

# PROGRESS IN MEDICAL EDUCATION



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# On Launching a New Journal ‘Progress in Medical Education’

Xiangbing Shui

Professor of School of Anesthesiology, Naval Medical University, Shanghai 200433, China.

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Medical education serves as the foundation of healthcare systems worldwide, shaping the knowledge, skills, and professional values of future healthcare providers. It is through education that we equip the next generation of doctors, nurses, and allied health professionals to navigate the complexities of patient care, scientific discovery, and public health. In an era marked by rapid advancements in medical science and technology, the need for innovative, evidence-based, and effective educational strategies has never been more pressing. Against this backdrop, we are launching Progress in Medical Education (PME), a new open-access, peer-reviewed journal dedicated to the timely publication of articles on health professions education.

Our journal aspires to be an international platform where educators, researchers, and clinicians can exchange insights, explore novel approaches, and collaborate on solutions to the evolving challenges in medical education. At PME, we are committed to fostering a vibrant community that values scholarly dialogue and practical innovation. By disseminating innovative research, sharing best practices, and providing actionable strategies, we seek to drive meaningful progress in medical education.

In our maiden issue, PME presents eight studies that collectively address pressing challenges in medical training. The first four articles focus on educational strategies and clinical integration. A cross-sectional survey of Chinese anesthesia graduates identifies key factors affecting job satisfaction, including income disparities and occupational stress, and it calls for targeted support systems to retain skilled professionals. Building on this, a curricular innovation study proposes embedding spatial transcriptomics and 3D modeling into histology education, summarizing how these tools help students contextualize foundational knowledge within modern scientific paradigms. The third article reimagines pharmacology teaching through virtual reality simulations, illustrating

how immersive case studies enhance clinical reasoning skills. Finally, a randomized trial examines the integration of ideological education into anesthesiology residency programs, showing measurable improvements in residents' communication abilities and patient-centered care. Collectively, these studies showcase groundbreaking innovations that bridge theoretical knowledge with practical application, while addressing critical workforce and curricular gaps.

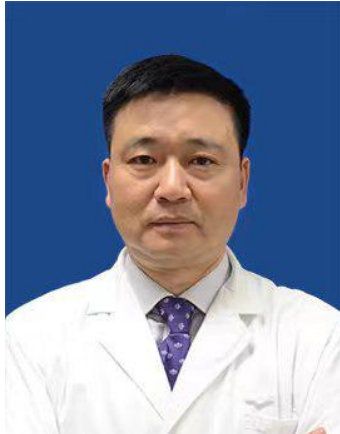
The remaining four articles tackle systemic and technological advancements. For example, a clinical trial confirms the superiority of visual double-lumen catheters for pulmonary isolation training, demonstrating reduced procedural complications and improved trainee confidence. An analysis of ethical approval processes uncovers institutional delays in postgraduate research, underscoring the need for streamlined protocols to align academic and clinical timelines. Another study explores China's medical employment landscape, emphasizing the role of AI-driven career guidance and school-hospital collaborations in mitigating job market saturation. Concluding this issue, a competency-based online platform for anesthesiology postgraduates addresses fragmented curricula through modular, updatable learning resources tailored to evolving clinical demands. Together, these contributions highlight transformative approaches to advancing medical education, offering both localized solutions and scalable innovations that address critical challenges in the field.

As an open-access journal, PME is dedicated to making research and educational content freely accessible to readers worldwide. By removing barriers to knowledge, we aim to foster a truly global dialogue in medical education, ensuring that valuable insights reach the widest possible audience and contribute to the continuous improvement of healthcare training.

We warmly invite the medical education com-

munity to contribute to join us in this endeavor by submitting high-quality research, innovative practices, and insightful perspectives. Together, we can drive progress in medical education and shape the future of healthcare training. We look

forward to fostering meaningful collaborations, engaging in thought-provoking discussions, and inspiring impactful contributions that will propel the field forward for years to come.



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#### **Editor-in-Chief of Progress in Medical Education**

##### **Xiangbing Shui**

Professor Shui is a senior anesthesiologist and medical education expert who graduated from the Naval Medical University and has nearly 40 years of experience in clinical anesthesia. He holds an authoritative role in anesthetic management and neonatal resuscitation for patients with multiple organ injuries, extensive burns, septic shock, and high-risk pregnancies, and he is also highly experienced in providing deep sedation without intubation for pediatric dental procedures. In addition, he has unique expertise in diagnosing and differentiating a wide range of pain conditions and is skilled in minimally invasive spinal interventions such as intervertebral foramen radiofrequency pulse thermocoagulation and plasma therapy. His work has a particular focus on managing challenging pain syndromes, including herpes zoster, postherpetic neuralgia, cancer pain, and intractable pain.

Throughout his career, Professor Shui has published more than 20 research papers in leading journals and has guided the publication of over 20 teaching-related papers. He has led a project in the Nanjing Military Region and has received multiple accolades, including an award for scientific and technological innovation as well as individual and collective third-class honors.



# Job satisfaction and its influencing factors among anesthesia graduates: Evidence from a cross-sectional study in China

Fengyan Yang<sup>1,\*</sup>, An Jiang<sup>2,\*</sup>, Bing Xu<sup>1</sup>, Kai Wei<sup>3</sup>, Zhengyu Jiang<sup>4</sup>, Jian Yu<sup>5</sup>, Tianying Xu<sup>1</sup>, Yuming Sun<sup>3</sup>, Mi Li<sup>1</sup>

<sup>1</sup>Department of Anesthesiology, Naval Medical University, Shanghai 200433, China. <sup>2</sup>Teaching Evaluation Center, Naval Medical University, Shanghai, China. <sup>3</sup>Department of Anesthesiology, The Third Affiliated Hospital of Naval Medical University, Shanghai 200438, China. <sup>4</sup>Department of Anesthesiology, Naval Medical Center, Naval Medical University, Shanghai 200050, China. <sup>5</sup>Department of Health Statistics, Naval Medical University, Shanghai 200433, China.

\*The authors contribute equally.

**Corresponding authors:** Yuming Sun and Mi Li.

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## Highlights

- There is a shortage of anesthesiologists in China, and the occupation is not attractive enough.
- The respondents were distributed in 30 provinces of China, and the overall satisfaction rate was  $75.85 \pm 12.57$ .
- Work stress and work hours influence on job satisfaction is not the lower the better.
- Expanding the pathway and providing effective training for anesthesiologists will help to improve job satisfaction.

## Abstract

**Objectives:** To assess job satisfaction among anesthesia graduates working in various medical institutions across China. **Methods:** A cross-sectional survey was conducted, collecting demographic information, Minnesota Satisfaction Questionnaire scores, work pressure, and turnover intentions. Multiple linear regression analysis was used to examine factors influencing job satisfaction. The electronic survey was distributed to Chinese anesthesia graduates from December 2021 to January 2022. **Results:** A total of 595 questionnaires were distributed, with 318 valid responses, resulting in a response rate of 53.4%. The participants' overall job satisfaction score on the Minnesota Satisfaction Questionnaire was  $75.85 \pm 12.57$ . Multiple linear regression analysis identified the following variables as significantly associated with job satisfaction: age, daily working hours, income, current position, and work pressure. **Conclusions:** Anesthesia graduates in China reported slightly higher-than-average overall job satisfaction. However, several issues remain. Attention should be given to the impact of factors such as youth, long working hours, low income, current position, and high work pressure on job satisfaction. The government should support anesthesiologists with improved training, job security, and benefits to enhance job satisfaction.

**Keywords:** Job satisfaction, anesthesia graduates, work pressure, turnover intentions, influencing factors, China

## Introduction

Job satisfaction refers to the level of contentment an individual feels with their work. According to Robbins, job satisfaction is "an individual's general attitude towards the work in which

he or she is engaged," and high job satisfaction fosters a positive work attitude [1]. The healthcare system is increasingly focused on anesthesiologists' job satisfaction [2]. In Finland, Canada, and Poland, more than 70% of anesthesiologists report high job satisfaction [3-5]. Conversely,

**Address correspondence to:** Yuming Sun, Department of Anesthesiology, Eastern Hepatobiliary Surgery Hospital, The Third Affiliated Hospital of Naval Medical University, No. 225, Changhai Road, Yangpu District, Shanghai 200438, China. Email: sunyuming0223@163.com; **Mi Li**, School of Anesthesiology, Naval Medical University, 168 Changhai Rd, Shanghai 200433, China. E-mail: limi@smmu.edu.cn.



anesthetists in economically underdeveloped regions show lower satisfaction levels. For example, job satisfaction among anesthetists in Nigeria and Ethiopia is 58.7% and 42.5%, respectively [6, 7]. Low job satisfaction risks both physician well-being and patient safety, leading to higher resignation rates, substance abuse, slower responses to changes in patient status, and more medical decision-making errors [8-11].

Evaluating the factors influencing job satisfaction is crucial, as these may vary by country and development level. In the United States, relationships with colleagues and job responsibility are the most satisfying aspects of work, while promotion opportunities are the least satisfying [12]. A study on nurses in Korea found that job satisfaction correlates directly with job stress, burnout, and turnover intentions [13]. In Ethiopia, factors such as gender, work environment, professional growth opportunities, relationships with colleagues, and supportive supervision affect job satisfaction [14]. In China, rural doctors' dissatisfaction is primarily attributed to low financial rewards, followed by low job security and high work stress [15]. Additionally, orthopedic and neurosurgical trainees report differing satisfaction levels regarding supervision and promotion, respectively [16].

However, research on anesthetists is relatively outdated. Over the past decade, the number of anesthesiologists in China has grown, yet a significant gap remains between supply and demand for anesthesia services. Given the dramatic changes in the healthcare environment, it is essential to reassess anesthetists' job satisfaction. By the end of 2018, China had approximately 92,726 anesthesiologists and 28,200 anesthesia nurses [17]. With the expansion of anesthesia services, the total number of anesthetic procedures has gradually increased each year [14, 15]. Owing to the shortage of anesthesiologists and their increasing workload, understanding their job satisfaction is crucial. Graduates from different medical institutions in various cities provide valuable insights into this topic [18]. This study explores the key factors influencing their job satisfaction and proposes practical solutions for improvement. The findings can inform policies aimed at retaining skilled anesthesiologists and support stable human resource management in healthcare.

## Methods

### Samples

We surveyed all graduates of the School of

Anesthesiology at Naval Medical University who graduated between 1995 and 2021. This cross-sectional questionnaire study included graduates currently working across 71 cities in 30 provinces in China, employed in various levels of medical institutions. The study was conducted from December 2021 to January 2022. Before commencing the questionnaire, all respondents voluntarily agreed to participate and provided informed consent. Their privacy was strictly protected throughout the study.

### Assessment tools

The questionnaire consisted of 17 items, focusing on three main aspects: (1) basic social and demographic information, including gender, age, educational level, city classification, and years since graduation; (2) occupational characteristics, such as daily working hours, income, current position, level of medical institution, years of employment at the current workplace, and professional title; (3) turnover intentions, assessing work pressure and three factors related to turnover intentions: opinions on the future development of the anesthesia specialty, willingness to leave the current unit, and willingness to leave the specialty. Turnover intentions were measured on a 5-point scale, ranging from 1 (extremely likely to leave) to 5 (extremely unlikely to leave).

After completing the main questionnaire, respondents' job satisfaction was assessed using the short version of the Minnesota Satisfaction Questionnaire (MSQ). The Chinese version of the MSQ has been widely used and demonstrates satisfactory reliability and validity [19, 20]. In this study, the modified MSQ version showed a Cronbach's alpha coefficient of 0.933, indicating strong internal consistency. Job satisfaction was measured using a 5-point Likert scale, ranging from 1 (extremely dissatisfied) to 5 (extremely satisfied), with a total score of 100 points; higher scores reflect greater satisfaction.

The MSQ comprises 20 items and three subscales: general satisfaction, intrinsic satisfaction, and extrinsic satisfaction. The general satisfaction score is the average of all 20 items. The intrinsic satisfaction score, reflecting satisfaction with factors related to the internal quality of the job, is calculated by averaging scores from 12 specific items: #1, #2, #3, #4, #7, #8, #9, #10, #11, #15, #16, and #20. The extrinsic satisfaction score, representing satisfaction with the external work environment, is calculated by averaging scores from 8 items: #5, #6, #12, #13, #14, #17, and #18 [21].

**Table 1. Participants' sociodemographic characteristics in relation to their job satisfaction**

| Variables                       | Overall<br>(n=318) |       | Total         |         | Intrinsic satisfaction |         | Extrinsic satisfaction |         |
|---------------------------------|--------------------|-------|---------------|---------|------------------------|---------|------------------------|---------|
|                                 | n                  | %     | Mean (SD)     | p value | Mean (SD)              | p value | Mean (SD)              | p value |
| Gender                          |                    |       |               |         |                        |         |                        |         |
| Male                            | 261                | 82.1% | 75.66 (12.57) |         | 47.51 (6.95)           |         | 20.40 (4.83)           |         |
| Female                          | 57                 | 17.9% | 76.74 (12.62) | 0.558   | 48.09 (7.09)           | 0.571   | 20.81 (4.70)           | 0.561   |
| Age (years)                     |                    |       |               |         |                        |         |                        |         |
| 20-30                           | 93                 | 29.2% | 73.09 (13.13) |         | 46.13 (7.04)           |         | 19.63 (4.97)           |         |
| 31-40                           | 127                | 39.9% | 75.71 (12.34) |         | 47.77 (7.07)           |         | 20.13 (4.69)           |         |
| >40                             | 98                 | 30.8% | 78.66 (11.82) | 0.009   | 48.82 (6.56)           | 0.027   | 21.71 (4.56)           | 0.006   |
| Educational level               |                    |       |               |         |                        |         |                        |         |
| Bachelor                        | 147                | 46.2% | 73.76 (12.55) |         | 44.62 (7.07)           |         | 19.64 (4.73)           |         |
| Graduate                        | 171                | 53.8% | 77.65 (12.34) | 0.006   | 48.47 (6.79)           | 0.018   | 21.19 (4.76)           | 0.004   |
| City level                      |                    |       |               |         |                        |         |                        |         |
| Developed                       | 216                | 67.9% | 77.78 (12.09) |         | 48.59 (6.72)           |         | 21.17 (4.65)           |         |
| Underdeveloped                  | 102                | 32.1% | 71.77 (12.64) | <0.001  | 45.55 (7.07)           | <0.001  | 19.00 (4.79)           | <0.001  |
| Length of graduation<br>(years) |                    |       |               |         |                        |         |                        |         |
| 1-10                            | 115                | 36.2% | 73.08 (13.33) |         | 46.07 (7.20)           |         | 19.65 (5.03)           |         |
| 11-20                           | 152                | 47.8% | 76.89 (11.64) |         | 48.39 (6.63)           |         | 20.53 (4.52)           |         |
| >20                             | 51                 | 16.0% | 79.00 (12.64) | 0.007   | 48.76 (6.95)           | 0.011   | 22.14 (4.71)           | 0.008   |

Note: The 2022 Ranking of Commercial Cities classifies first-tier and new first-tier cities as developed, and second-tier, third-tier, fourth-tier, and fifth-tier cities as underdeveloped.

The electronic survey was created using the Questionnaire Star platform and distributed via WeChat. Initially, 15 graduates participated in a pre-survey, and based on their feedback, the questionnaire was revised. Once finalized, the survey was sent to all remaining graduates for completion. Invalid questionnaires were excluded based on three criteria: incomplete sociodemographic data, more than five missing responses, and patterns indicating systematic measurement errors (e.g., fluctuating response curves or an excessive concentration of identical answers), which could undermine the study's validity.

#### Data analysis

Data were analyzed using IBM SPSS Statistics version 26.0. A two-tailed  $p < 0.05$  was considered statistically significant. Gender (male/female), educational level (bachelor/graduate), and city classification (developed/underdeveloped cities) were treated as dichotomous variables. Other variables were treated as categorical. To compare job satisfaction scores, the Student's t-test was employed for categorical variables with two categories, and one-way analysis of variance with Tukey post hoc analysis was used for those with three or more categories. Categorical variables are presented as frequencies and percentages, and continuous variables are presented as means and standard deviations. The means (standard

deviations) of the MSQ's 20 items across the intrinsic, extrinsic, and general satisfaction subscales are reported. Additionally, job satisfaction scores were re-categorized into three groups: "satisfied" (scores of 4 and 5), "neutral" (score of 3), and "dissatisfied" (scores of 1 and 2). Multiple linear regression was performed to identify potential risk factors for intrinsic, extrinsic, and overall job satisfaction.

#### Results

In total, 595 questionnaires were distributed, with 326 returned, yielding a response rate of 54.79%. Of these, 318 were valid, representing an effective response rate of 53.45%.

#### Overall sociodemographic characteristics and their relation to MSQ scores

**Table 1** presents the sociodemographic characteristics of the sample. Respondents were predominantly male (82.1%) with a mean age of  $36.2 \pm 14.8$  years. A clear pattern of increasing job satisfaction with age was observed. Younger respondents reported the lowest overall, intrinsic, and extrinsic job satisfaction levels. Further analysis of MSQ scores identified the top three contributing factors to this dissatisfaction as limited opportunities for further education, inadequate compensation and benefits, and insufficient utilization of personal talents. In terms of geographic location, 67.9% of respondents worked in developed cities, while 32.1%

**Table 2. Participants' occupational characteristics in relation to their job satisfaction**

| Variables                             | Overall (n=318) |       | Total            |         | Intrinsic satisfaction |         | Extrinsic satisfaction |         |
|---------------------------------------|-----------------|-------|------------------|---------|------------------------|---------|------------------------|---------|
|                                       | n               | %     | Mean (SD)        | p value | Mean (SD)              | p value | Mean (SD)              | p value |
| Working hours per day                 |                 |       |                  |         |                        |         |                        |         |
| <8                                    | 74              | 23.3% | 72.78<br>(11.70) | 0.013   | 46.09<br>(6.54)        | 0.012   | 19.23 (4.51)           | 0.02    |
| 8–10                                  | 168             | 52.8% | 77.71<br>(11.72) |         | 48.69<br>(6.46)        |         | 21.09 (4.58)           |         |
| >10                                   | 76              | 23.9% | 74.74<br>(14.49) |         | 46.71<br>(8.06)        |         | 20.32 (5.34)           |         |
| Income                                |                 |       |                  |         |                        |         |                        |         |
| Low                                   | 52              | 16.4% | 62.29<br>(8.72)  | <0.001  | 41.60<br>(5.41)        | <0.001  | 14.69 (3.09)           | <0.001  |
| Moderate                              | 151             | 47.5% | 72.93<br>(9.36)  |         | 46.13<br>(5.91)        |         | 19.32 (3.23)           |         |
| High                                  | 115             | 36.2% | 85.83<br>(9.71)  |         | 52.29<br>(5.88)        |         | 24.60 (3.45)           |         |
| Current position                      |                 |       |                  |         |                        |         |                        |         |
| Anesthesia-related                    | 227             | 71.4% | 77.18<br>(11.03) | <0.001  | 48.22<br>(6.32)        | <0.001  | 20.93 (4.30)           | <0.001  |
| Other departments                     | 19              | 6.0%  | 79.53<br>(13.78) |         | 48.89<br>(8.01)        |         | 22.58 (4.41)           |         |
| Primary care position                 | 40              | 12.6% | 62.00<br>(10.15) |         | 41.23<br>(6.00)        |         | 15.10 (3.64)           |         |
| Others                                | 32              | 10.1% | 81.56<br>(13.66) |         | 50.53<br>(7.59)        |         | 22.69 (5.14)           |         |
| Hospital category                     |                 |       |                  |         |                        |         |                        |         |
| Tertiary hospital                     | 221             | 69.5% | 77.92<br>(11.19) | <0.001  | 48.51<br>(6.44)        | <0.001  | 21.28 (4.31)           | <0.001  |
| Secondary hospital                    | 18              | 5.7%  | 71.56<br>(10.77) |         | 45.22<br>(6.18)        |         | 19.06 (4.15)           |         |
| Primary healthcare institution        | 51              | 16.0% | 65.37<br>(11.85) |         | 43.08<br>(6.80)        |         | 16.22 (4.11)           |         |
| Non-medical institution               | 28              | 8.8%  | 81.36<br>(14.66) |         | 50.32<br>(8.07)        |         | 22.75 (5.51)           |         |
| Years of working in current workplace |                 |       |                  |         |                        |         |                        |         |
| <3                                    | 60              | 18.9% | 77.03<br>(14.13) | 0.356   | 47.70<br>(7.74)        | 0.627   | 21.55 (4.95)           | 0.139   |
| 3-5                                   | 89              | 28.0% | 74.19<br>(11.04) |         | 46.96<br>(6.08)        |         | 19.78 (4.41)           |         |
| 6-10                                  | 44              | 13.8% | 74.73<br>(16.00) |         | 47.23<br>(8.58)        |         | 19.98 (6.01)           |         |
| >10                                   | 125             | 39.3% | 76.86<br>(11.37) |         | 48.18<br>(6.57)        |         | 20.62 (4.45)           |         |
| Professional status                   |                 |       |                  |         |                        |         |                        |         |
| Primary                               | 92              | 28.9% | 73.33<br>(13.72) | <0.001  | 46.29<br>(7.37)        | 0.001   | 19.67 (5.27)           | 0.001   |
| Intermediate                          | 90              | 28.3% | 73.40<br>(11.71) |         | 46.39<br>(6.74)        |         | 19.51 (4.41)           |         |
| Senior                                | 136             | 42.8% | 79.18<br>(11.58) |         | 49.32<br>(6.51)        |         | 21.65 (4.48)           |         |

worked in underdeveloped cities [22]. Those in developed cities reported significantly higher job satisfaction levels than those in underdeveloped cities ( $p<0.001$ ).

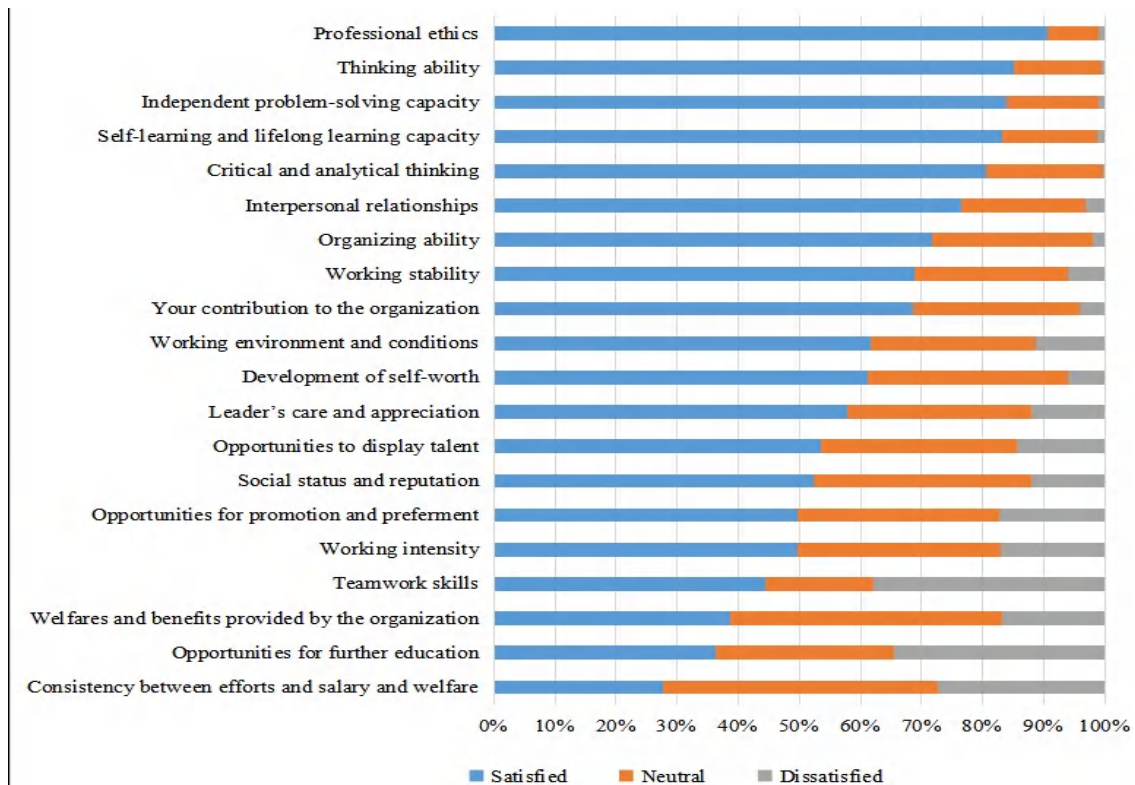
#### **Overall occupational characteristics and their relation to MSQ scores**

**Table 2** outlines the occupational characteris-

tics of participants. Among respondents, 52.8% worked 8–10 hours per day and reported the highest job satisfaction levels, followed by those who worked over 10 hours. Those working fewer than 8 hours reported the lowest job satisfaction levels. More than 70% of respondents were employed in anesthesia-related positions, and those in primary care roles reported the lowest job satisfaction due to limited opportu-

**Table 3. Scores and internal reliability of job satisfaction items and scales**

|                                                    | Mean (SD)     | Intrinsic    | Extrinsic    |
|----------------------------------------------------|---------------|--------------|--------------|
| Working intensity                                  | 3.43 (1.07)   | √            |              |
| Independent problem-solving capacity               | 4.25 (0.74)   | √            |              |
| Self-learning and lifelong learning capacity       | 4.23 (0.76)   | √            |              |
| Your contribution to the organization              | 3.92 (0.91)   | √            |              |
| Professional ethics                                | 4.37 (0.68)   | √            |              |
| Working stability                                  | 3.88 (0.92)   | √            |              |
| Development of self-worth                          | 3.78 (0.94)   | √            |              |
| Teamwork skills                                    | 4.18 (0.74)   | √            |              |
| Opportunities to display talent                    | 3.57 (1.14)   | √            |              |
| Critical and analytical thinking                   | 4.14 (0.74)   | √            |              |
| Thinking ability                                   | 4.29 (0.73)   | √            |              |
| Social status and reputation                       | 3.58 (1.03)   | √            |              |
| Leader's care and appreciation                     | 3.70 (1.08)   |              | √            |
| Organizing ability                                 | 4.03 (0.82)   |              | √            |
| Welfares and benefits provided by the organization | 3.31 (1.02)   |              | √            |
| Consistency between efforts and salary and welfare | 2.99 (0.99)   |              | √            |
| Opportunities for promotion and preferment         | 3.46 (1.12)   |              | √            |
| Opportunities for further education                | 2.98 (1.32)   |              | √            |
| Working environment and conditions                 | 3.71 (1.07)   |              |              |
| Interpersonal relationships                        | 4.06 (0.88)   |              |              |
| Average score, mean (SD)                           | 3.79 (1.03)   | 3.97 (0.93)  | 3.41 (1.13)  |
| Total score, mean (SD)                             | 75.85 (12.57) | 47.61 (6.97) | 20.47 (4.80) |
| Cronbach's alpha                                   | 0.933         | 0.883        | 0.887        |

**Figure 1. Levels for satisfaction related to the 20 items of the Minnesota Satisfaction Questionnaire.**

nities for further education, poor utilization of their talents, and lack of promotion prospects. Additionally, high personal income was positively correlated with job satisfaction ( $p < 0.001$ ). Respondents with low incomes were the most dissatisfied, citing insufficient benefits, educa-

tional opportunities, and compensation.

#### **Analysis of participants' MSQ scores**

**Table 3** presents the general job satisfaction scores as well as the intrinsic and extrinsic

**Table 4. Participants' work pressure, anesthesia prospects, and turnover intentions**

|                                                             | Frequency (n) | Percentage (%) |
|-------------------------------------------------------------|---------------|----------------|
| Work pressure                                               |               |                |
| Overload                                                    | 26            | 8.2            |
| Frequently high                                             | 120           | 37.6           |
| Occasionally high                                           | 131           | 41.1           |
| Less pressure                                               | 30            | 9.4            |
| Easy without pressure                                       | 11            | 3.4            |
| Anesthesia development prospects                            |               |                |
| Extremely poor                                              | 5             | 1.6            |
| Poor                                                        | 20            | 6.3            |
| General                                                     | 95            | 29.8           |
| Comparatively good                                          | 103           | 32.3           |
| Extremely good                                              | 95            | 29.8           |
| Willingness to leave the field you are currently working in |               |                |
| Desperately want to leave                                   | 21            | 6.6            |
| Want to leave                                               | 31            | 9.7            |
| General                                                     | 72            | 22.6           |
| Do not want to leave                                        | 72            | 22.6           |
| Extremely reluctant to leave                                | 122           | 38.2           |
| Willingness to leave current unit                           |               |                |
| Desperately want to leave                                   | 38            | 11.9           |
| Want to leave                                               | 36            | 11.3           |
| General                                                     | 102           | 32             |
| Do not want to leave                                        | 76            | 23.8           |
| Extremely reluctant to leave                                | 66            | 20.8           |

satisfaction scores for the 318 participants. The total MSQ score was  $75.85 \pm 12.57$ , with intrinsic and extrinsic satisfaction scores of  $47.61 \pm 6.97$  and  $20.47 \pm 4.80$ , respectively. The highest scoring item was question 7 (professional ethics,  $4.37 \pm 0.68$ ), while the lowest scoring item was question 19 (further education,  $2.98 \pm 1.32$ ). Cronbach's alpha coefficients for the total, intrinsic, and extrinsic satisfaction scales were 0.933, 0.883 and 0.887, respectively.

Additionally, the MSQ scores for the 20 items varied across different participant groups. Responses were categorized based on a five-point Likert scale into three groups: satisfied (satisfied and extremely satisfied), neutral, and dissatisfied (dissatisfied and extremely dissatisfied). Participants rated professional ethics, thinking ability, independent problem-solving skills, self-learning, lifelong learning skills, and critical and analytical thinking as the most satisfying aspects, with overall satisfaction scores above 80. In contrast, payment and return on salary and benefits, further education opportunities, and organizational welfare and benefits were the least satisfying factors, with overall satisfaction scores below 40 (**Figure 1**).

#### ***Turnover intentions, work pressure, and related factors***

Job stress, professional development prospects in anesthesia, and intentions to leave the current organization and profession were assessed (**Table 4**). The majority of participants ( $n = 277$ , 86.9%) reported experiencing job stress, while 12.8% reported feeling little to no stress in their work environment. The most commonly cited sources of work pressure were promotion (55.7%), scientific research demands (52.5%), and work hours/intensity (39.9%). Other reported stress factors included occupational risk (36.2%), job prospects (27.4%), and academic or further education opportunities (24.8%); 12.3% reported miscellaneous reasons. Additionally, 5.7% of respondents found communication with patients and their families to be psychologically stressful (**Figure 2**).

Moreover, over 60% of participants expressed a positive outlook on the future of the anesthesia profession and reported satisfaction with their current positions, indicating no desire to leave. However, 74 (23.2%) participants showed a high intent to leave, 102 (32.0%) had a mod-

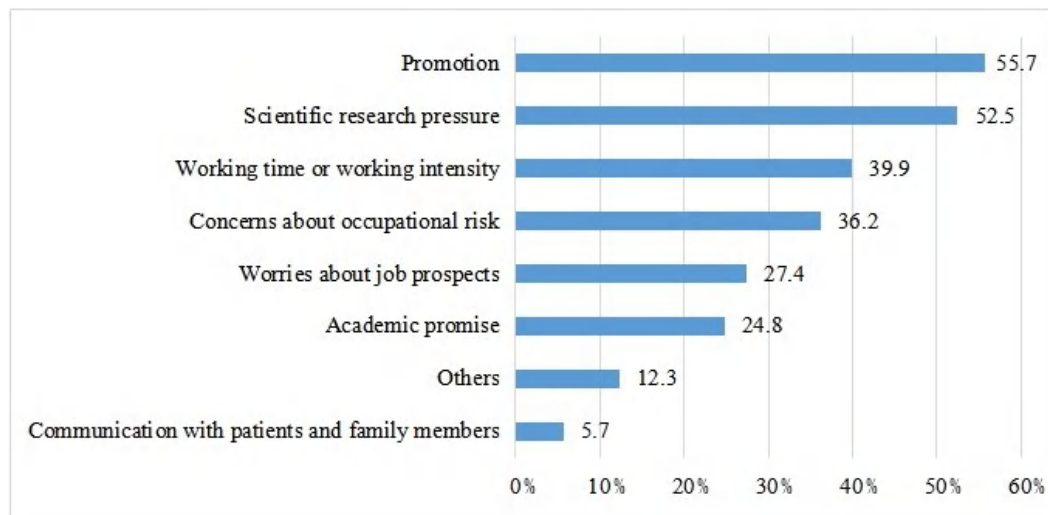


Figure 2. Main reasons for work pressure.

erate intent, and 142 (44.6%) had a low intent to leave. Further analysis revealed that participants who perceived the anesthesia profession as having poor prospects were more likely to consider leaving their current profession or organization and reported lower satisfaction levels. The primary reasons for this included limited educational opportunities, underutilization of personal talents, inadequate pay and benefits, and lack of promotion prospects.

#### **Multiple linear regression analysis of job satisfaction and associated factors**

Multiple linear regression was conducted to identify factors influencing job satisfaction. The analysis revealed that age, hours worked per day, income, current position, and work pressure were significantly associated with job satisfaction. However, other demographic factors—including gender, city level, length of graduation, hospital category, years working in the current workplace, and professional status—were not significantly associated.

The multivariate model showed that age was negatively associated with job satisfaction ( $-1.94$ ,  $p < 0.05$ , for participants aged 31–40 years, compared to the 20–30 age group). Participants working 8–10 hours per day had higher job satisfaction scores than those working 8 hours or less (4.102, 2.364, and 1.507,  $p < 0.05$  for general, intrinsic, and extrinsic satisfaction, respectively). Income was positively correlated with job satisfaction (8.868, 3.828, and 3.909,  $p < 0.05$ , for moderate income compared to low income, for general, intrinsic, and extrinsic satisfaction). Participants in anesthesia-related positions reported higher job satisfaction than those in primary care positions ( $-8.151$ ,  $-4.66$ ,

and  $-2.288$ ,  $p < 0.05$ , for general, intrinsic, and extrinsic satisfaction, respectively). The extrinsic job satisfaction of participants with lower work pressure was 2.056 points higher than those experiencing higher job stress ( $p < 0.05$ ). See Table 5.

#### **Discussion**

This study evaluated 318 anesthesia graduates across 30 provinces in China, focusing on job satisfaction, its determinants, work pressure, and turnover intentions. The results indicated that job satisfaction was associated with age, working hours, income, job position, and work pressure. Further analysis explored why certain independent variables were linked to job satisfaction. For instance, respondents working less than 8 hours per day and expressing dissatisfaction were further analyzed based on their MSQ scores to identify underlying causes. This analysis is crucial for developing targeted and effective interventions.

The general job satisfaction score of the surveyed anesthesiologists was  $75.85 \pm 12.57$  (of 100), with an average item score of  $3.79 \pm 1.03$  (of 5), indicating moderate to suboptimal satisfaction [2]. This score was lower than that of Chinese primary care providers (80.6 of 100) in 2020 and hospital staff in second-grade comprehensive hospitals ( $3.931 \pm 0.693$  of 5) in 2021, but closer to that of radiologic technologists in Saudi Arabia (3.77 of 5) in 2022 [23–25]. In contrast, it was higher than scores from Chinese physicians in tertiary public hospitals ( $70.31 \pm 12.67$ ) in 2019, anesthesiologists in the Beijing-Tianjin-Hebei region ( $65.3 \pm 11.5$ ), and Chinese psychiatrists and psychiatric nurses ( $71.6 \pm 14.3$  and  $73.7$ , respectively) in 2017

**Table 5. Multiple linear regression analysis of factors associated with general, intrinsic, and extrinsic job satisfaction**

| Variables                                     | General Unstandardized Coefficients | Intrinsic Unstandardized Coefficients | Extrinsic Unstandardized Coefficients |
|-----------------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|
| Women (ref. women)                            | 1.113                               | 0.684                                 | 0.148                                 |
| Age (ref. 20–30)                              |                                     |                                       |                                       |
| 31–40                                         | -4.414                              | -1.944                                | -1.94*                                |
| >40                                           | -6.214*                             | -3.183                                | -2.268*                               |
| Graduate (ref. bachelor)                      | 0.204                               | 0.206                                 | 0.024                                 |
| Underdeveloped cities (ref. Developed cities) | 1.408                               | 0.897                                 | 0.375                                 |
| Length of graduation (ref. 1–10)              |                                     |                                       |                                       |
| 11–20                                         | 1.058                               | 1.059                                 | -0.047                                |
| >20                                           | -0.994                              | -0.584                                | -0.143                                |
| Working hours per day (ref. <8)               |                                     |                                       |                                       |
| 8–10                                          | 4.102*                              | 2.364*                                | 1.507*                                |
| >10                                           | 3.638*                              | 1.404                                 | 1.837*                                |
| Income (ref. Low)                             |                                     |                                       |                                       |
| Moderate                                      | 8.868*                              | 3.828*                                | 3.909*                                |
| High                                          | 21.018*                             | 9.672*                                | 8.828*                                |
| Current position (ref. Anesthesia-related)    |                                     |                                       |                                       |
| Other departments                             | 1.59                                | 0.405                                 | 1.197                                 |
| Primary care position                         | -8.151*                             | -4.66*                                | -2.288*                               |
| Others                                        | 1.086                               | 1.269                                 | -0.319                                |
| Hospital category (ref. Tertiary hospitals)   |                                     |                                       |                                       |
| Secondary hospitals                           | -3.456                              | -1.873                                | -1.145                                |
| Primary healthcare institutions               | -1.777                              | 0.37                                  | -1.568                                |
| Non-medical institutions                      | 2.059                               | 0.476                                 | 1.466                                 |
| Working years in current workplace (ref. <3)  |                                     |                                       |                                       |
| 3–5                                           | 2.598                               | 1.749                                 | 0.49                                  |
| 6–10                                          | 2.838                               | 1.601                                 | 0.743                                 |
| >10                                           | 2.774                               | 1.533                                 | 0.55                                  |
| Professional status (ref. Primary)            |                                     |                                       |                                       |
| Intermediate                                  | -0.064                              | -0.391                                | 0.327                                 |
| Senior                                        | 2.832                               | 1.428                                 | 1.091                                 |
| Work pressure (ref. Overload)                 |                                     |                                       |                                       |
| Frequently high                               | -1.39                               | -2.018                                | 0.613                                 |
| Occasionally high                             | -0.697                              | -1.403                                | 0.729                                 |
| Less pressure                                 | 2.622                               | 0.042                                 | 2.056*                                |
| Easy without pressure                         | 1.915                               | 0.29                                  | 1.984                                 |

Note: \*p &lt; 0.05.

[2, 19, 21, 26]. Since 2015, no new literature has emerged regarding job satisfaction among Chinese anesthesiologists. However, during this period, the Chinese government has introduced several policies aimed at strengthening anesthesiologists' training, which has led to increased attention to their professional development and, consequently, improved job satisfaction. Given the anticipated shortage of anesthesiologists by 2030 and ongoing challenges in their career development, our study offers targeted insights into the factors influencing current job satisfaction and proposes action-

able strategies for continued improvement.

Per the results of this study, individuals aged 20–30 years exhibited the highest levels of job dissatisfaction, with job satisfaction increasing with age. Younger respondents reported the lowest levels of overall, intrinsic, and extrinsic job satisfaction. Further analysis of the MSQ scores revealed that the top three reasons for dissatisfaction were limited opportunities for further education, insufficient payoffs and compensation benefits, and underutilization of personal talents. A similar survey of French

anesthesiologists found that junior anesthesiologists reported higher job dissatisfaction than their senior counterparts [27]. Our study also found that respondents aged 20–30 years, with limited educational opportunities, were the least satisfied, scoring an average of only 2.73. This suggests that additional educational opportunities are particularly significant for individuals in this age group.

In China, postgraduate training for medical undergraduates primarily involves residency training, continuing education, advanced studies, and higher degrees [28]. Young doctors—especially those in primary healthcare positions or as junior hospital staff—are highly motivated to continue professional learning and skills development. Over the past decade, China has made significant progress in training primary care physicians [29]. However, many primary healthcare workers express dissatisfaction with certain aspects of the training, especially the limited opportunities and the relevance of training materials to their work [30]. A survey conducted between 2013 and 2016 on anesthesiology residency training highlighted that clinical expertise, skills training, and residency experiences were viewed by most respondents as crucial for developing independent practitioners [31].

In 2020, the National Health Commission issued a notice outlining objectives, goals, methods, content, and requirements for anesthesiologists' training. In 2021, military departments released residency training guidelines to enhance first aid, diagnosis, and treatment capabilities for newly graduated medical students. Currently, academic groups are actively promoting diverse professional training programs, and in the future, anesthesiologists will have the opportunity to select relevant programs suited to their roles. Training options, including online, offline, and virtual reality alternatives, allow doctors to receive direct training without leaving their work environments.

Notably, daily working hours is an important factor. Our survey revealed that respondents working <8 hours per day reported the lowest job satisfaction, which contrasts with findings from previous studies [32–34]. Additional analysis indicated that for participants working <8 hours, the main reasons for dissatisfaction were limited educational opportunities, payoffs and compensation benefits, and underutilization of personal talents. In contrast, for participants working >10 hours, the primary factors influencing dissatisfaction were work intensity, effort-to-reward ratio, pay, and limited opportu-

nities for further education.

To enhance job satisfaction among those working less than 8 hours, it is essential to offer more opportunities for personal growth and incentives. For those working more than 10 hours, special attention is required. Historically, doctors in China have had a heavier workload compared to their international counterparts, with reports of sudden deaths due to overwork. Anesthesiologists often experience unpredictable and irregular working hours, limiting their control over personal lives [35]. Additionally, according to data from the 2015–2020 China Statistical Yearbook, hospital admissions increased by 22.65 million across all levels, with an annual growth rate of 11.32% for anesthesia cases between 2015 and 2017 [36]. In contrast, the number of anesthesiologists increased by only 5.97% [37]. As the number of patients and operating tables rises annually, anesthesiologists are facing an increasing workload. This, coupled with long-term overwork, weekend shifts, and high-risk patients, puts them under significant pressure [38].

Future efforts should focus on reducing working hours for anesthesiologists. One potential solution is expanding the undergraduate anesthesiology program to attract more clinical graduates into the field. However, low career attractiveness has limited the effectiveness of this approach. Therefore, efforts should focus on enhancing the appeal of anesthesiology as a career. Government departments recognize the high work intensity and long overtime hours of Chinese anesthesiologists, which further underlines the need for strategic solutions. Training anesthesia assistants is a crucial strategy to alleviate clinical pressures. In countries such as the United States, the United Kingdom, Germany, Australia, and Belgium, a significant number of anesthesia assistants work under the supervision of anesthesiologists [39]. These assistants play an essential role in supporting anesthesiologists. In 2019, the Guidelines for the Capacity Building of Anesthesiology Medical Services were established, recommending that medical institutions improve teamwork within the anesthesia department by ensuring an adequate number of nurses, technicians, and anesthesiologists [40]. Collaboration with assistants helps anesthesiologists reduce their workload, mitigate work-related stress, prevent burnout, and improve the quality of their work.

Work pressure is another key factor influencing job satisfaction. Respondents identified promotion prospects, research pressure, and work intensity as the primary stressors. Government

departments must continue to focus on maintaining anesthesiologists' engagement and improving the attractiveness of anesthesiology. A 2021 guideline on the reform of professional titles for health professionals indicated that papers, scientific research projects, awards, and overseas experience would no longer be required for applications. It was recommended that the specific nature of anesthesiologists' work and the value of technical services be fully considered in performance evaluations, job assignments, and income distribution. Although the standard has improved, it has not undergone fundamental changes.

Respondents working in tertiary hospitals face both scientific research and clinical pressures. They are motivated to conduct research not only out of interest but also due to promotional pressures. The survey revealed that 26 respondents were overworked and stressed, 16 (61.5%) of whom worked in tertiary hospitals. In these hospitals, anesthesiologists often conduct most of their scientific research and teaching work during personal rest time, making their actual working hours significantly higher than what is reported in the questionnaire.

Income is another important factor. In this study, high personal income was positively associated with high job satisfaction; low-income respondents expressed the highest levels of dissatisfaction, primarily due to inadequate benefits, limited further education opportunities, and insufficient payoffs and compensation. A survey of anesthesiologists in the United States, Austria, and Switzerland found income to be one of the most important factors influencing job satisfaction [41, 42]. According to Forbes magazine, anesthesiologists were ranked first among the top 25 highest-paying occupations worldwide in 2021, earning an average of \$184,340 [43]. In contrast, anesthesiologists in the Beijing-Tianjin-Hebei region of China earn less than \$1,500 per month or under \$18,000 per year [2]. Additionally, anesthesiologists in China earn less than their counterparts in oncology, general internal medicine, cardiology, endocrinology, and neurosurgery [44]. During the perioperative period, anesthesiologists must monitor and diagnose changes in patients' vital signs to ensure the latter's safety. However, the technical value of anesthesiologists' in the medical work processes is not reflected in the current income distribution mode. Notably, in 2021, the guiding opinions on deepening the reform of the salary system in public hospitals emphasized that, knowledge, technology, management, and other elements should be included in the distribution model according to medical professionals'

contributions. Future salary reforms should aim to better reflect the technical value of medical personnel.

Anesthesiology graduates work in various roles and report differing levels of job satisfaction. However, compared to physicians in other departments, anesthesiologists generally report lower job satisfaction, which contributes to anesthesiology's relatively low career attractiveness. Efforts should be directed toward improving the appeal of the anesthesiology career and enhancing job satisfaction among anesthesiologists. Positions related to anesthesia exhibit the highest job satisfaction levels. On the other hand, low job satisfaction among primary care physicians in China is primarily due to limited opportunities for training, promotion, and utilization of their personal talents, compared to their counterparts in large public hospitals. Most primary care physicians are unable to showcase their professional abilities in their work environments. In daily practice, they encounter few complex cases, mostly mild diseases, outdated medical equipment, and limited opportunities for clinical operations or further education in higher-level hospitals. Respondents working in primary healthcare institutions reported dissatisfaction with their career advancement, development, and promotion prospects. This could be due to an inflated ratio of professional titles within the organization. Currently, China is promoting the establishment of medical consortiums to integrate medical resources within regions [45]. A medical consortium typically includes tertiary and secondary hospitals, as well as community and rural healthcare facilities [46]. By fostering a sense of belonging and promoting community among physicians, medical consortiums can enhance business exchanges, clinical collaboration, and technical communication between senior and junior staff [22].

This study has several limitations. First, although the participants represented 53.4% of all anesthesiology graduates, the absolute number of respondents was insufficient. Future studies should recruit a larger sample of anesthesiology graduates. Additionally, the cross-sectional design of this study limited the scope of the data collected. China is currently undergoing policy reforms that will likely improve anesthesiologists' job satisfaction. Therefore, future research should continue to monitor changes in job satisfaction, burnout, stress, professional commitment, and quality of patient care.

## Conclusion

In conclusion, this large-scale survey of anesthesia graduates across 30 provinces and cities in China found that they exhibit high levels of job satisfaction, as measured by the MSQ. Improving job satisfaction among medical personnel requires the collaborative efforts of the government, society, medical institutions, and other stakeholders. The long-term development of healthcare can only be achieved through the collective concern and support of society.

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# Importance of integrating ideological and political education into anesthesiology training

Zhenghuan Song<sup>1,2\*</sup>, Miao Zhou<sup>1\*</sup>, Tingting Bao<sup>1</sup>, Zhu Yu<sup>1</sup>, Yihu Zhou<sup>1</sup>, Mengling Huwang<sup>3</sup>, Qinyu Bao<sup>2</sup>, Tongyan Liu<sup>3</sup>, Jing Tan<sup>1,2</sup>

<sup>1</sup>Department of Anesthesiology, Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research & The Affiliated Cancer Hospital of Nanjing Medical University, Nanjing 210009, Jiangsu Province, China. <sup>2</sup>Jiangsu Province Key Laboratory of Anesthesiology, Xuzhou Medical University, Xuzhou 221004, Jiangsu Province, China. <sup>3</sup>Department of Thoracic Surgery, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, the Affiliated Cancer Hospital of Nanjing Medical University, Jiangsu Key Laboratory of Molecular and Translational Cancer Research, Collaborative Innovation Center for Cancer Personalized Medicine, Nanjing 210009, Jiangsu Province, China. <sup>4</sup>Department of Clinical Medicine, Bengbu Medical University, Bengbu 233030, Anhui Province, China.

\*The authors contribute equally.

**Corresponding authors:** Jing Tan and Tongyan Liu.

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## Highlights

- Integrating ideological and political education into anesthesiology residency training enhances doctor-patient communication and humanistic care.
- Residents in the combined training model demonstrated improved professional competence and clinical skills compared to those in the traditional training model.
- Patient satisfaction was significantly higher in the observation group that received additional ideological and political education.
- Mini-CEX and DOPS assessments can effectively measure the impact of the new teaching model on resident performance and patient interactions.

## Abstract

**Objective:** To evaluate the effectiveness of incorporating ideological and political education into anesthesiology residency training, using the Mini Clinical Evaluation Exercise combined with Direct Observation of Procedural Skills. **Methods:** Sixty resident physicians undergoing standardized training in the Anesthesiology Department of Jiangsu Cancer Hospital from December 2023 to June 2024 were randomly assigned to a control group and an observation group, with 30 residents in each. The control group received traditional clinical skill training, while the observation group received additional ideological and political education on the basis of control group. Both groups were evaluated using Mini Clinical Evaluation Exercise and Direct Observation of Procedural Skills. Patient satisfaction with the residents was rated anonymously, and student feedback on the training model was collected via a questionnaire. **Results:** The residents in the observation group demonstrated superior performance in doctor-patient communication, humanistic care, and professional competence compared to the control group ( $P < 0.05$ ). Patient satisfaction scores were also higher in the observation group ( $P < 0.05$ ). **Conclusion:** Integrating ideological and political education into standardized anesthesiology residency training can significantly enhance residents' communication skills, humanistic care, and professional competence, leading to higher patient satisfaction.

**Keywords:** Ideological and political education, standardized residency training, mini-clinical evaluation exercise, clinical skills, direct observation of procedural skills, teaching

**Address correspondence to:** Jing Tan, Department of Anesthesiology, Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research & The Affiliated Cancer Hospital of Nanjing Medical University, No.42 Baiziting, Xuanwu District, Nanjing 210009, Jiangsu, China. Tel: +86-025-8328465, E-mail: tanjing@njmu.edu.cn. **Tongyan Liu**, Department of Thoracic Surgery, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, the Affiliated Cancer Hospital of Nanjing Medical University, Jiangsu Key Laboratory of Molecular and Translational Cancer Research, Collaborative Innovation Center for Cancer Personalized Medicine, Nanjing 210009, Jiangsu Province, China. E-mail: liutongyan@njmu.edu.cn



## Introduction

Since the Ministry of Education released the Guidelines for Ideological and Political Education in Higher Education Curriculum in May 2020, integrating ideological and political education into university courses has become a crucial initiative for improving talent cultivation and achieving the “Three-Wide Education” goal [1, 2]. In medical education, it is insufficient for students to merely acquire clinical skills; they must also cultivate strong ethics and social responsibility. This is particularly critical in anesthesiology residency training, where both technical proficiency and humanistic care are paramount. Anesthesiology residents must master complex procedures, such as tracheal intubation and arterial and venous catheterization. However, surgical patients often endure emotional distress and physical pain due to illness and financial pressures, which can lead to feelings of hopelessness and even resistance to treatment. These challenges heighten expectations for anesthesiologists, who must not only demonstrate strong procedural skills but also effectively communicate, provide emotional support, and make sound ethical decisions.

Integrating ideological and political education into clinical skill training offers a way to enhance anesthesiology residents’ professional competence, moral integrity, and humanistic care [3]. This approach addresses the unique challenges faced by surgical patients by fostering a deeper awareness of humanistic care and social responsibility among residents, enabling them to better meet patients’ emotional and physical needs. Embedding ideological and political concepts into the entire clinical teaching process has become a vital and unavoidable focus of current educational reform [4, 5]. Despite its importance, research on the specific effects of integrating ideological and political education into procedural skill training in anesthesiology remains limited. Previous studies have shown that under the “New Medicine” framework, constructing an ideological and political system for anesthesiology graduate courses based on the Outcome-Based Education concept improves students’ clinical practice ability, enhances assessment outcomes, and increases satisfaction with graduate teaching [6]. To fully implement the “Three-Wide Education” concept, prioritizing moral education is essential. It is necessary to continuously explore the internal connection between anesthesiology and curriculum ideology and politics. By identifying the ideological and political elements within the “Anesthesiology” course and aligning them with students’ learning process-

es, educators can organically integrate these elements with professional training, thereby improving teaching efficiency and cultivating high-quality medical talent [7].

This study enrolled 60 resident physicians undergoing standardized training in the Department of Anesthesiology at Nanjing Medical University Affiliated Cancer Hospital between December 2023 and August 2024. It investigated the incorporation of ideological and political education into clinical procedural training, assessing its effectiveness with the Mini Clinical Evaluation Exercise (Mini-CEX) and Direct Observation of Procedural Skills (DOPS) systems. By combining ideological and political education with clinical skill training, the study aims to cultivate medical professionals with both exemplary moral integrity and advanced clinical skills, providing valuable insights for advancing educational practices.

## Materials and methods

### *Ethics statement*

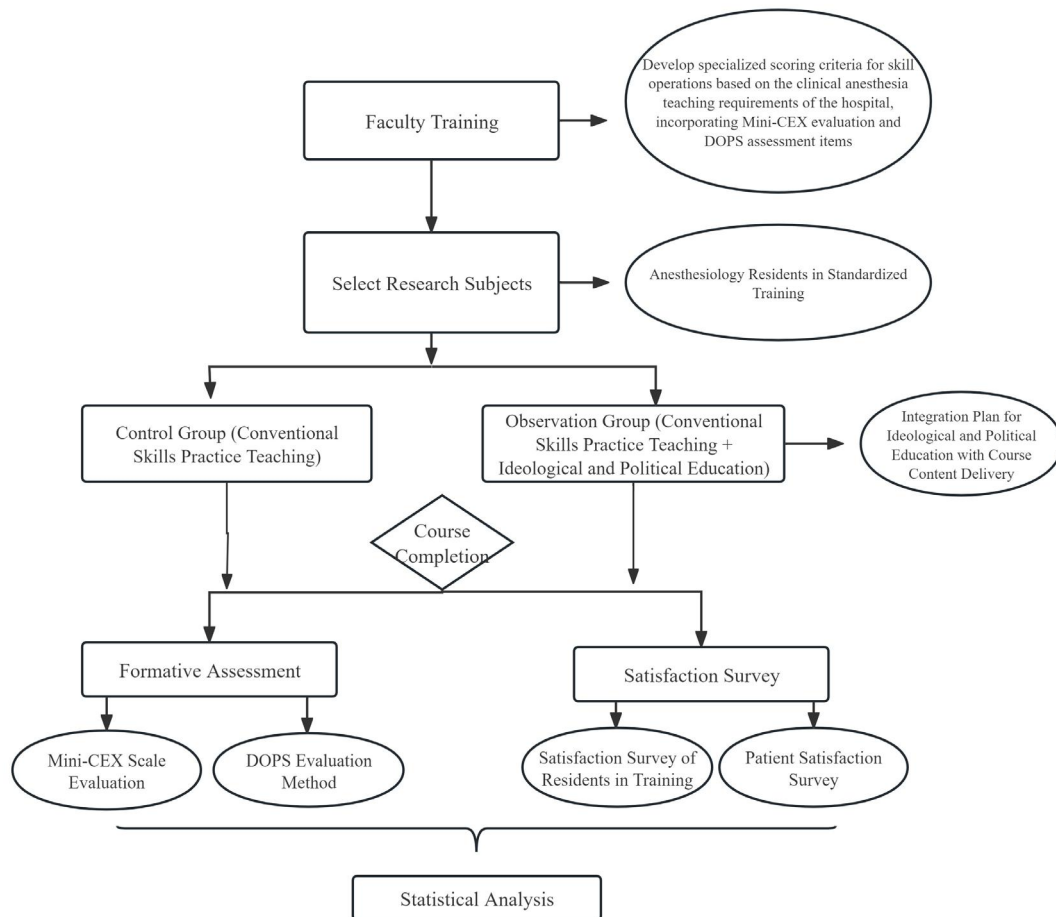
All the participants provided informed consent prior to participating in the study. The ethics approval was obtained from the Institutional Review Board at Jiangsu Cancer Hospital.

### *Preparatory work*

To ensure the effective implementation of the Mini-CEX and DOPS evaluations, specialized training was provided to the teaching staff. The research team developed tailored scoring criteria for procedural skills, aligning with the hospital’s clinical anesthesiology teaching requirements and the evaluation standards of the Mini-CEX and DOPS systems. Training sessions, including lectures and simulated teaching, were conducted to ensure that each instructor fully understood the methodology and steps involved in Mini-CEX and DOPS assessments. Furthermore, instructors were thoroughly familiarized with and required to internalize the specific scoring details for each evaluation criterion, ensuring consistency and reliability in the assessment outcomes.

### *Teaching process*

In developing the curriculum for standardized residency training in procedural skills, our research team incorporated four routine clinical procedures: arterial puncture, nerve block, central venous catheterization, and lumbar puncture. During the two-month training period, the control group received standard skills practice



**Figure 1. The flowchart of the process.** Mini-CEX, mini clinical evaluation exercise; DOPS, direct observation of procedural skills.

and was evaluated at the end of each month using the Mini-CEX and DOPS assessments. The observation group received the same standard skills practice with additional ideological and political education throughout the teaching process. Instructors in the observation group integrated elements of medical ethics into procedural skills training through consistent and timely interactions with students. Key values such as respect for life, dedication to science, commitment to medicine, and compassion for patients were woven into the technical instruction. By adopting patient-centered practices, including explaining the purpose of each procedure to patients, monitoring and responding to patients' reactions, and demonstrating genuine care, instructors subtly influenced students' attitudes and behaviors. Throughout the training, instructors reinforced the importance of precision, meticulousness, and standardized techniques, while also instilling the value of patient care and respect for life. The detailed flow of the teaching process is illustrated in **Figure 1**.

### **Observation indicators**

#### *Formative assessment*

During the standardized training, residents selected patients requiring one of the following procedures: arterial puncture, central venous catheterization, nerve block, or lumbar puncture from those they were responsible for anesthetizing. After fully informing and obtaining consent from both the patients and their families, the procedural steps were incorporated into the assessment. Evaluators accompanied the residents throughout the procedure and provided on-site scoring and feedback, utilizing a modified Mini-CEX combined with the DOPS assessment system.

#### *Mini-CEX*

The Mini-CEX is a micro-multi-focus evaluation method known for its feasibility, reliability and efficiency. It is well-suited for daily clinical settings such as outpatient and inpatient wards. Implementing the Mini-CEX in clinical teaching enhances practical learning opportunities in bedside teaching and improves students' overall clinical abilities [8, 9]. This assessment includes ten scoring criteria: preoperative consultation, anesthetic planning, preoperative preparation, anesthetic procedure execution,

intraoperative management, communication skills, professionalism and confidence, responsiveness to instructions and accountability, overall clinical competence, and patient satisfaction.

#### *DOPS evaluation*

The DOPS assessment is an effective tool for teaching and evaluating anesthesia-related operation skills. It has been shown to enhance students' competency in anesthesia operations [10]. The DOPS assessment includes ten specific criteria, covering understanding of anesthetic procedure indications, knowledge of anatomy and techniques, obtaining preoperative informed consent, procedural preparation, adherence to aseptic practices, compliance with anesthetic protocols, appropriate escalation to senior physicians, professionalism in patient care, delivery of humanistic care, and an overall evaluation.

Both the Mini-CEX and DOPS employ a streamlined 9-point scoring system, with each criterion rated from 1 to 9. The maximum score for both evaluations is 90 points. The scoring criteria were tailored to reflect the specific attributes of each invasive procedure, ensuring a fair and relevant assessment. Each assessment session lasted 15-20 minutes, allowing sufficient time for observation of resident performance and feedback delivery. They specifically highlighted areas of excellence with positive remarks while also identifying aspects that require improvement. This approach ensures that residents receive clear, actionable insights into their clinical strengths and areas for development. The streamlined evaluation process is designed to minimize redundant assessments and comments while maximizing learning opportunities.

The combination of Mini-CEX and DOPS can improve the theoretical knowledge and clinical procedural skills of anesthesiology residents, increase teaching satisfaction among both students and educators, and enhance the overall quality of clinical anesthesia education. This evaluation model is particularly well-suited for application in the anesthesiology department, offering a robust framework for developing high-quality medical professionals [11].

#### *Residents' satisfaction survey*

A structured questionnaire was developed to evaluate the effectiveness of the training model from the residents' perspective. Responses were scored on a scale of 0 to 100 points, with higher scores indicating greater satisfaction

with the training experience.

#### *Patients' satisfaction survey*

Patient satisfaction was assessed immediately following the completion of invasive procedures. Surveys were administered in the absence of the evaluated residents to ensure unbiased responses. The survey measured patients' perceptions of the physicians' diagnostic and treatment processes, with a maximum score of 100 points.

#### *Statistical analysis*

All statistical analyses were conducted using SPSS version 19.0 software. Continuous data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), and comparisons between groups were conducted using the t-test. Categorical data were represented as proportions, with inter-group comparisons performed using the chi-square ( $\chi^2$ ) test. A p-value of less than 0.05 was considered statistically significant.

#### *Results*

A total of 60 anesthesiology master's students undergoing standardized residency training in the Department of Anesthesiology at Jiangsu Cancer Hospital were enrolled in this study. The participants were randomly assigned into a control group and an observation group, with 30 students in each group, using a random number method. In the observation group, there were 24 male and 18 female students, with an average age of ( $21.49 \pm 0.23$ ) years (ranging from 22-24). In the control group, there were 26 male and 16 female students, with an average age of ( $21.38 \pm 0.35$ ) years (ranging from 20-22). The gender and age distributions between the two groups were comparable, with no statistically significant differences ( $P > 0.05$ ).

#### *Comparison of Mini-CEX scores*

The evaluation scores for intraoperative management, communication skills, responsiveness to instructions and accountability, integrity and confidence, overall clinical competence, and overall satisfaction in the observation group were significantly higher than those in the control group (all  $P < 0.05$ ) (Table 1).

#### *Comparison of DOPS evaluation scores between groups*

The observation group also outperformed the control group in the DOPS assessment, with significantly higher scores in obtaining informed

**Table 1. Mini-CEX scale (Score, Mean  $\pm$  Standard Deviation)**

| Evaluation Content                                   | Control Group<br>(n=30) | Observation Group<br>(n=30) | t     | P       |
|------------------------------------------------------|-------------------------|-----------------------------|-------|---------|
| Preoperative Visit                                   | 7.60 $\pm$ 0.56         | 7.80 $\pm$ 0.55             | 1.390 | 0.170   |
| Anesthesia Plan Formulation                          | 7.73 $\pm$ 0.69         | 7.97 $\pm$ 0.62             | 1.381 | 0.173   |
| Preoperative Preparation                             | 7.70 $\pm$ 0.49         | 7.83 $\pm$ 0.51             | 1.034 | 0.305   |
| Anesthesia Procedure                                 | 7.83 $\pm$ 0.64         | 7.93 $\pm$ 0.64             | 0.602 | 0.549   |
| Intraoperative Management                            | 7.47 $\pm$ 0.63         | 8.03 $\pm$ 0.56             | 3.698 | 0.005 * |
| Communication Skills                                 | 7.27 $\pm$ 0.70         | 7.73 $\pm$ 0.58             | 2.825 | 0.007 * |
| Response to Instructions and Sense of Responsibility | 7.13 $\pm$ 0.68         | 7.73 $\pm$ 0.52             | 3.832 | 0.003 * |
| Integrity and Confidence                             | 7.37 $\pm$ 0.61         | 7.93 $\pm$ 0.58             | 3.662 | 0.005 * |
| Overall Clinical Competence                          | 7.37 $\pm$ 0.56         | 7.73 $\pm$ 0.45             | 2.808 | 0.007 * |
| Overall Satisfaction                                 | 7.40 $\pm$ 0.50         | 7.77 $\pm$ 0.50             | 2.834 | 0.006 * |

Note: \*P<0.05 compared to control group.

consent from patients or their families, professionalism and patient management, ability to correctly and promptly seek assistance from senior physicians, humanistic care, and overall assessment (all P<0.05) (**Table 2**).

#### **Comparison of student satisfaction with teaching models**

The satisfaction score of residency physicians in the observation group regarding the teaching model was 92.83 $\pm$ 2.18, significantly higher than 87.43 $\pm$ 2.70 in the control group (P<0.05) (**Table 3**).

#### **Comparison of patient satisfaction between two groups**

The patient satisfaction with the physician's diagnostic and treatment process in the observation group was 92.97 $\pm$ 2.15, notably higher than 87.23 $\pm$ 2.91 of the control group (P<0.05) (**Table 3**).

### **Discussion**

#### **The role of ideological and political education in anesthesiology courses**

The clinical skill training curriculum in anesthesiology covers a wide range of teaching content and knowledge points. As a high-risk, high-stress, and highly practical discipline, anesthesiologists must be equipped with not only advanced technical proficiency but also exceptional professional integrity. With the expanding role of anesthesiology in medical services and patient safety, the ethical expectations for resident anesthesiologists continue to rise. Ideological and political education (IPE) is a funda-

mental component in modern higher education. Its primary objective is to transform course knowledge into core values and personal qualities, ultimately improving the overall quality of education and talent development [12, 13]. IPE plays a vital role in medical education, particularly in anesthesiology, where strengthening IPE is essential for achieving training goals and advancing the quality of talent cultivation. Standardized anesthesiology training program should comprehensively integrate IPE resources to improve teaching quality across objectives, methods, content, and evaluation [14]. This integration fosters a holistic approach to education that combines knowledge transmission and character development. The ultimate goal is to cultivate anesthesiologists with both high moral and professional standards, aligned with the mission of standardized residency training in anesthesiology.

#### **Integration of IPE and teaching evaluation**

Traditional clinical skills assessment often face limitations in format and feedback quality, particularly in evaluating humanistic aspects of medicine such as doctor-patient communication and professional integrity. An effective evaluation system for IPE is essential, as the absence of assessment and feedback impedes timely teaching improvements [15, 16]. The Mini-CEX and DOPS are flexible and rapid assessment tools that incorporate humanistic medicine elements, including medical ethics, communication skills, and professional integrity. These tools provide scientifically grounded evaluations, facilitating clinical training through feedback-driven exercises that swiftly improve clinical skills. This teaching model effectively merges problem-based learning with practice

**Table 2. DOPS evaluation method (Score, Mean  $\pm$  Standard Deviation)**

| Evaluation Content                                       | Control Group (n=30) | Observation Group(n=30) | t     | P       |
|----------------------------------------------------------|----------------------|-------------------------|-------|---------|
| Mastery of Anesthesia Indications                        | 7.63 $\pm$ 0.56      | 7.87 $\pm$ 0.63         | 1.603 | 0.114   |
| Understanding of Anatomy and Procedural Technique        | 7.77 $\pm$ 0.63      | 7.80 $\pm$ 0.61         | 0.209 | 0.835   |
| Informed Consent with Patient or Family Pre-operatively  | 7.43 $\pm$ 0.77      | 8.13 $\pm$ 0.51         | 4.143 | 0.001 * |
| Procedure Preparation                                    | 7.80 $\pm$ 0.55      | 7.73 $\pm$ 0.53         | 0.481 | 0.631   |
| Aseptic Technique                                        | 7.77 $\pm$ 0.50      | 7.80 $\pm$ 0.55         | 0.245 | 0.808   |
| Compliance with Standards in Anesthesia Procedures       | 7.77 $\pm$ 0.43      | 7.90 $\pm$ 0.55         | 1.049 | 0.299   |
| Ability to Seek Timely Assistance from Senior Physicians | 7.40 $\pm$ 0.62      | 7.87 $\pm$ 0.57         | 3.028 | 0.003 * |
| Professional Competence and Patient Management           | 7.53 $\pm$ 0.63      | 8.03 $\pm$ 0.61         | 3.114 | 0.003 * |
| Humanistic Care                                          | 7.43 $\pm$ 0.68      | 7.93 $\pm$ 0.58         | 3.060 | 0.003 * |
| Comprehensive Evaluation                                 | 7.57 $\pm$ 0.50      | 7.93 $\pm$ 0.52         | 2.771 | 0.008 * |

Note: \*P<0.05 compared to control group.

**Table 3. Satisfaction scores of residents on incorporating ideological and political education into training (Score, Mean  $\pm$  Standard Deviation)**

|                      | Control Group (n=30) | Observation Group (n=30) | t       | P     |
|----------------------|----------------------|--------------------------|---------|-------|
| Student Satisfaction | 87.63 $\pm$ 2.53     | 92.83 $\pm$ 2.18         | t=9.035 | <0.01 |
| Patient Satisfaction | 87.03 $\pm$ 2.97     | 93.19 $\pm$ 1.99         | t=9.591 | <0.01 |

content [17-19]. The combined use of Mini-CEX and DOPS offers distinct advantages by closely simulating real clinical scenarios. This approach not only provides a comprehensive evaluation of students' technical proficiency but also assesses professional integrity, empathy, and communication abilities [20]. Previous studies have explored the integration of IPE throughout the entire teaching and training process of Traditional Chinese Medicine clinical skill courses, offering valuable insights for the reform of IPE in Traditional Chinese Medicine clinical training [21]. Furthermore, research from a moral development perspective in clinical medicine curricula, such as oral sciences, indicates that ideological and political guidance helps shape proper values and contributes to the cultivation of well-rounded medical professionals [22].

In this study, the evaluation using the Mini-CEX and DOPS showed that the observation group significantly outperformed the control group in critical areas, including obtaining informed consent, appropriately consulting senior physicians, demonstrating professional competence, managing patient care, showing empathy, and overall assessment. Students who received IPE showed superior performance in intraoperative management, communication skills, responsiveness to instructions, responsibility, integrity, confidence, clinical competence, and overall

satisfaction. These findings indicate that a comprehensive evaluation system not only provides a fair and thorough assessment of professional skills but also enhances self-directed learning, ultimately helping students master anesthesiology more effectively. IPE guidance offers anesthesiology students a profound understanding of the responsibilities and obligations underlying technical procedures. This guidance increases students' respect for the anesthesiology profession and fosters a genuine understanding and acceptance of its ethical imperatives. Consequently, students become more cautious and attentive in their practice, recognizing the significant impact of their actions on patients' lives. Cultivating this sense of responsibility is crucial in promoting professional integrity, preparing students to undertake anesthesiology work with greater accountability [23].

#### ***The role of IPE in enhancing humanistic care and patient satisfaction***

The results demonstrate that incorporating IPE elements into residency training significantly improved patient satisfaction during clinical invasive procedures. This highlights the value of integrating IPE into residency training in procedural skills. IPE encourages students to prioritize patient rights and safety, promoting respect

for patient privacy and dignity. Humanistic care goes beyond physical health, addressing patients' psychological and emotional well-beings. Surgical patients often experience anxiety and fear, and empathy and support from medical staff are critical. IPE guides students to attend to patients' mental health by providing verbal and behavioral encouragement, recognizing patient needs, and delivering timely care.

### ***Improved teaching satisfaction and increased student engagement***

This study also found that students in the observation group reported significantly higher satisfaction with the teaching process compared to the control group. This increased satisfaction may stem from IPE's ability to help students recognize that medical education involves not only technical instruction but also cultivating social responsibility and values [24]. Through IPE, students may gain a deeper understanding of their professional responsibilities, leading to enhanced engagement and a stronger sense of purpose in their educational journey. Integrating IPE into anesthesiology clinical skills teaching encourages instructors to adopt diverse and student-centered teaching methods. This innovative teaching methods can further boost students' interest, promote active participation, and enhance their sense of accomplishment, ultimately improving their satisfaction with the teaching process.

### ***Improvements and future prospects for the IPE evaluation system***

While this study demonstrated the effectiveness of integrating IPE in anesthesiology education, several limitations highlight areas for further refinement. While the Mini-CEX and DOPS evaluation systems were effective in assessing clinical skills, potential subjectivity and limitations in fully capturing the breadth of students' capabilities remain concerns. Developing a more detailed and tailored set of assessment indicators specifically for anesthesiology could enhance the scientific validity and reliability of the evaluation process. Additionally, applying IPE in anesthesiology education must keep pace with advances in medical technology and evolving healthcare needs. Achieving this requires regular updates to teaching content, enhanced faculty training, robust feedback mechanisms, and strengthened interdisciplinary collaboration. These enhancements will contribute to a more comprehensive and effective anesthesiology education framework.

### **Conclusion**

This study validated the effectiveness of IPE in standardized residency training for anesthesiology, especially through the application of the Mini-CEX and DOPS evaluation systems. The results demonstrate the significant value of IPE in enhancing students' clinical competencies and professional ethics. This provides an important reference for future improvements in teaching anesthesiology skills and lays the foundation for broader IPE integration in medical education. As teaching practices continue to evolve, the comprehensive integration of IPE will help cultivate anesthesiologists with both high-level professional skills and exemplary medical ethics, providing robust talent support for the sustainable development of healthcare.

**Author contributions:** Zhenghuan Song, Jing Tan, and Tongyan Liu conceived and designed the study; Miao Zhou, Tingting Bao, Zhu Yu, Yihu Zhou, Mengling Huwang, Qinyu Bao performed experiments; Jing Tan, Miao Zhou contributed significantly to analysis and manuscript preparation; Zhenghuan Song, Jing Tan, Tongyan Liu performed the data analyses and wrote the manuscript; Miao Zhou, Tingting Bao helped perform the analysis with constructive discussions.

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# Efficacy of visual double-lumen bronchial catheter in teaching lung isolation

Minhao Zhang<sup>1</sup>, Halisa Paerhati<sup>2</sup>, Miao Zhou<sup>1</sup>, Jiahui Chen<sup>3</sup>, Zhiyan Wang<sup>4</sup>, Lianbing Gu<sup>1</sup>, Pengyi Li<sup>1</sup>

<sup>1</sup>Department of Anesthesiology, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, the Affiliated Cancer Hospital of Nanjing Medical University, Nanjing 210009, Jiangsu Province, China. <sup>2</sup>Department of Anesthesiology, the Affiliated Cancer Hospital of Nanjing Medical University, Jiangsu Cancer Hospital, Nanjing 210009, Jiangsu Province, China. <sup>3</sup>Affiliated Anesthesia College of Xuzhou Medical University, Xuzhou 221004, Jiangsu Province, China. <sup>4</sup>Department of Nursing, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, the Affiliated Cancer Hospital of Nanjing Medical University, Nanjing 210009, Jiangsu Province, China.

Corresponding author: Pengyi Li.

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## Highlights

- The study highlights the effective integration of visual double-lumen bronchial catheters in anesthesia residency training. It significantly shortens intubation time, enhances first-attempt success rates and surgeon satisfaction.
- This approach notably reduces post-intubation complications, including pharyngeal pain, hoarseness, and dry cough, leading to better patient outcomes and enhanced educational efficacy.

## Abstract

**Objective:** To assess the effectiveness of a visual double-lumen bronchial catheter in teaching lung isolation skills to anesthesia resident trainees. **Methods:** Between September 2023 and September 2024, 20 anesthesiology residents from Jiangsu Cancer Hospital were randomly divided into two groups: the visual double-lumen group (n=10) and the conventional double-lumen group (n=10). Randomization was achieved using a random number table. The study assessed several outcomes, including total intubation time, positioning time, one-time intubation success rate, intraoperative catheter displacement rate, surgeon satisfaction scores, and the incidence of postoperative complications (pharyngeal pain, hoarseness, and dry cough) within 24 hours. **Results:** The visual double-lumen group demonstrated superior results compared to the conventional double-lumen group in the following measures: total intubation time (70.2±11.8 s vs 224.9±35.6 s), positioning time (30.1±5.7s vs 176.6±26.4 s), one-time intubation success rate (85% vs 45%), intraoperative catheter displacement rate (10% vs 40%), surgeon's intubation satisfaction score (8.10±1.07 vs 6.90±1.41), satisfaction score for pulmonary isolation (8.35±1.04 vs 6.55±1.36), and airway management satisfaction score (8.40±1.3 vs 6.70±1.34). Additionally, the incidence of postoperative pharyngeal pain (15% vs 45%), hoarseness (10% vs 40%), and dry cough (5% vs 35%) was significantly lower in the visual double-lumen group (all P<0.05). **Conclusion:** The visual double-lumen bronchial catheter significantly enhances the training of anesthesia residents in lung isolation by reducing intubation and positioning times, improving intubation success rate, increasing surgeon satisfaction, and reducing intubation-related complications. This method offers a more effective teaching approach compared to conventional techniques.

**Keywords:** Visual double-lumen catheter, pulmonary isolation, educational techniques, teaching effect, standardized residency training

## Introduction

Tracheal intubation is essential for establishing an artificial airway to facilitate mechanical ventilation, meeting the demands of most clinical anesthesia and emergency scenarios. However,

the rhythmic expansion and contraction of lung tissue during respiration can compromise the surgical field and operating space. Consequently, procedures involving the lungs, esophagus, mediastinum, pleura, trachea, and other thoracic structures necessitate techniques that



collapse one lung while maintaining ventilation in the contralateral lung, a technique known as lung isolation.

The double-lumen bronchial tube is the most commonly used tool for lung isolation [1]. However, its relatively large diameter, precise positioning requirements, and operational complexity can lead to complications such as tooth loss, airway injury, cricoarytenoid joint dislocation, and glottic edema [2]. These risks are exacerbated due to the inexperience of resident physicians, which increases their psychological pressure and negatively impacts their learning efficiency. Clinically, positioning double-lumen bronchial tubes can be performed through auscultation or fiberoptic bronchoscopy [3]. While auscultation is less accurate, fiberoptic bronchoscopy demands advanced skills, making it difficult for trainees to quickly correct errors. In addition, fiberoptic bronchoscopy is reusable and involves invasive procedures, which poses a risk of hospital-acquired infections [4]. Furthermore, the assessment of trainees' operational skills primarily relies on subjective judgment from instructors, lacking standardized criteria. This approach tends to focus on procedural success while neglecting complication prevention and management, hindering comprehensive skill development. Anesthesiologists typically require extensive practice to master lung isolation techniques, which is constrained by training duration and case availability. Therefore, effectively training residents in lung isolation techniques is an pressing issue in standardized anesthesiology residency training.

With advancements in visualization technology, the use of visual double-lumen bronchial tubes in lung isolation surgery is becoming more prevalent. The camera at the catheter's tip enables direct visualization during bronchial intubation and positioning, improving intubation efficiency and facilitating early detection of catheter displacement [5]. Previous studies have shown that anesthesiologists using visual double-lumen bronchial tubes for lung isolation significantly reduce intubation time, increase intubation success rates, enable early detection of intraoperative catheter displacement, and decrease the reliance of fiberoptic bronchoscopy as well as intubation-related complications [6]. This study aims to evaluate the application value of visual double-lumen bronchial tubes in lung isolation training and assess their educational impact on anesthesiology residency training. Specifically, it investigates the teaching effectiveness of visual double-lumen bronchial tubes in this context.

## Materials and methods

### *General information of residents in the two groups*

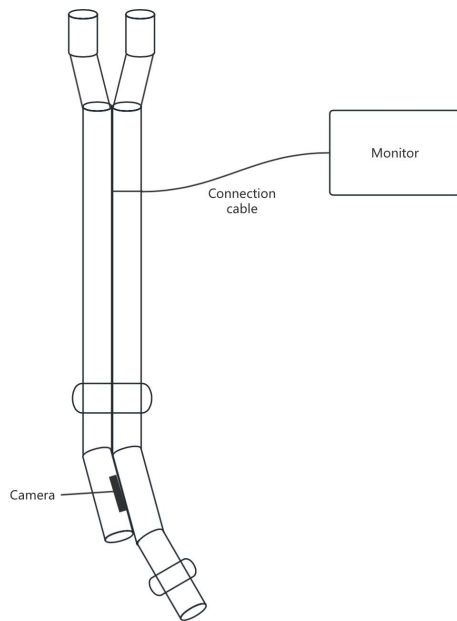
From September 2023 to September 2024, 20 trainees were selected from the standardized anesthesia residency training program at Jiangsu Provincial Cancer Hospital. To ensure random allocation, a random number table method was employed. Each trainee was assigned a unique identifier, and a random number generator was used to generate corresponding random numbers. Based on the values of these numbers, trainees were assigned to either the visual double-lumen bronchial intubation group or the conventional double-lumen bronchial intubation group, with 10 trainees in each group.

Inclusion criteria: (1) Full-time undergraduate students majoring in clinical medicine or anesthesiology; (2) Currently undergoing standardized residency training, including professional graduate students and socialized resident trainees; (3) Completion of at least three months of training in the anesthesiology department, with proficiency in tracheal intubation but no prior training in double-lumen bronchial intubation. Exclusion criteria: (1) Unwillingness to participate in the study; (2) Non-right-handed individuals.

### *General information of patients undergoing pulmonary isolation in the two groups*

The study was approved by the Ethics Committee of Jiangsu Cancer Hospital, and informed consent was obtained from all participants. The inclusion criteria for patients: (1) Age between 18 and 64 years, scheduled for elective right-sided partial lung resection; (2) Classification of American Society of Anesthesiologists (ASA) class I or II; (3) Body mass index (BMI) less than 28 kg/m<sup>2</sup>. Exclusion criteria: (1) Upper respiratory tract infection within two weeks prior to surgery; (2) Difficult or suspected difficult airway; (3) Preoperative CT scan indicating a difficult airway; (4) Preoperative CT scan showing abnormal respiratory tract anatomy; (5) Presence of underlying diseases such as asthma or severe cardiac insufficiency; (6) Preoperative symptoms of pharyngeal pain, hoarseness, or dry cough; (7) Operation duration exceeding 3 hours or less than 1 hour; (8) Postoperative admission to the ICU for further treatment. A total of 40 patients were enrolled, with 20 patients in each group.

In the conventional double-lumen catheter



**Figure 1. Schematic diagram of a visual double-lumen bronchial catheter.**



**Figure 2. Camera on the front of the visual dual-lumen bronchial catheter.**

group, there were 8 males and 12 females, aged 33 to 61 years, with a mean age of  $48.5 \pm 9.8$  years, a BMI range of 20.5 to 25.8  $\text{kg/m}^2$ , and a mean BMI of  $24.2 \pm 3.0$   $\text{kg/m}^2$ . ASA classification was class I in 8 cases and class II in 12 cases. In the visual double-lumen catheter group, there were 10 males and 10 females, aged 30 to 63 years, with a mean age of  $50.3 \pm 11.4$  years, a BMI range of 22.0 to 25.6  $\text{kg/m}^2$ , and a mean BMI of  $23.3 \pm 3.4$   $\text{kg/m}^2$ . ASA classification was class I in 7 cases and class II in 13 cases. No significant differences were found between the two groups regarding gender composition, age, BMI, and ASA classification (all  $P > 0.05$ ).

#### **Preoperative teaching preparation**

On the eve of surgery, the instructor initially

guided the resident trainees in reviewing the patient's medical records and previewing the proposed surgical and anesthetic procedures. The trainees were instructed to meticulously examine the patient's chest CT scans to assess any anatomical anomalies of the airway, measure the dimensions of the trachea and bronchus, and select the appropriate left-sided double-lumen bronchial catheter. Subsequently, the instructor elucidated the principles of airway anatomy, detailed the structural differences between conventional and visual double-lumen bronchial tubes (**Figure 1-2**), and outlined the steps involved in intubation, fiberoptic bronchoscopy, and tube positioning techniques. Ultimately, the instructor conducted a live demonstration of the procedures, after which each resident trainee practiced the maneuvers ten times using simulation teaching aids. On the day of surgery, under the supervision of the teaching staff, each resident trainee performed double-lumen bronchial intubation on two patients.

#### **Double-lumen bronchial intubation procedure**

The distal end of the left double-lumen bronchial tube were thoroughly lubricated with sterile lubricant, ensuring that the lubricant does not contact the camera lens of the visual double-lumen tube to prevent blurring. The visual double-lumen tube's cable was connected to the monitor to ensure a clear and smooth image. The double-lumen catheter was shaped according to the patient's body habitus and the curvature of the disposable video laryngoscope blade. After anesthesia induction, the trainee, under instructor supervision, held the video laryngoscope in the left hand and inserted it into the patient's oral cavity. The blade was gradually centered and gently advanced to the junction of the epiglottis and the base of the tongue to visualize the epiglottis. The video laryngoscope was elevated to exposes the vocal cords.

**Conventional Double-Lumen Catheter Group:** With the right hand, the left double-lumen bronchial catheter was held in a pen-like grip and inserted along the blade from the patient's right oral corner, aligning the beveled end with the vocal cords. Once the branch end passes through the vocal cords, the stylet was removed and rotated 90 degrees to the right and gently advanced. For males, advance the catheter to 29-31 cm from the incisors, and for females, to 27-29 cm, stopping when resistance is felt. A fiberoptic bronchoscope was used to adjust the catheter's position; When inserting the bronchoscope through the right lumen, the carina and the openings of the right upper, middle,

**Table 1. Comparison of demographic data between two groups of residents (n, %)**

| Group                                           | Age (years) | Male<br>[n (%)] | Female<br>[n (%)] | Postgraduate Residents<br>[n (%)] | Socialized Residents<br>[n (%)] |
|-------------------------------------------------|-------------|-----------------|-------------------|-----------------------------------|---------------------------------|
| Visual Double-Lumen Catheter Group (n=10)       | 25.00±1.90  | 2 (20%)         | 8 (80%)           | 9 (90%)                           | 1 (10%)                         |
| Conventional Double-Lumen Catheter Group (n=10) | 24.70±1.60  | 3 (30%)         | 7 (70%)           | 8 (80%)                           | 2 (20%)                         |
| t/ $\chi^2$                                     | 0.387       | 0.268           |                   | 0.392                             |                                 |
| P-value                                         | 0.703       | 1.000           |                   | 1.000                             |                                 |

**Figure 3. Image of the visual dual-lumen bronchial catheter monitor.**

and lower lobar bronchi should be visible, as well as the blue cuff of the left main bronchus below the carina; when inserting through the left lumen, the openings of the left upper and lower lobar bronchi should be visible [7]. Securely fix the double-lumen bronchial catheter after satisfactory positioning.

**Visualized Double-Lumen Catheter Group:** Following the same initial procedures as the conventional group, the stylet was removed, and the double-lumen tube was slowly advanced. When the monitor shows that the catheter's tip is nearing the carina, rotate the tube to the left and insert the tip directly into the left main bronchus under direct vision. Once only the edge of the blue cuff is visible on the monitor (Figure 3), secure the double-lumen tube properly [8].

#### **Observation indicators**

The duration from the insertion of the laryngoscope by the resident trainee to the securing of the double-lumen tube was recorded, referred to as the total intubation time. Additionally, the period from the entry of the double-lumen tube into the vocal cords and the removal of the plastic stylet to the completion of the tube's positioning was documented, termed positioning time. Data on total intubation time, positioning time, first-attempt intubation success rate, and intraoperative catheter displacement rate were collected for both participant groups. Postoper-

atively, the surgeon was asked to provide a satisfaction score across three aspects: intubation satisfaction, pulmonary isolation satisfaction, and airway management satisfaction. Each category was rated on a scale from 0 to 10, with 10 indicating the highest level of satisfaction. Patients were followed up within 24 hours after surgery to document the incidence of pharyngeal pain, hoarseness, and dry cough.

#### **Statistical methods**

Statistical analyses were conducted using SPSS 22.0 software. Continuous data were expressed as mean  $\pm$  standard deviation, and between-group comparisons were performed using the independent samples t-test. Categorical data were analyzed using the chi-squared ( $\chi^2$ ) test. A p-value of less than 0.05 was considered statistically significant.

#### **Results**

##### **Comparison of demographic characteristics between two groups of residents**

A demographic comparison, including age, gender distribution, and educational background, between the two cohorts of resident trainees showed no statistically significant differences ( $P>0.05$ ) (Table 1).

##### **Comparison of intubation outcomes between the visual double-lumen catheter group and the conventional double-lumen catheter group**

The visual double-lumen catheter group demonstrated significantly shorter total intubation and positioning times than the conventional double-lumen catheter group (both  $P<0.05$ ). Additionally, the first-attempt intubation success rate was significantly higher in the visual double-lumen catheter group compared to the conventional group ( $P<0.05$ ). Furthermore, the incidence of intraoperative catheter displacement was significantly lower in the visual double-lumen catheter group than in the conventional group ( $P<0.05$ ) (Table 2).

##### **Comparison of surgeon satisfaction scores**

**Table 2. Comparison of intubation outcomes between the two groups of patients (mean  $\pm$  SD; n (%))**

| Group                                           | Total Intubation Time (s) | Positioning Time (s) | First-Attempt Intubation Success Rate [n (%)] | Intraoperative Catheter Displacement Rate [n (%)] |
|-------------------------------------------------|---------------------------|----------------------|-----------------------------------------------|---------------------------------------------------|
| Visual Double-Lumen Catheter Group (n=20)       | 70.20 $\pm$ 11.80         | 30.10 $\pm$ 5.70     | 17 (85%)                                      | 2 (10%)                                           |
| Conventional Double-Lumen Catheter Group (n=20) | 224.90 $\pm$ 35.60        | 176.60 $\pm$ 26.40   | 9 (45%)                                       | 8 (40%)                                           |
| t/ $\chi^2$                                     | 18.433                    | 24.228               | 7.033                                         | 4.800                                             |
| P-value                                         | 0.000                     | 0.000                | 0.008                                         | 0.028                                             |

**Table 3. Comparison of surgeon satisfaction scores between the two groups (mean  $\pm$  SD)**

| Group                                           | Intubation Satisfaction Score | Lung Isolation Satisfaction Score | Airway Management Satisfaction Score |
|-------------------------------------------------|-------------------------------|-----------------------------------|--------------------------------------|
| Visual Double-Lumen Catheter Group (n=20)       | 8.10 $\pm$ 1.07               | 8.35 $\pm$ 1.04                   | 8.40 $\pm$ 1.23                      |
| Conventional Double-Lumen Catheter Group (n=20) | 6.90 $\pm$ 1.41               | 6.55 $\pm$ 1.36                   | 6.70 $\pm$ 1.34                      |
| t/ $\chi^2$                                     | 1.407                         | 1.193                             | 0.202                                |
| P-value                                         | 0.004                         | 0.000                             | 0.000                                |

Note: Satisfaction scores are presented as mean  $\pm$  SD. A higher score indicates greater satisfaction, with a maximum possible score of 10 for each category.

**Table 4. Comparison of post-intubation complications between the two groups of patients**

| Group                                           | Pharyngeal Pain [n (%)] | Hoarseness [n (%)] | Dry Cough [n (%)] |
|-------------------------------------------------|-------------------------|--------------------|-------------------|
| Visual Double-Lumen Catheter Group (n=20)       | 3 (15%)                 | 2 (10%)            | 1 (5%)            |
| Conventional Double-Lumen Catheter Group (n=20) | 9 (45%)                 | 8 (40%)            | 7 (35%)           |
| t/ $\chi^2$                                     | 4.286                   | 4.800              | 3.906             |
| P-value                                         | 0.038                   | 0.028              | 0.048             |

The surgeon's satisfaction scores for intubation, lung isolation, and airway management were significantly higher in the visual double-lumen catheter group compared to the conventional double-lumen catheter group (all  $P < 0.05$ ) (Table 3).

#### **Comparison of post-intubation complications between the visual double-lumen catheter group and the conventional double-lumen catheter group**

The incidence of post-intubation complications, including pharyngeal pain, hoarseness, and dry cough, was significantly lower in the visual double-lumen catheter group compared to the conventional double-lumen catheter group (all  $P < 0.05$ ) (Table 4).

#### **Discussion**

Double-lumen tubes are commonly used for lung isolation during thoracic surgery. However, their larger diameter presents a greater challenge for intubation compared to standard single-lumen tracheal tubes. Repeated intubation attempts and positional adjustments can cause damage to the teeth, oropharynx, vocal cords, and tracheal mucosa, with severe cases potentially resulting in tracheal rupture [9]. In

practice, the anatomical characteristics of the right main bronchus—its steep and straight configuration, thick and short structure, and the high position of the right upper lobe bronchus, often result in the misplacement of left double-lumen bronchial catheters into the right side or improper alignment of right double-lumen bronchial catheters within the right upper lung. Additionally, factors such as changes in patient positioning, surgical manipulation, and intraoperative secretion obstruction can compromise lung isolation, necessitating operation interruptions and re-initiation of lung isolation [10]. Clinically, the placement of double-lumen bronchial catheters primarily relies on auscultation and fiberoptic bronchoscopy. Auscultation often fails to accurately determine the depth or position of the tube, resulting in suboptimal localization precision [11]. Although fiberoptic bronchoscopy is considered the gold standard for lung isolation localization, it is costly, scarce in many healthcare settings, requires physicians to possess advanced anatomical knowledge and technical skill. Furthermore, the cumbersome processes for cleaning, disinfection, sterilization, storage, maintenance, and repair limit its widespread clinical application [12]. These challenges make DLT intubation particularly difficult for resident trainees to master [13].

With the ongoing advancement of medical technology, visualization in teaching has become increasingly integrated into anesthesia education, helping students better understand the complex procedures [14]. Research by Niu Lijun et al. indicated that the use of light rods in visualizing tracheal intubation teaching significantly enhances the success rate of tracheal intubation among clinical interns [15]. A study by Zhou et al. demonstrated that ultrasound-guided teaching for truncal nerve blocks greatly boosts student motivation, improves teaching safety and efficiency, and achieves ideal and standardized teaching outcomes [16]. In a study by Feng et al., the application of visual laryngoscopy for teaching tracheal intubation to non-anesthesia residents provided clear visualization of pharyngeal anatomy, thereby improving the first-time intubation success rate of the trainees [17].

The visual dual-lumen bronchial catheter is an innovative tool for lung isolation, distinguishing itself from traditional dual-lumen bronchial catheters by incorporating an LED light source and a high-resolution camera at its distal end. This design enables real-time imaging of the airway during intubation and throughout the surgical procedure, with images transmitted to an external monitor [5]. As a result, anesthesiologists can precisely identify the carina, as well as the left and right main bronchi, during intubation, allowing for accurate adjustments in the direction and depth of the double-lumen catheter. This minimizes issues such as malpositioning and excessive catheter depth [18].

The study findings indicate that resident trainees required less time, achieved a higher first-attempt intubation success rate, and experienced a lower incidence of intraoperative catheter displacement when using the visual dual-lumen bronchial catheter for direct intubation and positioning. These results suggest superior performance in teaching lung isolation techniques, with a greater likelihood of students acquiring proficiency in these skills. Moreover, the anterior camera of the visual catheter allows for continuous monitoring of both the catheter's position and airway secretions throughout the procedure. If catheter displacement occurs, surgeons can promptly reposition the catheter without interrupting surgery and efficiently clear airway secretions, facilitating postoperative pulmonary rehabilitation [19, 20].

Additionally, the study demonstrated that using a visual double-lumen catheter reduces irritation to the vocal folds and airway mucosa

caused by repeated catheter adjustments. Patients experienced a significantly lower incidence of postoperative pharyngeal pain, hoarseness, and coughing, with improved surgeon satisfaction regarding intubation, lung isolation, and airway management. This suggests that teaching lung isolation with a visual double-lumen catheter not only reduces patient-related complications but also enhances surgeon satisfaction.

To achieve optimal outcomes during the visual double-lumen catheter placement, several key points must be noted:

- **Preoperative Preparation:** Thorough preparation is crucial. Instructors must guide students to review the patient's medical history and surgical plan in advance to fully understand the anesthesia strategy. Students are advised to consult relevant literature to familiarize themselves with the procedure and identify appropriate moments for collaboration with the surgeon. This includes tasks such as deepening anesthesia, suctioning secretions, disconnecting the respirator, initiating and terminating lung isolation, and assisting with lung positioning.

- **Understanding Airway Anatomy:** Students must have a deep understanding of airway anatomy. The tracheal cartilage is "C"-shaped, and the tracheal membrane wall, located in the dorsal notch of the tracheal cartilage, is composed of smooth muscle and connective tissue. Recognizing this wall is key to identifying the left and right main bronchi. Mastery of airway anatomy enables students to anticipate positioning challenges and quickly adjust the catheter if displacement occurs during surgery.

- **Interpretation of Chest CT Scans:** It is crucial for students to develop the ability to interpret chest CT scans. These scans reveal variations, stenosis, compression, and diverticula in the trachea and bronchi, as well as the angles, lengths, and diameters of the right and left main bronchi and trachea. Such information helps anticipate potential issues before intubation [21]. Additionally, three-dimensional airway reconstructions, available in some hospitals, can assist students in visualizing the extent of surgical resection and bronchial alignment, further enhancing their understanding of airway anatomy and double-lumen catheter placement [22].

- **Individualized Anesthesia:** Precision in anesthesia is critical for optimal patient recovery. Traditionally, anesthesiologists select double-lu-

men catheter models based on gender, height, and weight; however, this approach is imprecise. In adults, particularly women, tracheal length and diameter do not strongly correlate with height [23]. An oversized catheter may become lodged under the glottis, causing tracheal mucosa damage or even rupture in severe cases. Conversely, an undersized catheter may fail to adequately seal the bronchus after inflation, leading to lung isolation failure and increased risk of catheter displacement during positional changes or surgical manipulation [24]. Therefore, it is recommended to measure the length and diameter of the patient's trachea and main bronchus via chest CT to select a more appropriate double-lumen catheter model, achieving personalized and refined anesthesia [25].

While the visual double-lumen bronchial tube offers distinct advantages, it also presents several limitations. Firstly, its high cost, coupled with the requirement for additional monitoring systems in certain cases, increases expenses for medical institutions, limiting its widespread adoption. Secondly, its global availability is low, market demand is limited, and the range of indications is narrow, constraining opportunities for acquisition and utilization. Lastly, the fixed camera at the tube's front end is non-adjustable, resulting in a restricted field of view; and technical failures can impede emergency management.

Our study demonstrates that even with direct-vision placement of visual double-lumen bronchial tubes, reverse insertion can occur, which is a common issue in clinical practice. Therefore, it is imperative to analyze the causes and instruct students in proper management techniques. The primary cause often relates to the acute angle between the main bronchus and the trachea, along with significant twisting and displacement of the bulge. This issue can be addressed by gently retracting the catheter over the rongeur, followed by rotation and insertion into the contralateral bronchus. If repeated attempts are unsuccessful, intubation should be performed under fiberoptic bronchoscopic guidance [26]. During surgery, gentle maneuvers are crucial to prevent serious damage to the patient's vocal folds and airway. Intraoperative tracheal displacement was observed in both groups, associated with the patient's lateral position and surgical manipulation. Thus, when positioning the patient laterally, students must re-evaluate the double-lumen catheter's position and make timely adjustments. Visual impairment associated with the use of a visual double-lumen bronchial catheter can occur due to airway secretions or intraoperative bleeding

that obscures the camera. In such cases, a suction tube may be utilized to aspirate secretions or blood near the lens. Alternatively, a small amount of saline can be introduced to flush the lumen and then promptly aspirated.

In the educational process, instructors should prioritize the psychological well-being of resident trainees. Studies indicate that the prevalence of depression among Chinese medical students is as high as 14.1% [27]. Resident trainees, balancing dual roles as students and residents, face multiple pressures during their training, including a fast-paced work environment, long working hours, strained doctor-patient relationships, burnout, extensive learning content, frequent examinations, lack of sleep, and insufficient exercise. These challenges can overwhelm junior trainees who have recently graduated. A survey of 284 resident trainees revealed significant psychological stress, with employment, academic work, financial, and emotional stress being major contributors [28]. When performing complex clinical procedures such as lung isolation, resident trainees may experience psychological stress, nervousness, and a lack of self-confidence. Surrounded by peers or surgeons and confronted with operational mishaps, they may become disorganized and falter, leading to operational failure and a cycle of self-negation that affects subsequent training. Consequently, educators should support students, understand their psychological state, assist with life challenges, provide timely psychological counseling, and refine teaching methods to enhance learning and mastery of clinical skills.

### Limitations

Firstly, the sample size in this study was small, consisting of only 20 residents undergoing standardized training at a single center. As a result, individual differences may have influenced the outcomes. Secondly, the study did not include non-right-handed residents. This exclusion was based on differences in operating habits, hand coordination, and tool usage between right-handed and non-right-handed individuals. To ensure data comparability and minimize operational biases, it is important to control for handedness as a variable in research. Furthermore, most visible double-lumen tubes and their auxiliary tools (e.g., video laryngoscopes and control buttons) are designed for right-handed users. Therefore, non-right-handed individuals may experience decreased operational efficiency or accuracy during their practice. Finally, this study focused only on training with left-sided visual double-lumen tubes, and

all patients included had stable health conditions. There is a lack of research addressing training with right-sided visible double-lumen tubes or in patients with difficult airways.

### Conclusions

In summary, the use of visual double-lumen catheters in lung isolation training can significantly reduce both the total intubation time and the positioning time for resident trainees. It also enhances the success rate of first-attempt intubations, improves surgeon satisfaction, and reduces intubation-related complications. To achieve optimal teaching outcomes, instructors must guide trainees through comprehensive preoperative preparation, instruct them in proper handling techniques, and remain attentive to their psychological well-being. This approach is clinically viable and yields precise educational results.

Future research should consider conducting longitudinal studies to assess the long-term impact of visual double-lumen catheter training in clinical practice. Such studies would provide insights into the retention of acquired skills and determine whether this training sustainably enhances the accuracy and safety of medical procedures. Additionally, further research could explore strategies to optimize training methods and improve the clinical adoption of visual double-lumen catheters. Interdisciplinary collaboration, incorporating modern technologies such as artificial intelligence and virtual reality, may offer innovative approaches to training in this field. These advancements could lead to more effective training programs for medical professionals, ultimately enhancing patient care quality and clinical outcomes.

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# Construction of an online resource platform for anesthesiology postgraduates based on competency-based medical education concept

Zui Zou<sup>1</sup>, Tairan Zhou<sup>1,2</sup>, Mingyao Chen<sup>1</sup>, Na Zhao<sup>1</sup>, Tianying Xu<sup>1</sup>, Jinjun Bian<sup>3</sup>

<sup>1</sup>School of Anesthesiology, Naval Medical University, Shanghai 200433, China. <sup>2</sup>College of Basic Medicine, Naval Medical University, Shanghai 200433, China. <sup>3</sup>Faculty of Anesthesiology, Changhai Hospital, Naval Medical University, Shanghai 200433, China.

**Corresponding authors:** Jinjun Bian and Tianying Xu.

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## Highlights

- A competency based medical education (CBME) online resource platform is developed to bridge gaps in post graduate anesthesiology education, enhancing both curriculum content and teaching approaches.
- Classical and dynamic knowledge modules are incorporated to support competency-based learning, fostering systematic, self-directed, and lifelong learning.
- Innovative hybrid teaching models and real-time access to updated resources have significant potential to improve clinical decision-making and practical skills.

## Abstract

To bridge the gap between curriculum content and clinical needs, as well as address the insufficient quality of on-line educational resources in current postgraduate anesthesiology education, this study proposes a “library-style” network resource platform for anesthesia graduate students, grounded in the competency-based medical education framework. The platform’s primary focus is “classical knowledge module”, which covers six core domains in anesthesiology, such as clinical anesthesia management, anesthesia technical operation, and anesthesia pharmacology. The platform also integrates ‘Internet+’ technology, creating a multifunctional network resource to support comprehensive learning. The platform is characterized by modularized knowledge, diversified resources, dynamic updates, and universal accessibility, enabling postgraduate students to engage in independent and lifelong learning. This flexibility fosters the innovation of hybrid teaching models, combining both online and offline components. The study aims to strengthen the competency-oriented anesthesia training system, providing robust support for both clinical practice and academic research.

**Keywords:** Anesthesiology, postgraduate education, competency-oriented medical education, online resource construction, teaching reforms

## Introduction

In 2020, the General Office of the State Council issued a document emphasizing the anticipated expansion for postgraduate enrollment in anesthesiology, highlighting the need for innovative approaches in medical education [1]. Among these approaches, Competency-Based

Medical Education (CBME) has emerged as a cornerstone in modern medical education. CBME shifts the focus from traditional knowledge-based teaching to an outcome-driven model, where the acquisition of measurable competencies is the primary educational objective [2, 3]. This model ensures that postgraduate students develop the critical skills, atti-

**Address correspondence to:** Jinjun Bian, Faculty of Anesthesiology, Changhai Hospital, Naval Medical University, 168 Changhai Road, Shanghai 200433, China. E-mail: jinjunbian@smmu.edu.cn; Tianying Xu, Department of Anesthetic Pharmacology, School of Anesthesiology, Naval Medical University, 168 Changhai Road, Shanghai 200433, China. E-mail: xutianying@smmu.edu.cn.



tudes, and knowledge required to meet clinical demands and excel in professional practice. Addressing the specific challenges in anesthesiology education, this study seeks to integrate the CBME framework into the development of an online professional knowledge system. This system addresses gaps in curriculum content and resource quality, while enhancing competency-based training outcomes.

## **Theoretical foundations and research background**

### ***Concept of CBME***

CBME is an educational approach that employs a structured core competency framework, focusing on designing, implementing, and evaluating education based on measurable outcomes [4]. In this context, competencies encompass a combination of motivation, traits, attitudes, knowledge, and values. Competency refers to any of these characteristics that can be reliably measured, distinguishing high-performing learners from average-performing students. Developing medical students' competencies has become the mainstream approach in modern medical education globally, with continuous evolution and refinement over time [5-10]. In 2018, the Ministry of Education issued a document advocating for competency-oriented education and teaching reform [11]. The CBME-based educational model begins by defining the essential competencies required for exceptional anesthesiologists and clinical scientists. It prioritizes the development of these competencies, establishes a well-structured educational system and assessment methods, and uses the achievement of these competencies as indicators of successful learning [11]. This process is dynamic, reflecting ongoing development and adaptation.

### ***Prominent contradictions and problems in postgraduate anesthesiology education***

In the United States, anesthesiology residency training begins only after obtaining an M.D. degree, marking the start of comprehensive professional education in anesthesiology [12]. This training spans four years, beginning with a foundational clinical year that includes rotations in internal medicine, surgery, and emergency medicine, followed by three years of core clinical anesthesia training (CA1-CA3) [13]. This curriculum emphasizes perioperative management, critical care, and pain medicine, incorporating simulation-based education to cultivate crisis management and teamwork skills. Assessment methods are structured around the

Milestones framework, which tracks residents' competency development through tools such as direct observation, Mini-CEX, simulation assessments, and standardized examinations like the American Board of Anesthesiology exams [10, 14]. Simulation-based education plays a vital role by providing opportunities for clinical decision-making and teamwork practice in a controlled environment [15].

In contrast, postgraduate anesthesiology education in China integrates master's-level academic training with standardized residency training, leading to differences in curriculum structure, focus, and assessment strategies [16]. The U.S. system places greater emphasis on integrating basic sciences with clinical practice, while the Chinese system more emphasizes fundamental theories and technical skills, with relatively less focus on team collaboration and crisis management. Existing study reveals that postgraduate anesthesiology students in China are still constrained by traditional medical education models [17]. Besides, under the "Double Tracks" practical educational mode, the curriculum lacks distinctive teaching characteristics and sufficient class hours. This highlights the need for innovative technological measures and reforms in curriculum structure and teaching methods to cultivate the competency of clinically-oriented postgraduate anesthesiology students [18].

To address this gap, our department has conducted an exploration to strengthen the competency-oriented anesthesia talent training system. In 2022, we conducted a survey of nearly 600 graduates from our university, 18 local colleges and universities, and eight grassroots units [16]. The survey results on the professional competencies of graduates during their undergraduate years revealed that the top three self-evaluated dimensions were work ethics and perseverance, psychological quality, and professional ethics. The score for solid professional theoretical knowledge closely followed these, with over 85% of respondents rating these aspects as "very satisfied" or "generally satisfied." In the competency training needs survey, the top three areas identified for further development were clinical skills, anesthesia-related procedural skills, and oral and written communication skills. Based on these findings, alongside both domestic and international research on graduate education in anesthesiology, two prominent contradictions emerge in this field.

Firstly, the content of postgraduate courses does not align with the clinical anesthesia prac-

tices required by postgraduate students' knowledge systems, nor does it meet the demand for core competencies in knowledge and skills. Anesthesiology, due to its unique disciplinary nature, has a distinct technical system and knowledge framework. It focuses not only on the local body but also on the entire body. Anesthesiologists must understand the interconnections among various fields of professional knowledge, earning them the nickname "internists in the field of surgery." However, the current structure of graduate professional courses tends to be monotonous, making it difficult to build a comprehensive professional knowledge system through limited in-class teaching hours [19]. Furthermore, undergraduates majoring in clinical medicine constitute a significant portion of postgraduate students in anesthesiology, and they often lack sufficient exposure to anesthesiology courses [20]. This gap in foundational knowledge makes it challenging to meet the differentiated teaching requirements of postgraduate education. Additionally, some professional courses and teaching materials are overly theoretical, lacking practical relevance to clinical scenarios. For example, the course of anesthetic pharmacology introduces the mechanisms of action and pharmacological properties of drugs, but it does not offer guidance on how to use these drugs effectively in clinical situations. This disconnect prevents students from bridging basic knowledge with real-world applications. The slow pace of content updates further exacerbates this issue. Hence, it is essential to improve the knowledge system of postgraduate students through diverse means, such as self-directed learning both within and outside the classroom, to support competency-based education. Nevertheless, the current textbooks of subdisciplines are fragmented, and the knowledge within each subdiscipline is vast. This leads to an overall deficiency in students' understanding of the anesthesiology discipline as a whole [21, 22]. To address this, there is an urgent need to construct an integrated, systematic professional knowledge that facilitates independent learning and optimizes the content to better guide clinical practice.

Secondly, the scarcity and poor quality of online educational resources in anesthesiology hinder the effectiveness of postgraduate classroom teaching, autonomous learning, and lifelong learning in the digital age. We conducted surveys to assess graduates' evaluations and suggestions on various aspects of professional anesthesia education and curriculum planning. Among these, 10.03% of the graduating students expressed significant dissatisfaction with the "information-based teaching" aspect,

which ranked second to last among the nine survey items. High-quality online educational resources for anesthesia are generally scarce. Although some anesthesia knowledge resources are available on non-specialized platforms, they often suffer from issues such as disorganization, incomplete content, lack of peer review, high error rates, outdated information, complex retrieval processes, and low relevance to practical needs.

### ***Supporting role of network resources of professional knowledge systems based on CBME in anesthesiology postgraduate talent cultivation***

A "library-style" network resource platform for anesthesia graduate students, based on the CBME framework, provides multifaceted support for postgraduate education and training of anesthesiology talents. First, this practice-oriented, hierarchically structured, specialized, and integrated knowledge system compensates for shortcomings in classroom teaching, curricula, and existing teaching materials by providing novel and differentiated learning resources. Second, the platform supports a hybrid online-offline teaching mode, allowing students to learn flexibly in diverse circumstances and fostering the innovation and development of teaching models. In addition, the integrated resource network helps postgraduate anesthesiology students develop a holistic view of knowledge and independently build a comprehensive knowledge framework that spans interdisciplinary subjects. This enables them to better comprehend the discipline's intrinsic connections and evolving trends. The user-friendly interface and clear structure render knowledge accessible and searchable, providing students with convenient opportunities for autonomous and lifelong learning. Most importantly, this CBME-based online resource platform refines the competency-oriented talent cultivation system, promoting the overall development of students' theoretical knowledge and practical skills, thereby laying a solid foundation for their future clinical practice and academic research.

### ***Resource content and construction methodology***

Leveraging the features of 'Internet+' in the digital age and meeting the requirements of clinical anesthesia practice, course resources based on the CBME concept support the reform of the graduate curriculum and teaching approaches. The primary goal is to build a clinical practice-oriented professional knowledge system for postgraduate anesthesia students. Simultaneously, a multifunctional professional

**Table 1. Overview of the classical knowledge module's structure**

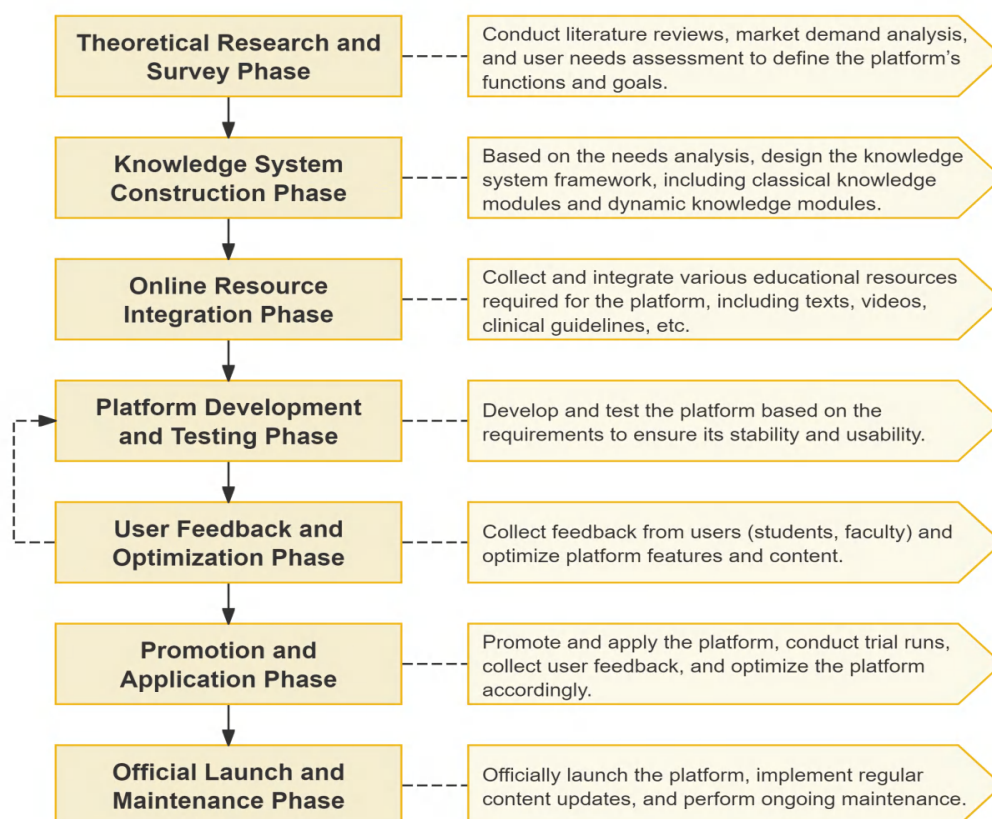
| Primary Directory                                 | Secondary Directory                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clinical anesthesia management                    | Preoperative evaluation and preoperative preparation<br>Basic anesthesia management strategy<br>Perioperative management of special crowd<br>Perioperative management of patients with special diseases<br>Special surgery perioperative management<br>Perioperative management in outpatient and day-care wards<br>Severe complications during anesthesia emergence and recovery from anesthesia |
| Clinical anesthesia techniques                    | Endotracheal intubation<br>Neuraxial anesthesia technique<br>Nerve block technique<br>Vascular puncture and catheterization<br>Mechanical ventilation techniques<br>Heart, lung, and brain recovery technology                                                                                                                                                                                    |
| Clinical anesthesia pharmacology                  | Intravenous anesthetics<br>Narcotic analgesics and antagonists<br>Gas anesthetics<br>Local anesthetics<br>Skeletal muscle relaxants and their antagonists<br>Anti-heart failure and anti-arrhythmia<br>Drugs acting on the autonomic nervous system<br>Other medications                                                                                                                          |
| Perioperative monitoring                          | Hemodynamic monitoring<br>Respiratory function monitoring<br>Brain function monitoring<br>Liver and kidney function monitoring<br>Internal environment monitoring<br>Neurological monitoring                                                                                                                                                                                                      |
| First aid and organ function protection           | Cardiovascular function and protection<br>Nervous system<br>Respiratory function and protection<br>Digestive system<br>Urinary system<br>Infection with sepsis<br>Multiple organ dysfunction syndrome<br>Trauma and hemorrhagic shock<br>Neonatal first aid                                                                                                                                       |
| Diagnosis and treatment of acute and chronic pain | Fundamentals of clinical assessment and treatment of pain<br>Postoperative pain management<br>Labor analgesia<br>Chronic pain treatment<br>Cancer pain treatment                                                                                                                                                                                                                                  |

network resource platform is established. By integrating these two modules, the platform adopts the characteristics of an open, systematic, easy-to-search, and dynamic 'library-type' resource. Finally, this model network resource platform is built through promotion, exploration, application, and continuous optimization.

During the construction process, a professional team reviewed relevant literature, expert consultations, and research on postgraduate anesthesiology students. The basic knowledge framework of anesthesiology was constructed by linking clinic requirements with anesthesia practice. The framework's content was further

enriched and refined to form a comprehensive knowledge network, which is finally embedded in the network resource platform. The construction of this platform was primarily led by the School of Anesthesiology at the Naval Medical University, with the support from invited experts across various academic disciplines.

The platform's primary focus is "classical knowledge module", which covers fundamental areas of clinical anesthesia practice that are relatively stable over time, including clinical anesthesia management, clinical anesthesia techniques, clinical anesthesia pharmacology, perioperative monitoring technology, first aid



**Figure 1. Flowchart of the construction process for the online resource platform.** The diagram outlines the seven main stages of the platform development, from theoretical research and survey to official launch and maintenance.

and organ function protection, and acute and chronic pain diagnosis and treatment. Classical knowledge provides a comprehensive and systematic overview of the essential information required for clinical anesthesia practice (Table 1). The knowledge content is presented in various forms, such as articles, pictures, and videos. In addition, the content can be further screened and optimized to better meet the practical needs of clinical anesthesia practice.

Dynamic knowledge module, such as those addressing medical frontiers, can be added later as the field evolves. This module addresses the continuously changing nature of medical education and clinical practices. It is updated based on advancements in clinical guidelines, significant publications in peer-reviewed journals, emerging technologies, and user feedback, through a systematic monitoring process.

The frequency of updates is typically semi-annual, ensuring the platform stays current and meets the latest clinical and educational needs. However, immediate updates are prioritized to address critical advancements or urgent clinical requirements. The content for updates is sourced from authoritative guidelines, high-impact research, and validated online repositories. To ensure the accuracy and

relevance of these updates, a multidisciplinary expert panel—comprising educators, clinicians, and technical specialists—reviews and validates the contents before it is incorporated into the platform.

The integration process not only involves incorporating validated content into the platform but also adding annotations and metadata to enhance traceability and usability. Users are notified of updates via the platform interface, supplemented by periodic newsletters summarizing key changes. This structured approach guarantees the operability and sustainability of the dynamic knowledge modules, enabling the platform to continuously support the competency development of postgraduate anesthesiology students. The development of the online resource platform follows a systematic process, comprising seven main stages, from theoretical research and surveys to official launch and ongoing maintenance. A detailed overview of this process is shown in Figure 1.

To demonstrate the practicality of the online resource platform, a teaching cases have been integrated into its design and evaluation. For instance, in the clinical anesthesiology course, students are guided to use the platform for pre-class preparation, such as reviewing multi-

media materials on perioperative management and studying case scenarios of severe complications. During class, the platform facilitates interactive discussions, with students referencing dynamic modules containing the latest clinical guidelines and engaging in real-time case simulations. After class, the platform supports review and self-assessment through quizzes and annotated video tutorials, reinforcing key concepts. Preliminary feedback from teaching practice suggests that the platform significantly enhances students' ability to independently analyze clinical scenarios, understand complex pharmacological mechanisms, and integrate interdisciplinary knowledge, thereby providing strong support for competency-based learning.

### Meaning and value of resource building

From a theoretical perspective, the construction of the resource system can bridge the gap within the CBME-oriented integrated knowledge system for clinical anesthesia practice. It addresses issues such as fragmented professional knowledge, the isolation of subdisciplines, and students' lack of a holistic understanding of the knowledge system.

From a practical standpoint, the specialized network resource platform contributes to the transformation and innovation of the postgraduate education teaching models, offering a platform and resources to support hybrid online-offline teaching modes. The knowledge system is closely aligned with clinical practice, emphasizing the practical knowledge needed to tackle real-world clinical problems, thereby enhancing its practical value. It enables students to independently and quickly construct their own professional knowledge system.

At the level of social value, the network resource platform, along with its integrated knowledge system and expanded content, is characterized with openness, systematization, searchability, and dynamics, providing diverse services such as self-directed learning and continuing education, not only for postgraduate students but also for professionals at large. By leveraging internet technology and a CBME-based professional knowledge system, the platform facilitates the transformation of graduate education models, aids in the competency development of graduate students majoring in anesthesiology, and ultimately enhances the quality of anesthesia talent cultivation.

### Discussion

The construction of the online resource plat-

form for anesthesiology postgraduate education marks a significant advancement in integrating technology into the education. This platform addresses key challenges in traditional education, such as fragmented knowledge and limited access to clinical training resources. By integrating classical and dynamic knowledge modules, the platform offers a more systematic, easy-to-search, and continuously updated learning experience for students.

Compared to traditional educational models, our platform enables students to interact with dynamic learning materials, conduct self-assessments, and access the latest clinical guidelines in real time. This approach is consistent with international trends in medical education, where competency-based models and online resources are increasingly used to enhance learning outcomes.

Despite its strengths, the platform faces several challenges, such as the need for ongoing content updates and integration with other educational systems. While early feedback from students has been positive, further research is required to evaluate its long-term impact on clinical competencies and critical thinking skills. Future developments could involve expanding the platform's content offerings and enhancing user engagement through advanced simulation tools.

### Conclusion

In conclusion, the development of the online resource platform for anesthesiology postgraduate education represents a significant advancement in modernizing teaching methods and enhancing clinical training. The platform provides a flexible, accessible, and comprehensive learning environment that supports competency-based education. As the platform continues to evolve, it holds great potential to improve the quality of anesthesiology education, both within our institution and across broader medical education contexts. Future efforts will focus on expanding the platform's capabilities, incorporating user feedback, and exploring its potential applications in other medical disciplines.

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revisions to the manuscript, and approved the final version for submission.

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# Integrating recent scientific breakthroughs and emerging technologies into basic medical education: A focus on histology and embryology

Li Li<sup>1,\*</sup>, Hongxiang He<sup>2,\*</sup>, Pinjie Zhang<sup>2,\*</sup>, Yinqing Wo<sup>3</sup>, Zhu Song<sup>2</sup>, Yili Yang<sup>2</sup>, Jiaqi Shen<sup>1</sup>, Haitao Ni<sup>1</sup>, Minjuan Wu<sup>1,2</sup>, Junfeng Jiang<sup>1,2</sup>

<sup>1</sup>Department of Histology and Embryology, College of Basic Medicine, Naval Medical University, Shanghai 200433, China. <sup>2</sup>Department of Precision and Regenerative Medicine, School of Gongli Hospital Medical Technology, University of Shanghai for Science and Technology, Shanghai 200093, China. <sup>3</sup>Department of Anatomy, College of Basic Medicine, Naval Medical University, Shanghai 200433, China.

\*The authors contribute equally.

**Corresponding authors:** Junfeng Jiang and Minjuan Wu.

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## Highlights

Integrating cutting-edge scientific advancements and new technologies into histology and embryology education not only enriches traditional teaching methods but also aligns the curriculum with the needs of the modern era. It broadens students' perspectives, fosters greater interest in scientific research, and lays a solid foundation for cultivating interdisciplinary medical professionals in the new era.

## Abstract

Basic medical education is the cornerstone of healthcare development, directly impacting the well-being of a nation's population. The advancement of modern medicine has raised increasing demands on the research capabilities of medical students. Therefore, it is crucial to foster their research interests and cultivate their research skills early in their education. As core components of basic medical science and introductory courses to immerse medical students in the intricate microscopic world of the human body, histology and embryology are indispensable in medical education, igniting their curiosity. Incorporating cutting-edge research into education courses can effectively stimulate medical students' research interests. This article primarily focuses on histology and embryology to explore how the latest scientific advancements and emerging technologies can be incorporated into basic medical curricula, offering insights and suggestions for future developments in medical education.

**Keywords:** Medical education, histology and embryology, progress in science, new technologies

## Introduction

Basic medical education serves as the foundation of a nation's healthcare development, directly influencing the health and well-being of its citizens. Over the years, China has established a higher education-based system to accelerate the advancement of medicine [1]. However, traditional basic medical education methods no longer meet the demands of rap-

idly evolving scientific and technological developments, nor do they fulfill the curiosity and broadening perspectives of modern students. Medical students often emphasize textbook learning over practical experience, which in turn hampers the progression of medical expertise. Therefore, improving the methods, practices, and levels of medical education has become a crucial issue.

**Address correspondence to:** Junfeng Jiang, Department of Histology and Embryology, College of Basic Medicine, Naval Medical University, Shanghai 200433, China. E-mail: 570538205@qq.com. **Minjuan Wu**, Department of Histology and Embryology, College of Basic Medicine, Naval Medical University, Shanghai 200433, China. E-mail: minjuanwu@163.com.



This paper reflects on the need to integrate cutting-edge scientific advances and new technologies into histology and embryology education to cultivate research-oriented medical professionals. It highlights the evolving role of these subjects in bridging basic anatomy with molecular medicine, emphasizing how current curricula often fall short in incorporating recent research and technological progress. By introducing innovative tools such as digital microscopy, spatial transcriptomics, and gene-editing techniques into both theoretical and practical components of the curriculum, educators can inspire students to engage in research, fostering the development of the next generation of medical researchers. The paper argues that this pedagogical shift is essential for preparing students for the challenges of future medical practice and scientific discovery, ensuring that they are equipped not only with clinical skills but also with a strong foundation in research and innovation.

#### **Cultivating research-oriented medical students for future healthcare demands**

##### ***Evolving research competencies in modern medical practice***

With the rapid advancement of science and technology, the medical education system in China is also undergoing rapid reform, particularly in areas such as medical education, residency training, specialist training, continuing medical education, and graduate education. Within this transformative landscape, two critical challenges emerge: the modernization of pedagogical approaches and the integration of scientific innovation into medical education [2, 3]. For medical students entering any medical-related profession, research competency is a key determinant of long-term career success. Modern medical professionals must combine teaching, clinical practice, and research skills, in line with the national strategy to cultivate talent for a technologically advanced nation. Therefore, it is imperative to introduce cutting-edge scientific knowledge early in undergraduate medical education.

##### ***Disparities between current curricula and future research requirements***

Universities aim to cultivate well-rounded talents by integrating basic education with innovative research. However, medical undergraduates predominantly acquire knowledge through textbooks, and there is often a significant lag in integrating scientific research into these educational materials. As a result, students who rely

solely on current coursework may fall behind in understanding contemporary scientific progress. It is crucial for students to stay informed about latest research development that has not yet been included in textbooks. While some students with an interest in research may join faculty research groups, this is only a small subset of the student body and does not reflect the broader educational goals of universities [4]. Given the vast scope of medical molecular sciences and the absence of standalone courses on recent scientific advances, it is neither practical nor feasible to establish a separate course solely dedicated to research advancements. Instead, integrating relevant scientific progress into existing courses is a more feasible approach. This would broaden students' perspectives, stimulate their interest in research, and motivate them to participate in research teams, thus fostering their research skills and preparing them for future postgraduate education.

#### **Developing research competencies through histology and embryology education**

##### ***Fundamental role of histology and embryology in medical education***

As crucial subjects in medical education, histology and embryology play a foundational role in understanding human anatomy at the microscopic level. These subjects bridge gross anatomy with cellular and molecular physiology and pathology, forming the foundation for more advanced medical disciplines. Additionally, histology and embryology heavily rely on cutting-edge research tools and techniques, which continue to evolve with advancements in technology. The rapid advancement of information technologies has led to the creation of innovative tools that deepen our understanding of histology and embryology, further driving progress in medical science. Therefore, histology and embryology are indispensable components of medical education [5].

##### ***Fostering research interest in medical students through histology and embryology education***

Histology and embryology are introductory subjects, in which medical students explore the microscopic world of the human body, offering an ideal opportunity to ignite curiosity about medical research. The complexity and beauty of microscopic structures, combined with the latest scientific discoveries, can inspire students to pursue research careers. By introducing new advances and technologies into the curriculum, educators can foster students' research interests and enhance their understanding of

current medical developments. For instance, educators can highlight which fundamental problems have been solved, which are currently being addressed, and which remain unresolved. This dual focus on both clinical practice and research helps cultivate future medical scientists and physicians equipped with research skills necessary to meet evolving healthcare needs [6].

### **Incorporating scientific advances and new technologies into histology and embryology education**

#### ***Current landscape of histology and embryology theory education***

Histology and embryology consist of two major components: histology, which studies the microscopic structures and functions of tissues, and embryology, which focuses on the development and growth patterns of the human body. As fundamental courses in medical education, they serve as introductory subjects for further study. Traditionally, the teaching of these subjects has relied heavily on textbook-based knowledge, with students often memorizing content through lectures. However, textbooks frequently fail to integrate the latest technological advancements, leading to a gap between students and current scientific progress. This reliance on outdated materials can dampen students' interest in research and hinder the development of innovative thinking.

#### ***Modernizing theoretical education through scientific and technological integration***

As students engage in the study of disciplines related to the structure and function of the human body at the microscopic level, they will discover that the fields of histology and embryology are rapidly advancing and progressing. Many new discoveries and research findings can enrich students' understanding of these fields. For example, traditional methods such as paraffin sectioning and hematoxylin-eosin staining are commonly taught in textbooks, enabling students to observe cellular arrangements and functions under a microscope. However, newer technologies, such as spatial transcriptomics and single-cell sequencing, which allow for RNA expression mapping within tissue slices, are not mentioned in most textbooks [7-9]. These advanced techniques provide insights into gene expression at subcellular levels, significantly enhancing their understanding of tissue architecture. Introducing such technologies during lectures on research techniques can spark students' interest and encourage their engage-

ment in hands-on practice.

### ***Enhancing practical education through research integration***

Traditional histology and embryology practical sessions often rely on outdated equipment, with students using optical microscopes to examine tissue sections. These methods can be time-consuming, and variations in slide quality can lead to confusion, leaving limited time for in-depth exploration of the subject. However, with the rapid advancement of science and technology, new tools and methods are emerging, making interactive digital microscopy systems a promising trend in histology education. These systems combine intelligent terminals, wireless communication, and digital imaging, providing high-resolution images and interactive features [10]. Such technology enables more efficient collaboration between students and instructors, as well as greater flexibility in learning [11-13]. Data can be stored on portable devices and synced to the cloud, enhancing both student engagement and teaching efficiency. By incorporating relevant scientific advances and new technologies into histology and embryology courses, educators can broaden students' horizons, keep their knowledge up to date, and better prepare them for careers in both medical practice and research. Some students may even become leading figures in the medical field, contributing to the advancement of healthcare.

#### ***Examples of integrating scientific advances and new technologies into histology and embryology education***

As introductory courses for medical students, histology and embryology cover the study of four major tissue types, eight systems, and embryonic development. During classroom instruction, educators can leverage advanced tools like the interactive spatial transcriptomics system to enhance students' efficiency in learning and identifying anatomical structures. Additionally, theoretical lessons should incorporate cutting-edge advancements to stimulate students' interest in scientific research and lay the groundwork for future exploration.

For instance, an introduction to spatial transcriptomics and single-cell technologies can be incorporated into the introductory section to demonstrate their relevance to histology and embryology [14, 15]. In the chapter on the circulatory system, educators can introduce the concept of extracellular vesicles to deepen students' understanding of blood components and

highlight the limitations of traditional textbook knowledge [16]. Furthermore, adding discussions on gene editing technologies and their role in the research and treatment of hereditary blood diseases can provide students with insight into how these innovations are transforming healthcare and shaping potential future treatments for various conditions [17-20].

In the section on the nervous system, educators can present findings from the department's research on neuroinflammatory diseases, giving students an opportunity to connect their theoretical learning with specific ongoing research within the institution [21]. Similarly, in the study of the skin, introducing recent research findings on skin injury, including contributions from the research lab and university, would broaden students' perspectives on this field [22, 23].

For the digestive, immune, and urinary systems, incorporating the latest advancements in liver research, along with the university's contributions to these fields, will keep students informed of current developments. In the embryology curriculum, instructors could introduce recent innovations in developmental biology, such as embryonic stem cells, induced pluripotent stem cells, and tissue engineering, highlighting breakthroughs in these fields and the contributions of the university's research teams. This approach not only expands students' knowledge but also stimulates their interest in research, laying a strong foundation for developing multi-talented medical professionals capable of thriving in the new era of healthcare.

### Feasibility exploration

Integrating new technologies and methods into histology and embryology education enhances students' structural recognition efficiency and exposes them to novel knowledge, techniques and theories beyond standard textbooks. While this approach significantly contributes to the professional development of medical students, its implementation faces several challenges. A primary limitation is the demand for comprehensive and in-depth knowledge frameworks, which substantially elevates the requirements for instructors' teaching and research capabilities. The establishment of an interactive slice learning system requires substantial financial support. It is crucial to draw upon successful case studies from other institutions and secure adequate preparation funding. Establishing an effective teaching framework is equally important. Given that educational reform is a gradual process, implementation should follow a struc-

tured approach encompassing conceptualization, preparation, staff training, system application, framework establishment, and feedback evaluation.

### Conclusion

As universities serve as the primary institutions for cultivating well-rounded medical professionals, it is essential to keep pace with the rapid advancements in modern medicine. While new knowledge, technologies, and theories emerge at an unprecedented pace, their integration into standard textbooks often experiences significant delays. Modernizing traditional pedagogical approaches through the systematic incorporation of these advancements into the curriculum can substantially enhance the professional competencies of medical students.

Furthermore, the development of exceptional medical professionals requires not only clinical proficiency but also robust research capabilities. Scientific research and innovation have become indispensable attributes for future medical practitioners. Contemporary medical education must therefore emphasize the cultivation of scientific research foundations and innovative thinking to address the increasingly complex challenges of healthcare [24, 25]. As a leading medical institution, the strategic integration of theoretical knowledge, clinical skills, and research literacy represents a crucial approach to fostering the scientific acumen and innovative spirit essential for students' professional development. Enhancing foundational medical education through these measures will undoubtedly yield more effective results in developing medical professionals capable of meeting future healthcare challenges.

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# Optimization strategies for lesson preparation and lecturing in anesthetic pharmacology

Panpan Hu, Tianying Xu

Department of Anesthetic Pharmacology, School of Anesthesiology, Second Military Medical University/Naval Medical University, Shanghai 200433, China.

**Corresponding author:** Tianying Xu.

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## Highlights

- This review clearly defines the role of anesthetic pharmacology in the medical curriculum.
- It emphasizes analyzing students' prior knowledge and specific needs for targeted lesson preparation.
- It proposes actionable methods to integrate anesthetic pharmacology with clinical practice.
- It advocates for continuous updates to teaching materials to incorporate the latest advancements in the field.
- It highlights the role of modern teaching tools (multimedia, virtual reality, interactive simulations, etc.) in improving instructional design and student engagement.

## Abstract

Anesthetic pharmacology, a specialized branch of pharmacology, differs significantly from the foundational pharmacology taught in undergraduate medical programs. A key challenge lies in effectively distinguishing and integrating these two courses to enhance students' theoretical understanding and foster their clinical anesthesia skills. This paper explores strategies for optimizing lesson preparation and delivery in anesthetic pharmacology, focusing on course positioning, student knowledge assessment, clinical integration, objective setting, content development, instructional design, innovative teaching tools, and classroom management. The ultimate aim is to enhance teaching effectiveness and train anesthesiology professionals with robust theoretical knowledge and practical competence.

**Keywords:** Anesthetic pharmacology, instructional design, course positioning, teaching tools

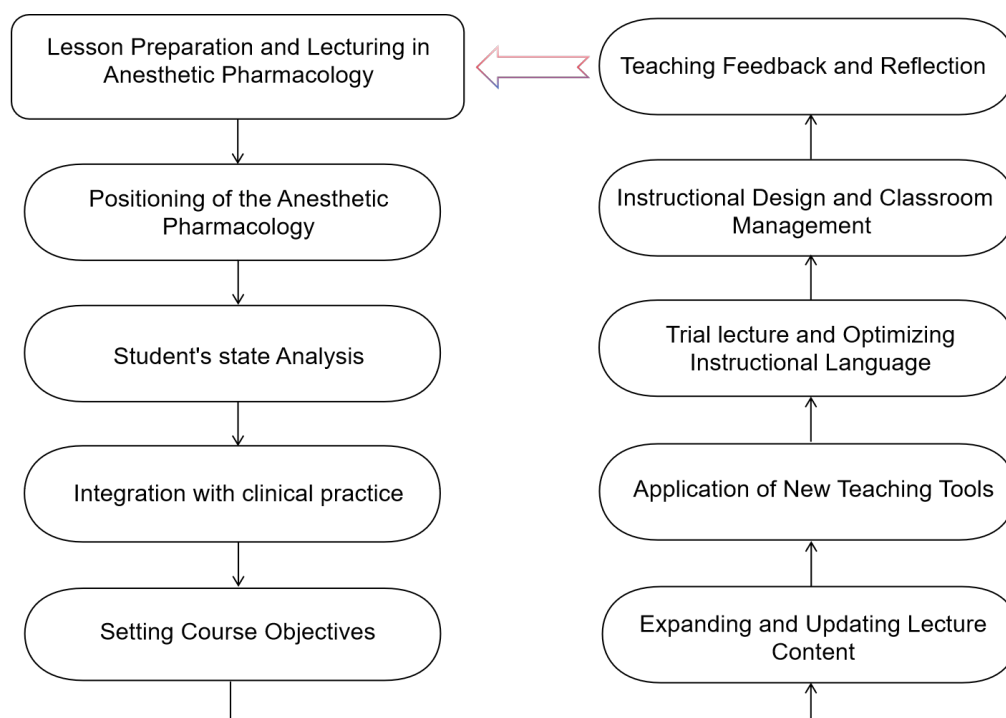
## Introduction

Anesthetic pharmacology is a core course in the undergraduate anesthesiology curriculum, focusing primarily on the mechanisms of interaction between commonly used anesthetic drugs and the human body during anesthesia [1]. As a foundational precursor to clinical anesthesiology, it not only provides essential knowledge about anesthetic drug mechanisms but also establishes the theoretical basis for subsequent clinical skills training. Therefore, it is crucial for instructors to carefully design course content, ensuring that students acquire

a solid understanding of pharmacological theory and its application in clinical practice.

With the rapid advancements in anesthesiology, the global diversity of anesthetic drugs and techniques continues to expand [2]. To keep pace with these developments, anesthetic pharmacology teaching must integrate cutting-edge knowledge and effective teaching strategies. This dual focus enables students to consolidate their understanding of traditional pharmacology while addressing the challenges posed by modern anesthetic technologies [3]. However, due to the inherent delay in textbook updates





**Figure 1.** The model of lesson preparation and lecturing in anesthetic pharmacology.

relative to academic advancements, instructors must actively broaden their knowledge and update course content to ensure students remain informed about the latest theories and practical skills in anesthetic pharmacology.

To enhance the teaching outcomes of the anesthetic pharmacology course, this study explores strategies for optimizing its preparation and delivery (**Figure 1**).

#### **Positioning of the anesthetic pharmacology course**

In the medical education system, anesthetic pharmacology serves as a critical bridge between foundational pharmacology and clinical practice. As an extension of pharmacology, the course explores the mechanisms, clinical applications, and effects of anesthetic drugs across various anesthetic techniques [4]. Simultaneously, as a precursor to clinical anesthesiology, it addresses essential topics such as drug mechanisms, metabolism, and interactions. To meet teaching objectives, instructors must clarify the course's relationship with other subjects, avoiding redundancy with foundational pharmacology while emphasizing deeper and more advanced content.

Additionally, anesthetic pharmacology must cater to the practical needs of anesthesiology, particularly in drug selection, administration protocols, and ensuring drug safety during clinical

procedures [5]. A well-defined course positioning not only enhances students' motivation but also allows instructors to design cohesive and comprehensive teaching content, avoiding fragmented or disorganized knowledge delivery.

#### **Student analysis**

Understanding the student cohort is essential for optimizing lesson preparation. The primary audience for anesthetic pharmacology typically includes third- and fourth-year undergraduate medical students who have completed foundational courses in pharmacology, anatomy, and physiology but have limited exposure to clinical anesthesia. Teachers can assess students' prior knowledge, cognitive levels, and learning needs through pre-class surveys, individual discussions, and collaboration with other instructors [6].

Furthermore, students' needs vary by grade and major. For those preparing for clinical practice, the course should emphasize drug application and emergency management during practical procedures. For junior students, the focus should shift to foundational theories. This tailored approach helps avoid redundancy with other courses, ensures balanced coverage of key teaching points, and enhances student engagement and learning outcomes.

#### **Integration with clinical practice**

Anesthetic pharmacology stands at the intersection of pharmacology and clinical anesthesia, encompassing both theoretical knowledge and practical skills. Given that some instructors may lack direct clinical anesthesia experience, the following strategies are recommended to optimize teaching content and improve quality:

- **Knowledge Updates:** Teachers should actively collaborate with clinicians involved in anesthesia practice over the past two years to gather up-to-date information on anesthetic drugs and techniques [7].
- **Synchronization of Teaching Content:** Recognizing the lag in textbook updates, instructors should integrate recent findings on drug reactions, precautions, and new anesthetic formulations shared by clinical anesthesiologists into their teaching materials [8].
- **Content Review:** Regular discussions with practicing anesthesiologists should be conducted to review and update content on dosage, administration, adverse reactions, contraindications, and indications, ensuring clinical relevance and timeliness [9].
- **Alignment with Clinical Needs:** Teaching content should reflect the competencies required in clinical practice, focusing on developing students' practical skills and readiness for real-world applications [10].
- **Continuous Education for Instructors:** Teachers should engage in professional development through seminars, workshops, and clinical training to keep their knowledge current.

By implementing these measures, the teaching of anesthetic pharmacology can be closely aligned with clinical practice, enhancing both the practicality and effectiveness of the course while providing students with high-quality education.

### Setting course objectives

Instructors should establish clear course objectives tailored to the backgrounds and needs of students at different academic levels. These objectives should encompass knowledge, skill, and competency goals [11].

- **Knowledge Goals:** Students should master the foundational concepts of anesthetic pharmacology, including the classification, pharmacological actions, pharmacokinetics, and pharmacodynamics of commonly used anesthetic drugs. To address varying levels of complexity,

instructors must allocate class time effectively, ensuring the material is neither overly dense nor overly simplified. This allows students to consolidate their understanding while building a strong knowledge foundation.

- **Skill Goals:** Anesthetic pharmacology requires students to apply theoretical knowledge in clinical settings. Methods such as case analysis, group discussions, and scenario-based simulations can help students bridge the gap between theory and practice, enhancing their clinical problem-solving abilities.
- **Competency Goals:** Modern higher education emphasizes integrating ideological and political education into professional courses. Teachers should inspire students' sense of responsibility and professional ethics in anesthesiology through well-designed course content. Competency goals should incorporate topics such as ideology, morality, legal regulations, and professional ethics, fostering social responsibility, teamwork, and a commitment to excellence in anesthesiology.

### Expanding and updating lecture content

Given that textbooks often lag behind advancements in anesthetic pharmacology, instructors must continuously update and expand lecture content. This ensures students remain informed about the latest developments, including new anesthetic drugs, targeted anesthesia techniques, and personalized anesthesia strategies [12-15]. To address these gaps, instructors can:

Regularly review research literature, attend professional academic conferences, and consult clinical practitioners to stay current with emerging trends.

Encourage students to engage in self-directed learning by introducing them to recent scientific papers, online databases, and other resources. This practice not only broadens students' knowledge but also fosters a habit of lifelong learning.

### Application of new teaching tools

Incorporating modern teaching tools is essential for enhancing instructional design. Technologies such as multimedia, virtual reality, and 3D simulations can make lessons more interactive and engaging. For example:

- **Virtual reality Simulations:** Simulating anesthesia scenarios using virtual reality can pro-

vide students with an immersive understanding of drug effects and procedural workflows.

- **Multimedia Tools:** Videos and animations are effective for explaining complex pharmacological mechanisms, enabling students to better grasp abstract concepts.

Instructors should stay informed about emerging teaching tools and integrate them into the curriculum to enrich lecture content and stimulate student interest. Diversified teaching approaches not only improve learning outcomes but also offer students a broader and more dynamic educational experience.

### **Trial lecture and optimizing instructional language**

Trial lectures are a crucial step in ensuring effective instructional design and classroom delivery. Instructors should prepare detailed lecture scripts and practice their presentations to refine their instructional language, avoiding unnecessary verbal fillers, frequent pauses, or repetitive expressions. Trial lectures allow instructors to better control teaching time, ensuring a coherent and logical flow of content. Additionally, focusing on facial expressions, gestures, and tone during presentations can enhance engagement with students. Repeated rehearsals help young instructors build confidence, improve their teaching language, and achieve smoother classroom management and delivery [16].

### **Instructional design and classroom management**

Effective instructional design is key to achieving successful teaching outcomes. Instructors should develop diverse instructional activities that promote student interaction and engagement. For example, integrating approaches such as problem-based learning, team-based learning, and case analysis can stimulate active student participation and critical thinking during class [17, 18]. Furthermore, course content should be closely tied to clinical practice, ensuring that students not only grasp theoretical concepts but also develop the skills to apply them in clinical scenarios.

Classroom management is equally critical. Instructors should monitor students' learning progress throughout the course, particularly during lengthy lectures. Techniques such as questioning, interactive activities, and discussions can help maintain student focus and create a dynamic learning environment. For

students who struggle or show low motivation, individual counseling and guidance can help overcome learning barriers and foster greater engagement [19].

### **Teaching feedback and reflection**

Gathering teaching feedback and engaging in reflection are essential for improving instructional quality. Instructors can use real-time assessment tools, such as Rain Classroom, to deliver examination questions and evaluate students' understanding after each session [20]. Collecting student feedback on their learning experiences and suggestions allows instructors to make targeted improvements in subsequent lessons.

Reflection is equally important for professional growth. Instructors should regularly evaluate their teaching strategies and experiences, identifying successful approaches and areas needing improvement. For instance, after each lecture, instructors can analyze which instructional designs were effective and adjust their strategies accordingly. This iterative process ensures continuous enhancement of teaching quality and better alignment with student needs [21].

### **Conclusion**

Teaching anesthetic pharmacology requires instructors to possess foundational pharmacological knowledge, up-to-date clinical practice insights, and well-designed instructional strategies complemented by effective classroom management. By carefully positioning the course, conducting thorough student analyses, and setting clear objectives, instructors can optimize lesson preparation and enhance student learning outcomes. Additionally, staying informed about the latest developments in anesthetic drugs and techniques ensures that teaching content remains relevant and cutting-edge. The integration of modern teaching tools and rehearsal techniques further improves classroom interactivity and instructional effectiveness. Finally, a commitment to continuous feedback and reflection enables instructors to refine their teaching strategies, ultimately cultivating anesthesiology professionals with robust theoretical knowledge and practical skills.

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# Ethical challenges in research faced by master's students in anesthesiology

Zhenghuan Song<sup>1,2,\*</sup>, Qinyu Bao<sup>2,\*</sup>, Jiaqin Cai<sup>2</sup>, Tingting Bao<sup>1</sup>, Zhu Yu<sup>1</sup>, Yihu Zhou<sup>1</sup>, Mengling Huwang<sup>3</sup>, Miao Zhou<sup>1</sup>, Jing Tan<sup>1,2</sup>

<sup>1</sup>Department of Anesthesiology, Jiangsu Cancer Hospital & Jiangsu Institute of Cancer Research & The Affiliated Cancer Hospital of Nanjing Medical University, Nanjing 210009, Jiangsu Province, China. <sup>2</sup>Jiangsu Province Key Laboratory of Anesthesiology, Xuzhou Medical University, Xuzhou 221004, Jiangsu Province, China. <sup>3</sup>Department of clinical medicine, Bengbu medical university, Bengbu 233030, Anhui Province, China.

\*The authors contribute equally.

**Corresponding author:** Jing Tan.

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## Highlights

- Ethical approval is a fundamental step in research for anesthesiology master's students.
- Conflicts between ethical approval timelines and clinical training schedules hinder research progress.
- Lengthy review periods can delay research completion and dissertation submission.

## Abstract

Ethical approval is the first essential step for medical master's students to officially initiate research. This article discusses the ethical issues encountered in various types of research projects conducted by professional master's students, the preparation of ethical application materials, conflicts between the timing of ethical applications and the clinical training rotation schedules, and the continuity of ethical applications among students within the same cohort and across different cohorts.

**Keywords:** Ethics, professional master's, application, approval, standardized training, retrospective analysis

## Introduction

The current training system for medical master's students in China divides them into two categories: research-oriented and clinical-oriented programs [1]. Among these, the clinical-oriented master's program, commonly known as the professional master's track, emphasizes practical skills development, focusing on clinical practice relevance and teamwork cultivation. This program also has stringent evaluation standards to assess students' academic and practical competencies [2, 3]. Consequently, professional master's students must complete clinical training while also racing against time to fulfill their research requirements [4]. Ethical approval is a critical first step in formally launching a research project, making it essential for students to have a solid

understanding and proficient application of ethical principles. This study aims to: (1) comprehensively explore the ethical challenges faced by anesthesiology master's students in various research projects; (2) analyze how the ethical application process impacts their research progress, especially with respect to conflicts between approval timelines and clinical training schedules; and (3) propose and evaluate effective strategies to address these challenges. The research questions include: What specific ethical issues arise in anesthesiology clinical and basic research? How do current ethical application procedures affect the research process? What are the most practical and efficient ways to optimize rotation schedules to balance clinical training and ethical approval waiting time? This article will discuss the concept of ethical approval, its importance, the ethical challeng-



es encountered in different types of research projects by professional master's students, and the difficulties in preparing ethical application materials and managing their timing.

### **Concept of ethical applications in research**

Ethical applications in scientific research refer to a structured process designed to identify and address ethical issues and risks within a research project [5]. This process typically requires researchers to provide detailed information, ensuring adherence to ethical principles and legal regulations throughout the study. Ethical applications are based on core principles such as respect for human dignity, informed consent, privacy protection, research justice, honesty, and transparency. These principles ensure that research activities do not harm participants, society, or the environment and that research integrity and fairness are maintained. Informed consent, a key principle, mandates that researchers provide participants with clear, sufficient information about the study, enabling voluntary and informed decisions regarding participation. Ethical applications also involve comprehensive risk assessments, requiring researchers to evaluate and address potential risks their projects may pose to participants, society, or the environment. Research design must meet ethical standards, with a clear outline of study methodologies and data collection practices that respect ethical guidelines. Effective data management is crucial, as researchers must detail how research data will be stored and protected to safeguard participant privacy and data security. Often, ethical applications require review and approval by an ethics board or committee to ensure compliance with ethical principles and protection of participant rights. Additionally, transparency in reporting is essential; researchers must present findings honestly and accurately, including both positive and negative results, maintaining the integrity and reproducibility of scientific research. In essence, ethical applications provide a framework guiding scientific research within ethical and legal boundaries, protecting participant rights, ensuring research integrity, and fostering public trust in research findings. This process strengthens the reputation of the research community and supports sustainable progress in science.

### **Ethical issues in different types of scientific research**

Ethical issues in anesthesiology research vary across different research types, with clinical and basic research each requiring distinct

ethical considerations [6]. In clinical research, which involves direct interventions and observations on human subjects, informed consent is essential. A patient-centered clinical trial concept must be developed [7]. Participants must be fully informed about the study's purpose, methods, and potential risks, and their consent must be documented through a signed form. For individuals unable to consent, such as children, the elderly, or those with disabilities, consent must be obtained from a legal guardian or representative [8].

Confidentiality is also crucial, with personal information must be protected from unauthorized access [9]. Additionally, participant safety must be prioritized, with anesthetic doses carefully calculated based on factors like medical condition, age, and weight, and vital signs closely monitored to prevent adverse effects. Balancing benefits and risks is critical, ensuring that the study's potential benefits outweigh its risks, with harm minimized. Justice and fairness must also be ensured by adopting an unbiased approach to participant selection and allocation.

In anesthesiology basic research, which typically involves animal and cell experiments to investigate drug mechanisms, efficacy, pharmacokinetics, and toxicology, distinct ethical standards are required. Ethical approval from relevant institutions is necessary to ensure compliance with research standards, and animal welfare must be protected [10]. This includes minimizing harm and suffering by using minimally invasive methods, regularly monitoring animal health, and providing adequate nutrition, water, and sanitary conditions. Researchers are encouraged to explore alternative methods, such as computer simulations or cell cultures, to reduce or replace animal use whenever possible, thus minimizing harm. The balance of benefits and risks remains crucial, as researchers must ensure the study's value justifies any potential harm to animals. Furthermore, researchers must prioritize data and privacy protection, implementing measures to prevent unauthorized access to research data.

In summary, anesthesiology research, whether clinical or basic, requires strict ethical standards that prioritize participant welfare, data confidentiality, research safety, and fairness, ensuring the research's reliability, compliance, and ethical integrity. Anesthesiology basic research must also respect animal welfare and rights, ensuring research reliability and legal compliance [11]. Efforts should be made to adopt alternative methods to reduce harm to animals and safeguard animal welfare to the

greatest extent possible. Additionally, appropriate measures should be implemented to protect the confidentiality of research data and participants' privacy.

### **The importance and necessity of research ethics applications**

The importance and necessity of research ethics applications lie in ensuring that scientific research is conducted within ethical and legal boundaries, thereby safeguarding the integrity, fairness, and safety of research activities [12]. At their core, ethics applications focus on protecting the rights of participants—whether human or animal—by requiring researchers to provide detailed plans on how they will safeguard privacy, autonomy, and safety [13]. This includes securing informed consent and ensuring that participants have the freedom to withdraw.

Ethics applications also play a critical role in preventing scientific misconduct by mandating transparency in reporting methods and findings [14]. This transparency enhances the credibility of research, reducing the likelihood of biased or dishonest practices, thereby upholding the reputation of the research community. By requiring clear descriptions of study designs, methodologies, and data handling processes, ethics applications promote openness, enabling independent validation and replication, which strengthens the reliability of findings.

Compliance with legal regulations is another crucial aspect, as many countries and institutions have established laws governing research ethics. Ethics applications ensure adherence to these regulations, helping researchers avoid legal disputes and penalties [15]. Additionally, they help protect the environment and biosecurity by requiring researchers to assess and mitigate any potential ecological or societal harm. This not only preserves ecosystems but also aligns with broader societal responsibilities. Ethics applications further contribute to improving research quality by prompting researchers to consider the ethical and societal impacts of their work, leading to more credible and sustainable outcomes [16].

Beyond practical measures, these applications foster a culture of ethical awareness and moral responsibility, strengthening ethical standards within the scientific community. In sum, research ethics applications are essential for ensuring adherence to ethical principles and legal requirements, protecting participants, promoting transparency and integrity, and cultivat-

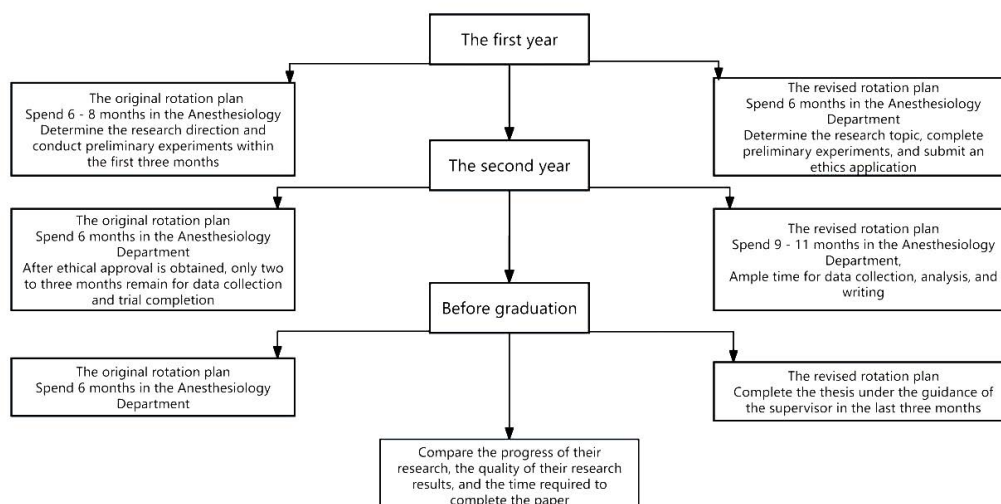
ing a responsible and ethically aware research environment.

### **Current status of ethical applications in graduate research**

Institutions have established Institutional Review Boards (IRBs) and standardized approval procedures to ensure ethical compliance in graduate research projects, marking a significant advancement in research integrity [17]. However, the ethical application process for graduate students remains notably complex. When applying for ethics approval, students must provide comprehensive details on their project's objectives, research design, data handling, and participant protection measures. Specific templates are required depending on the research type. For instance, in our teaching group, projects involving human genetic resources or non-drug research are initially reviewed by the institution's science office before advancing to the IRBs, while drug and device trials must go through the clinical trial office. These drug-related studies require additional documentation—such as consent forms, questionnaires, and, when applicable, insurance arrangements—before being submitted on platforms like Wetrail.

The IRBs approval process may involve either an expedited review for simpler studies, such as retrospective analyses, or a full review that requires written submissions and an oral defense. The committee's decision may range from approval to conditional acceptance or suspension, highlighting the process's rigor. This IRB framework has also heightened advisors' ethical awareness, prompting them to prioritize ethics training for graduate students, especially those involved in human-subject research. Such rigorous oversight not only strengthens ethical considerations but also enhances the credibility of research findings by requiring adherence to ethical guidelines, thus improving the trustworthiness of outcomes.

Furthermore, most institutions now mandate that ethics approval be obtained before any research begins, prohibiting reviews for ongoing studies. This policy encourages students to begin the ethics application process promptly after preliminary experiments, ensuring proper review without risking study termination. Overall, the ethics application process has become a critical regulatory step in graduate research, and its importance will continue to grow as ethical standards and technological advancements evolve.



**Figure 1. Clinical training rotation plan.**

In anesthesiology, the clinical training for professional master's students lasts 18-20 months, usually organized into three rotations: 6-8 months in the anesthesia department in the first year, 6 months in the second year, and 6 months before graduation [18]. This schedule demands that students determine their research direction and conduct preliminary trials within the first three months of their first rotation. However, by the time ethical approval is obtained—often more than halfway through their second-year anesthesia rotation—students may have only 2-3 months remaining for data collection and trial completion. This tight timeline can impede research progress and postpone thesis writing and publication.

To tackle this issue, our department suggests adjusting the rotation schedule. Students should be given 6 months in the anesthesia department during the first year to finalize research topics, complete preliminary trials, and submit ethics applications. During the waiting period for approval, students can rotate through other departments, review literature, and draft initial results. In the second year, 9-11 months should be allocated in the anesthesia department for data collection, analysis, and writing, with the last three months set aside for thesis completion under the advisor's guidance (Figure 1).

#### **Assessing the effectiveness of the proposed rotation schedule**

To evaluate the usefulness and effectiveness of the proposed rotation schedule, investigations can be conducted to determine if the new plan better aligns research activities with the ethical approval process [19]. First, a longitu-

dinal study could be carried out on a group of anesthesiology master's students following the adjusted rotation schedule. By comparing their research progress, the quality of their results, and the time required to complete their dissertations with students following the traditional schedule, we can quantitatively assess the impact of the new schedule on research efficiency.

Second, feedback from students, advisors, and relevant teaching staff could be gathered through questionnaires and interviews. Their subjective experiences and opinions on the new rotation schedule—such as whether it facilitates learning and research—could provide valuable qualitative insights into its effectiveness. Additionally, we could track the success rate of ethical approvals during the implementation of the new schedule and monitor how many research projects avoid disruption due to ethical issues.

Furthermore, since an IRBs decision to suspend or terminate a clinical trial can cause graduation delays, we recommend strategies to mitigate these challenges [20]. Advisors should encourage students to explore multiple aspects within the same research area, enabling later students to use existing ethical approvals. Students could also apply for multiple ethical approvals simultaneously, ensuring that unused approvals are available for subsequent cohorts. Finally, submitting retrospective analysis applications early is advisable, as these typically bypass full review, allowing faster approval. Retrospective analyses may also identify promising areas for future prospective studies, fostering a beneficial research cycle for successive cohorts.

While the proposed adjustment of the rotation schedule seeks to improve the balance between clinical training and research activities, several potential limitations should be considered. One challenge is the feasibility of implementing this schedule across all institutions, as it may require significant adjustments to existing clinical training frameworks and teaching resources. Some hospitals or medical schools may face difficulties in reallocating clinical training time, especially in departments with high patient volumes or limited faculty capacity. Additionally, ensuring that students receive adequate mentorship and research support during extended research periods may place an additional burden on faculty members, who might already have heavy workloads. Moreover, the proposed schedule may require more funding for research support, such as laboratory resources and data analysis tools, which could be a constraint for institutions with limited financial resources. Finally, resistance may come from students who prefer a more traditional, clinically focused training model, as well as from clinical departments that might feel the adjusted schedule reduces their access to students for clinical duties. These challenges should be carefully considered when implementing the revised rotation plan.

## Conclusion

Ethical approval is a key step in the research training of anesthesiology master's students, underscoring the need for robust ethics education. Our teaching group recommends aligning non-anesthesiology rotations with the ethical review waiting period to maximize students' time and ensure ethical compliance in their research. This adjustment may help improve clinical training programs by better balancing research and clinical duties. Future research could examine the long-term impact of such adjustments on academic performance and ethical research practices. Additionally, policymakers may consider integrating more structured ethical training into the curriculum to better prepare students for clinical research challenges.

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discussions.

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# Exploring the path of high-quality employment in medical colleges and universities through party building leadership

Shangping Fang, Chao Zhang

School of Anesthesiology, Wannan Medical College, Wuhu 241002, Anhui Province, China.

**Corresponding author:** Shangping Fang.

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## Highlights

- This review proposed Party-building strategies to enhance high-quality employment outcomes of medical majors:
- Strengthen ideological guidance and refine the employment-related ideological and political education system;
  - Enhance medical skills to improve employment competitiveness;
  - Improve the training system to cultivate precise talents meeting social needs;
  - Establish employment assistance and create new job opportunities.

## Abstract

Employment is the cornerstone of people's livelihood and a vital component of talent cultivation in higher education institutions. In the pursuit of the "Healthy China 2030" initiative, medical colleges and universities are committed to ensuring high-quality and comprehensive employment for their students by strengthening Party-building efforts. This approach aims to enhance students' employability, secure favorable employment rates, and align their career development with societal needs. This article explores the significance of Party-building in guiding college students towards proactive employment. It provides a comprehensive analysis of the current employment landscape in medical colleges and universities, identifying key challenges and opportunities. In response to these challenges, the article offers targeted recommendations on how Party-building initiatives within these institutions can foster high-quality and full employment for medical students. By integrating ideological guidance, skill enhancement, and strategic training reforms, the proposed measures aim to support medical graduates in making informed career choices and securing suitable employment, thereby contributing to the advancement of health-care and societal well-being.

**Keywords:** IParty building, medical colleges and universities, employment

## Introduction

Employment is fundamental to people's livelihood and a crucial element in the talent-cultivation process in higher education institutions [1, 2]. The report delivered at the 20<sup>th</sup> National Congress of the Communist Party of China set the goal of promoting "high-quality and full employment" [3]. The employment of students from medical colleges and universities, the

primary providers of medical and healthcare professionals, is intrinsically linked to the advancement of the medical sector and the improvement of public health standards.

In recent years, the rapid growth of the medical and healthcare industry, coupled with ongoing reforms in the sector, has introduced both new challenges and opportunities for medical colleges and universities in terms of employ-



ment-related tasks [4]. In this new-era context, leveraging Party-building guidance to promote high-quality and full employment in medical institutions has become a pressing issue.

This article explores the intersection of Party-building guidance and employment initiatives. It delves into how Party-building efforts in colleges and universities can promote high-quality employment for medical students, explores the implementation routes, and evaluates the resultant achievements. The goal is to establish a mutually reinforcing relationship between Party-building and employment efforts, fostering coordinated development.

### **Analysis of the employment situation in medical colleges and universities**

#### ***Intensified employment competition***

##### *Expansion of medical education*

The continuous expansion of medical education has led to an annual increase in the number of medical graduates. As a result, the supply of medical professionals now significantly exceeds market demand, intensifying employment competition [5].

##### *Saturation of hospital positions*

In many urban areas, especially in large public hospitals, there is a saturation of medical positions, resulting in limited job openings for new graduates. While small and medium-sized hospitals may still require medical talent, they often struggle to attract top-tier graduates due to relatively inferior working conditions.

##### *Increasingly stringent academic requirements*

With advances in medical technology and improvements in medical services, hospitals are raising academic requirements for new hires. Many positions now necessitate a master's degree or higher, placing those with only a bachelor's degree at a disadvantage in the job market.

#### ***Changes in employment structure***

##### *Shifts in academic qualification requirements*

The increasingly stringent academic thresholds for medical professionals have consequently driven a growing number of medical graduates to pursue advanced degrees, aiming to bolster both their academic qualifications and competitive edge in the job market. Postgraduate study

has thus become a mainstream option among medical graduates.

#### ***Evolution of employment patterns in medical field***

Historically, the majority of medical graduates have primarily pursued career opportunities at public hospitals and large-scale medical institutions. Nevertheless, in recent years, with the deepening of medical reforms and the rapid growth of private medical institutions, a growing number of medical graduates are now opting for positions in grassroots medical facilities, including private hospitals and community health service centers. Concurrently, a notable trend has emerged with some graduates diversifying their career paths by entering related industries, such as pharmaceutical corporations and medical device manufacturing enterprises.

##### *Alterations in employment locations*

Historically, medical graduates have demonstrated a strong preference for employment opportunities in metropolitan areas and economically advanced coastal regions. However, a notable transformation has emerged in recent years, coinciding with the government's intensified focus and substantial investment in grassroots healthcare services. This policy shift has prompted an increasing number of medical graduates to pursue career paths in central and western regions, as well as in primary healthcare settings. Despite relatively underdeveloped economic conditions in these areas, the substantial demand for healthcare services presents medical graduates with more employment opportunities and room for development.

#### ***Emerging trends in healthcare employment sectors***

The rapid development of digital healthcare technologies has revolutionized traditional medical practices, bringing unprecedented attention to innovative medical platforms such as internet-based hospitals, online consultations, and digital pharmacy. This has opened new employment domains and opportunities for medical graduates, with many entering emerging fields like telemedicine, health management, and medical data analysis. These occupations not only offer significant development prospects but also present medical graduates with diversified career trajectories and enhanced opportunities for specialization.

#### ***Inadequate employment services***

*Insufficient career guidance infrastructure*

Some medical higher education institutions often fail to allocate sufficient resources to establish comprehensive career planning and professional development programs. They lack comprehensive career-planning and employment-guidance curricula. The existing career guidance services tend to be superficial, primarily focusing on basic skill development such as resume preparation and interview techniques. More critically, there is a notable lack of systematic analysis and instruction regarding emerging industry trends, evolving employment patterns, and the specific competency requirements of healthcare employers.

*Ineffective employment information dissemination*

The communication channels between medical educational institutions and potential employers remain underdeveloped, resulting in a significant information gap for students regarding current market demands. The absence of an integrated, user-friendly employment information platform creates substantial barriers for students attempting to access timely recruitment updates and industry trends.

*Insufficient practical training opportunities*

The availability of clinical internships and practical training positions provided by medical colleges fails to meet the growing demand from students. Moreover, many healthcare institutions impose rigorous prerequisites regarding students' clinical competencies and practical experience, thereby limiting access to high-quality internship opportunities that are crucial for professional development.

*Underdeveloped school-enterprise cooperation*

The collaborative efforts between medical institutions and industry stakeholders, including medical facilities and pharmaceutical enterprises, remain superficial and underdeveloped. Current partnerships are typically limited to basic arrangements such as establishing internship sites and conducting joint training sessions, lacking more substantive and innovative collaborative models that could significantly enhance students' professional readiness and employment prospects.

**The significance of party building in facilitating graduate employment in medical institutions*****Enhancing employment rate and professional******development of medical graduates***

Medical colleges serve as crucial bases for cultivating healthcare professionals, where the employment rate and professional competence of graduates directly impact the development of the medical and healthcare industry and the improvement of public health standards [6]. Party-building initiatives play a pivotal role in improving both the employment rate and career development quality of graduates. Through the guidance and education provided by Party organizations, students can develop a more comprehensive understanding of their career orientation and professional trajectories, thereby enhancing their employment awareness and competencies. Additionally, providing graduates with expanded access to employment information and opportunities, which effectively elevates employment rates. Furthermore, Party-building initiatives guide graduates in cultivating appropriate employment perspectives, selecting suitable professional positions, and achieving the integration of personal aspirations and societal values, consequently enhancing employment outcomes [7].

***Strengthening grassroots party organizations and enhancing their cohesion and combat effectiveness***

Grassroots Party organizations in medical colleges are integral components of the Party's grassroots organizations and serve as bridges and ties between the Party and the broader faculty and student body. Leading graduate employment efforts through Party building can further strengthen grassroots Party organizations and improve their cohesion and combat effectiveness [8]. On one hand, Party organizations can enhance Party members' Party spirit and sense of responsibility by conducting various organizational activities, social practices, and volunteer services, thereby improving the cohesion and centripetal force of Party organizations. On the other hand, Party organizations can strengthen Party member education and training, enhancing their political quality and professional competence, thereby boosting the combat effectiveness of Party organizations. These efforts help grassroots Party organizations better fulfill their roles as battle forts and provide robust organizational support for graduate employment efforts.

***Fostering a synergistic relationship: mutual reinforcement and collaborative development between party building and employment initiatives***

The integration of Party-building with graduate employment strategies not only enhances employment outcomes and strengthens grassroots Party organizations but also creates a dynamic framework of mutual promotion, collaborative development, and shared benefits between Party building and employment work. On one hand, Party organizations can significantly enhance graduates' understanding of the employment landscape and market dynamics through comprehensive career guidance programs and professional development workshops. These initiatives not only improve graduates' employability but also serve as vital platforms for Party organizations to engage with and serve the academic community, thereby strengthening their organizational cohesion and social influence. On the other hand, the successful implementation of employment efforts can provide Party organizations with more practical opportunities and platforms for showcasing their effectiveness. Through the strategic integration of Party building and employment services, a mutually reinforcing relationship is cultivated, leading to a new paradigm of collaborative success and shared achievements.

#### **Strategic implementation of party building to facilitate high-quality employment for medical students**

##### ***Enhancing ideological leadership and optimizing the political-educational framework for employment***

Employment is a key outcome of talent cultivation in universities, and employment education plays a crucial role in the ideological and political education of students. To provide high-quality employment services for medical students, medical colleges should establish a comprehensive ideological and political work system for employment, guiding students to establish correct employment values aligned with the medical and healthcare professional spirit of the new era [9].

**Constructing a Participation-Based Work Structure:** Medical colleges should implement the "top leader" initiative, where key university and college leaders actively engage in researching, planning, and executing employment-related work. They should treat graduate employment as a significant political task, aiming to build a collaborative employment education community involving university leaders, renowned medical experts, medical staff, student affairs teams, and students' families. A comprehensive employment framework should be established, with the employment department overseeing

the overall strategy and relevant functional departments handling specific tasks.

**Delivering Excellent Ideological and Political Courses on Employment Education:** Adhering to the principle of cultivating both moral values and medical expertise, ideological education should be integrated throughout the talent cultivation process. A series of ideological, practical, and vocational courses should be tailored for medical colleges. Employment-focused thematic activities centered on "views on talent cultivation, career outlook, and employment concepts" should be organized to enhance medical students' employment awareness, encourage positive shifts in their employment attitudes, and foster innovative and entrepreneurial thinking. Additionally, role models of the times and heroes from the anti-epidemic efforts can be used as educational tools to vividly explain medical professionalism, instill patriotic sentiments, and guide students to view preventing diseases, alleviating pain, and safeguarding public health as their sacred responsibilities.

**Highlighting the Main Theme of Grassroots Employment:** The grassroots serve as a vital platform for medical students to realize their life values. Strengthening the exemplary role of grassroots employment is crucial, and activities such as "Searching for the Most Beautiful Grassroots Doctors" and "Forums for Alumni Employed and Entrepreneurial at the Grassroots Level" can be used to promote this cause. Continuous attention and widespread publicity should be given to the exemplary deeds of outstanding graduates and alumni who choose grassroots employment [10]. By highlighting their stories, medical students will be inspired to focus on grassroots healthcare roles. Through the power of model role, more medical students should be encouraged to start their careers in primary medical institutions, contributing to significant achievements in ordinary positions.

For instance, at the School of Anesthesiology of Wannan Medical College, the college leaders attach great importance to employment work and incorporate it into the overall development plan of the college. To build a community for employment and education, the college invites senior professors, outstanding alumni, and industry experts to participate in employment guidance activities. For example, Zhang, an alumnus who has worked in the anesthesia department of grassroots hospitals for many years and has been highly praised by patients for his superb medical skills and noble medical ethics,

was invited back to the school to give a lecture titled “The Persistence and Growth of Grassroots Anesthesiologists”, where he shared his work experience and achievements in grassroots healthcare. This inspired many students to dedicate themselves to primary healthcare roles. Such activities help students recognize the importance and potential of grassroots employment, with many expressing a strong desire to follow in the footsteps of their alumni and serve in these vital positions.

#### ***Enhancing medical skills and improving employment competitiveness***

Party branches at both university and hospital levels should collaborate on Party-building efforts with teaching or affiliated hospitals to create platforms for medical skill development. These platforms should provide rich resources and practical opportunities for students [11]. For example, medical lectures, seminars, workshops should be organized, with experts and professors invited to share their knowledge and skills. Through early and frequent clinical experiences, students can improve their clinical skills and thinking abilities, ultimately enhancing their clinical competence.

At the School of Anesthesiology of Wannan Medical College, close Party-building collaborations with several affiliated hospitals have been established. These hospitals regularly send experienced anesthesiologists to the college to deliver lectures and provide skill training. In one notable instance, a special lecture and hands-on session on “Difficult Airway Management” was conducted, where the doctors not only explained theoretical concepts in detail but also demonstrated the procedure on a simulated patient, allowing students to practice firsthand.

In addition, the college also arranges early clinical internships for students, enabling them to gain exposure to the anesthesia department during their freshman and sophomore years and familiarize themselves with clinical work processes. With such opportunities, students’ clinical skills have significantly improved, and they have achieved excellent results in various medical skills competitions, enhancing their competitiveness in the job market. According to statistics, students who participate in such practical training are highly regarded by employers for their proficiency in professional knowledge and practical skills during job interviews, resulting in a significant increase in employment success rates.

#### ***Perfecting the training system to cultivate tal-***

#### ***ents precisely meeting social demands***

Medical education is a vital cornerstone for healthcare development [12]. Facing the new challenges posed by the pandemic, the new tasks of implementing the Healthy China strategy, and the new requirements of global medical development, medical schools should adhere to the orientation of serving national strategies and regional economic development needs. They must actively adapt to industrial development and economic transformation, beginning with the construction of new medical disciplines. Schools should focus on cultivating research-oriented, interdisciplinary, and applied talents, aiming to build a talent training system that aligns with the employment market’s needs. This will provide robust support for advancing the Healthy China initiative and safeguarding public health [13].

**Perfecting the talent training cycle system:** Medical schools should promote comprehensive evaluation of employment works, enhance the employment quality reporting system, and drive reforms that link employment, enrollment, and training. Improving graduate placement rates and employment quality should serve as key indicators for adjusting professional settings, optimizing training models, and refining curriculum systems. These efforts will continuously enhance the employment competitiveness of medical students. Additionally, market research and professional early-warning mechanisms should be strengthened to create a feedback loop where training and employment mutually reinforce each other.

**Optimizing the structure and layout of disciplines and majors:** Medical schools should actively respond to the urgent needs of national public health and emerging industries by deepening the reform of key majors such as clinical medicine, traditional Chinese medicine, preventive medicine, nursing, and health service and management. Efforts should be focused on strengthening second-tier disciplines such as pediatrics, obstetrics, psychiatry, infectious diseases, radiology, and anesthesiology, addressing the urgent societal need for professionals in these niche areas. Additionally, expanding order-oriented training programs and accelerating the cultivation of general medical professionals who integrate both prevention and treatment are essential.

**Constructing a new model of diversified participation in training:** Schools should enhance “medicine-education-industry-research” collaborative education mechanism, establish

multi-level and multi-field cooperation in medical training. The development of a new medical talent training model involving universities, teaching hospitals, industries, and enterprises should be prioritized. This should include deepening medical-education collaboration, industry-education integration, science-education fusion, and school-enterprise partnerships. Such a model will promote the seamless connection between the medical, education, talent, industry, and innovation chains, addressing structural contradictions in employment. Timely introduction of medical and healthcare industry standards will ensure that academic training aligns with job market requirements, producing graduates who are well-matched to their future roles.

The School of Anesthesiology of Wannan Medical College exemplifies this approach by continuously optimizing its curriculum based on market feedback. For example, in response to emerging trends in anesthesia, courses like “Anesthesia and Artificial Intelligence” are added to enhance students’ knowledge in cutting-edge fields. The school also focuses on cultivating talents in specialized medical areas, strengthening cooperation with hospital anesthesiology departments and medical device enterprises, and conducting industry-university research projects. A notable achievement is the joint development of a new anesthesia monitoring device with a medical device company, where students actively participated in the research and development process. This hands-on experience not only improved their professional skills but also deepened their understanding of the industry. Under this training model, students are better aligned with market demands. In recent years, the employment rate of graduates in anesthesia-related positions has steadily increased, with many securing positions at tertiary hospitals. Some graduates have also chosen careers in anesthesia research, contributing to the advancement of the field.

#### ***Establishing employment assistance and expanding new employment opportunities***

Universities play a central role in providing graduate employment guidance and services. However, to address the challenge of “difficulty in finding employment,” a collaborative effort is needed among the government, employers, and universities. Ensuring job opportunities, expanding employment channels, and increasing job supply are crucial. In light of the current challenging employment situation, concerted societal efforts are required, combining various

measures to stabilize the existing job market, expand new opportunities, create more entrepreneurial spaces, and offer more job positions to meet the diversified employment needs of graduates [14].

**Tapping the potential of market employment:** Exploring new job resource development channels and creating more job positions are key to achieving full employment for medical students. Medical schools should focus on developing effective job resource mechanisms by collaborating closely with government health departments, the medical industry, and the broader job market. Strengthening school-enterprise and school-locality partnerships, coordinating better with the labor market, and actively promoting initiatives like the “Stay and Work in Guangxi” program are essential steps. Special actions such as “university presidents and Party secretaries visiting enterprises to expand job opportunities” should also be implemented to broaden employment channels and stimulate job creation. Leveraging the unique advantages of university-affiliated hospitals, medical schools can create an “information database of key employers,” facilitating job placements through national regional medical centers, medical consortia, specialist alliances, private hospitals, and other healthcare organizations. Organizing regional, industry-specific, and alliance-based campus recruitment events will help gather a broader pool of job resources from the market and society, further enhancing employment opportunities for graduates.

**Creating a new engine for job supply:** Seizing new opportunities within the “big health” industry, which encompasses prevention, diagnosis, treatment, and healthcare services throughout the life cycle, is key to expanding employment options for medical students. Emerging fields such as life health, clinical diagnosis and treatment, biosafety, drug innovation, vaccine research, and artificial intelligence offer a wealth of new job positions. Medical schools should actively guide students toward employment and entrepreneurship in areas that address urgent societal needs and align with strategic emerging industries. Strengthen innovation and entrepreneurship practices is essential, including building platforms that connect students’ innovative projects and with social needs, implementing preferential policies for college students’ entrepreneurship, and supporting graduates in achieving diversified employment through new forms and flexible work arrangements will further enhance their career prospects.

Leveraging policy support as a regulator: Medical schools should capitalize on favorable policies for grassroots medical employment, ensuring effective placement and contract management for rural order-oriented free medical students. Flexible use of employment assistance policies, such as “Three Supports and One Assistance” and the “Western Plan” is vital. Government should consider broadening recruitment criteria for county and township medical institutions in remote and undeveloped areas to fill the employment gap. Additionally, developing community public service roles that integrate medical and healthcare services, rehabilitation, and healthcare, and hospice care can create more employment opportunities for medical students. These measures not only improve grassroots disease prevention, treatment, and health management capabilities but also meet the employment needs of medical graduates.

The School of Anesthesiology of Wannan Medical College actively implements various employment assistance measures. The college leadership has spearheaded the special initiative, “Secretary and President Visiting Enterprises to Expand Jobs and Promote Employment”, establishing partnerships with multiple hospitals and enterprises. For example, the college is currently negotiating with a major medical group to secure anesthesia-related positions for its graduates. In addition, the college capitalizes on the growth of the “big health” industry by encouraging students to participate in innovation and entrepreneurship projects. It also promotes grassroots employment policies, such as “Three Supports and One Assistance” and “Western Plan”. Several students have joined grassroots hospitals in western regions to work in anesthesia under the “Western Plan,” gaining valuable experience while contributing to local healthcare. Through these efforts, the college has effectively broadened employment channels for its students, enhancing their job prospects and career development.

## Conclusion

This article demonstrates that integrating Party-building guidance into university employment efforts can effectively improve students’ employment rates, facilitate their smooth transition into the workforce, strengthen grassroots Party organizations, and create a mutually supportive environment where Party-building and employment initiatives reinforce each other.

To address the current employment challenges faced by university students, it is crucial for

colleges and universities to promote the synergy between Party-building and employment efforts. This includes enhancing ideological guidance, helping students establish correct employment values, and offering clear interpretations of the current job market. Additionally, universities should provide employment assistance, skills development programs, and broaden employment opportunities for students. These measures will strengthen students’ employability, expand their career prospects, and ensure smoother transitions into the workforce.

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