innovation processes. Simultaneously, capacity building should involve structured innovation programs, mentorship in leadership, and access to necessary technical and informational resources. Additionally, value realization mechanisms that formally acknowledge and reward clinical innovation contributions are essential to reinforce motivation. To further strengthen psychological empowerment, hospitals should develop dynamic authorization systems that delegate substantive decision–making authority in innovation initiatives, establish clinical engineering collaboration platforms to accelerate the translation of ideas into prototypes, and ensure timely access to new technologies with structured onboarding programs to reduce the learning curve. Moreover, supporting surgeons in integrating and adapting to advanced tools and digital systems will enhance their technological readiness. Collectively, these strategies foster a psychologically empowered workforce capable of driving sustained innovation in surgical practice.

3. Cultivating a Sustainable Innovation Ecosystem Among Surgeons

Innovation in diagnosis and treatment requires sustained engagement across cognitive, collaborative, and institutional levels. The study confirms that both leadership development and psychological empowerment are crucial drivers of innovation behavior. Based on this, hospitals should construct a multi–level innovation ecosystem that supports individual surgeon development while reinforcing institutional innovation capacity. To strengthen the innovation drive among surgeons, hospitals should adopt an integrated approach encompassing clinical relevance, interdisciplinary collaboration, and continuous professional development. First, innovation should be driven by clinical needs, encouraging surgeons to systematically identify inefficiencies, patient concerns, and procedural pain points, thereby ensuring that innovation efforts are grounded in real–world clinical relevance. Second, interdisciplinary collaboration networks should be established by fostering structured partnerships between surgical

teams and experts in engineering, artificial intelligence, and biomedical sciences. This can be achieved through the development of translational research centers, joint industry–academic initiatives, and support for early–stage prototyping that connects clinical challenges with technological solutions. Third, a dual–track model of clinical practice and research development should be promoted, enabling continuous knowledge renewal. This includes facilitating surgeons' participation in international conferences and innovation bootcamps, providing training in research methodology and data analysis, and encouraging involvement in structured innovation projects. Collectively, these strategies cultivate a culture of innovation rooted in practical problem–solving, cross–disciplinary collaboration, and leadership growth, thereby positioning surgical teams at the forefront of medical advancement.

References

Abbas, A. A. H., & Khali, H. H. (2016). Effect of the empowerment leadership on job involvement reinforcement through a mediator role for strategic thinking skills. *International Journal of Academic Research in Business and Social Sciences, 6*(6), 2222–6990. http://dx.doi.org/10.6007/IJARBSS/v6–i6/2193

Abubakar, S. K., & Sanda, M. A. (2024). The influence of front–line employees' engagement and psychological empowerment on job satisfaction and organizational citizenship behavior in 1–and 2–star hotels in Ghana. *Journal of Human Resources in Hospitality & Tourism*, *23*(1), 101–127.https://doi.org/10.1080/15332845.2023.2253681

Alshawabkeh, I., Ahmad, N. N., Rashid, A. H. A., Panatik, S. A., Al–Rusan, A., & Liyana, A. (2024). The Role of Transformational Leadership and Psychological Empowerment Toward Employee Creativity. *Advances in Social Sciences Research Journal*, *11*(2.2). https://doi.org/10.14738/assrj.112.2.16425

Benitez, J., Arenas, A., Castillo, A., & Esteves, J. (2022). Impact of digital leadership capability on innovation performance: The role of platform digitization capability. *Information & Management, 59*(2), 103590. https://doi.org/10.1016/j.im.2022.103590

Day, D. V., & Dragoni, L. (2015). Leadership development: An outcome–oriented review based on time and levels of analyses. *Annu. Rev. Organ. Psychol. Organ. Behav.*, *2*(1), 133–156. https://doi.org/10.1146/annurev–orgpsych–032414–111333

Day, D. V., Fleenor, J. W., Atwater, L. E., Sturm, R. E., & McKee, R. A. (2014). Advances in leader and leadership development: A review of 25 years of research and theory. *The Leadership Quarterly*, *25*(1), 63–82. https://doi.org/10.1016/j.leaqua.2013.11.004

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self–Determination in Human Behavior.* Plenum.

Ergun, E., Tunca, S., Cetinkaya, G., & Balcıoğlu, Y. S. (2025). Exploring the Roles of Work Engagement, Psychological Empowerment, and Perceived Organizational Support in Innovative Work Behavior: A Latent Class Analysis for Sustainable Organizational Practices. *Sustainability, 17*(4), 1663.https://doi.org/10.3390/su17041663

Geerts, J. M., Goodall, A. H., & Agius, S. (2020). Evidence–based leadership development for physicians: A systematic literature review. *Social Science & Medicine,* 246, 112709. https://doi.org/10.1016/j.socscimed.2019.112709

Goldman, E., & Scott, A. R. (2016). Competency models for assessing strategic thinking. *Journal of Strategy and Management, 9*(3), 258–280. https://doi.org/10.1108/JSMA–07–2015–0059

Ibrahim, I. A., El–Monshed, A. H., Altheeb, M., & El–Sehrawy, M. G. (2024). Transformational leadership, psychological empowerment, and organizational citizenship behaviors among nursing workforce: A single mediation analysis. *Journal of Nursing Management, 2024*(1), 9919371. http://dx.doi.org/10.1155/2024/9919371

James, M. M., Hughes, M., Ramos, H. M., & Melanie, R. H. (2023). Middle–managers' innovation behavior: The roles of psychological empowerment and personal initiative. *The International Journal of Human Resource Management,34*(18). http://dx.doi.org/10.1080/09585192.2022.2126946

Jun, K., & Lee, J. (2023). Transformational leadership and followers' innovative behavior: Roles of commitment to change and organizational support for creativity. *Behavioral Sciences, 13*(4), 320. https://doi.org/10.3390/bs13040320

Lee, Y., & Kim, J. (2021). Cultivating employee creativity through strategic internal communication: The role of leadership, symmetry, and feedback seeking behaviors. *Public Relations Review,* 47(1), 101998. https://doi.org/10.1016/j.pubrev.2020.101998

Li, B., Yin, S., & Zhang, B. (2024). Incentive mechanism of multiple green innovation behaviors of equipment manufacturing enterprises: A managers, green coordination groups and employees perspective. *PloS one, 19*(3), e0300533–e0300533. https://doi.org/10.1371/journal.pone.0300533

Mohammed, A. A., & Al–Abrrow, H. (2024). The impact of empowering and transformational leadership on innovative behaviour: the mediating role of psychological empowerment in health–care sector. Leadership in Health Services, *37*(2), 231–246. https://doi.org/10.1108/LHS–05–2023–0036

Nurhidayati, N., & Sabrina, M. N. (2023). The Effect of Personality and Knowledge Sharing Toward Innovation Behavior of Employees. *IJIBE (International Journal of Islamic Business Ethics), 8*(2), 129–143. http://dx.doi.org/10.30659/ijibe.8.2.129–143

Qalati, S. A., Barbosa, B., & Ibrahim, B. (2023). Factors influencing employees' eco–friendly innovation capabilities and behavior: the role of green culture and employees' motivations. *Environment, Development and Sustainability,* 1–22. https://doi.org/10.1007/s10668–023–03982–8

Saira, S., Mansoor, S., & Ali, M. (2021). Transformational leadership and employee outcomes: The mediating role of psychological empowerment. *Leadership & Organization Development Journal, 42*(1), 130–143. https://doi.org/10.1108/LODJ–05–2020–0189

Schumpeter, J. A., & Swedberg, R. (2021). *The theory of economic development.* Routledge.

Schermuly, C. C., Creon, L., Gerlach, P., Graβmann, C., & Koch, J. (2022). Leadership styles and psychological empowerment: A meta–analysis. *Journal of Leadership & Organizational Studies, 29*(1), 73–95. https://doi.org/10.1177/15480518221075568

Soenens, G., Marchand, B., Doyen, B., Grantcharov, T., Van Herzeele, I., & Vlerick, P. (2023). Surgeons' leadership style and team behavior in the hybrid operating room: prospective cohort study. Annals of surgery, *278*(1), e5–e12. https://doi.org/10.1097/SLA.0000000000005645

Spreitzer, G. M. (1995). Psychological empowerment in the workplace: Dimensions, measurement, and validation. *Academy of Management Journal*, *38*(5), 1442–1465. https://doi.org/10.5465/256865

State Council of China. (2016). *Healthy China 2030 Planning Outline.* http://www.gov.cn/zhengce/2016–10/25/content_5124174.htm

Stanescu, D. F., Zbuchea, A., & Pinzaru, F. (2021). Transformational leadership and innovative work behaviour: The mediating role of psychological empowerment. *Kybernetes, 50*(5), 1041–1057. https://doi.org/10.1108/K–07–2019–0491

Tuan, L. T. (2022). Transformational leadership and employee innovation in healthcare: The mediating roles of empowerment and organizational learning. *Journal of Health Organization and Management, 36*(2), 174–193. https://doi.org/10.1108/JHOM-07-2021-0270

Tikas, G. (2024), "Towards measuring strategic leadership capabilities for innovation: an empirical validation", *Evidence-based HRM*, *12* (3), 704-723. https://doi.org/10.1108/EBHRM-03-2023-0054

Yamane, T. (1967). *Statistics: An introductory analysis (2nd ed.)*. Harper & Row.

Wang, D., Wang, L., Wei, S., Yu, P., Sun, H., Jiang, X., & Hu, Y. (2022). Effects of authoritarian leadership on employees' safety behavior: A moderated mediation model. *Frontiers in Public Health, 10*, 846842. https://doi.org/10.3389/fpubh.2022.846842

Wang, K., Ma, D., Jin, P., & Guo, X. (2023). The mediating effect of psychological empowerment between structural empowerment and innovation behaviors among pediatric nurses. *Journal of Clinical Psychosomatic Disorders, 29*(04), 30–34+47. https://doi.org/10.3389/fpubh.2022.846842

Weissman, C., Hollingsworth, E., & Yule, S. (2020). Surgical leadership: Contextual challenges and necessary competencies. *Annals of Surgery Open*, *1*(2), e018. https://doi.org/10.1097/AS9.0000000000000018

Yang, Y. (2019). *Our hospital's middle-level cadres participated in overseas training: Mayo Clinic leadership program successfully completed.* Peking Union Medical College Hospital. https://www.pumch.cn/detail/22333.html

Zhang, S., Liu, Y., Li, G., Zhang, Z., & Fa, T. (2022). Chinese nurses' innovation capacity: The influence of inclusive leadership, empowering leadership and psychological empowerment. *Journal of Nursing Management, 30*(6), 1990–1999. https://doi.org/10.1111/jonm.13654