

BMJ Open Anaesthesia provision, infrastructure and resources in the Heilongjiang Province, China: a cross-sectional observational study

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ABSTRACT

Objective The aim of this study was to explore the current status of the anaesthesia provision, infrastructure and resources in the Heilongjiang Province, China.

Design A cross-sectional observational study of hospitals, anaesthesiologists, assistant anaesthesiologists and anaesthetic nurses in the Heilongjiang Province.

Setting All hospitals in the Heilongjiang Province.

Participants The hospitals, anaesthesiologists (attending physicians, associate chief physicians and chief physicians), assistant anaesthesiologists (licenced assistant physicians, resident physicians and other trainees) and anaesthetic nurses.

Main outcome measures Standard descriptive statistics (percentages and numbers) were used to summarise the data.

Results The investigation involved 1123 hospitals, 405 of these hospitals had anaesthesiology departments (36.06%). There were 2406 anaesthesiologists, 175 assistant anaesthesiologists and 409 anaesthetic nurses. The proportion of anaesthesiologists was 56.60% in tertiary hospitals, 40.15% in secondary hospitals and 3.25% in primary hospitals and ungraded hospitals, respectively. Anaesthesiologists were present in 91.20% of public hospitals and 8.80% of private hospitals. Anaesthesiologists were present in 83.55% general hospitals and 16.45% of specialised hospitals. The Heilongjiang Province has a total of 2041 operating rooms and 543 beds in recovery rooms. The number of anaesthesia cases per capita per year was 326.86. The percentages of anaesthesiologists' age ≥ 46 , 36–45, 25–35 and < 25 are 24.03%, 41.80%, 33.91% and 0.27%, respectively. The proportions of resident physicians and attending physicians were 60.87%, and the proportions of associate chief physicians and chief physicians were 39.13%. The proportions of anaesthesiologists working > 12 hours, 10 hours \leq time \leq 12 hours, 8 hours \leq time $<$ 10 hours and < 8 hours were 0.55%, 22.04%, 64.30% and 13.11%, respectively.

Conclusions The present study demonstrated for the first time that the proportion of anaesthesiologists in the Heilongjiang Province, China, is still insufficient. The structure of anaesthesiologists needs to be optimised.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Strengths of this study include a large sample size, and this is the first cross-sectional observational study investigating hospitals, anaesthesiologists, assistant anaesthesiologists and anaesthetic nurses in the Heilongjiang Province.
- ⇒ Two separate sets of questionnaires, the department version and the individual version, were used in this study, which makes this survey more comprehensive.
- ⇒ This study used standard descriptive statistics (percentages and numbers) to summarise the data, which is a simple and clear representation.
- ⇒ The working hours and job satisfaction of anaesthesiologists were collected, but the data of anaesthesia assistants and nurses were not acquired.

INTRODUCTION

Greater than one-quarter (28%) of diseases are impacted by insufficient access to emergency and essential surgical and anaesthesia care globally, amounting to 1.4 million preventable deaths and 77.2 million disability-adjusted life-years per year.¹ Surgical conditions, including anaesthesia conditions, are estimated to account for 11% of these diseases.² Many of these conditions can be prevented or treated through simple surgical interventions. The morbidity and mortality associated with conditions amenable to surgical intervention continue to grow and have long been neglected by global public health services.³ Anaesthesia is a rate-limiting step for access to surgery in low-income and middle-income countries.⁴ Monitoring the anaesthetic capacity of a country or region is essential to ensure that population's anaesthesia needs are met and identify areas for targeted health system interventions.

The Chinese economy has enjoyed rapid growth in the past four decades. The Chinese

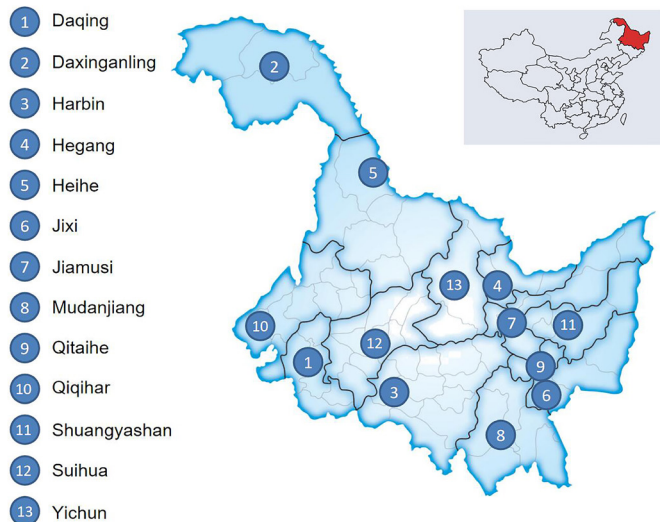


Figure 1 Surveyed hospitals in 13 counties of the Heilongjiang Province, China.

healthcare system has also undergone tremendous changes to meet the needs of 19% of the world population.⁵ However, medical resources, including human resources, are unevenly distributed, creating the potential for substantial work-related stress.⁵ Based on the annual statistics released by the National Health and Family Planning Commission of the People's Republic of China, the number of inpatient surgeries in China has doubled in the past 10 years, whereas the Chinese anaesthesiologist population has increased much more slowly. In 2018, the number of inpatient surgeries in the medical and health institutions of China reached 55 957 100, and there were approximately 78 000 anaesthesiologists.⁵ According to the World Federation of Societies of Anaesthesiologists Global Anesthesia Workforce Survey, some countries in the USA and Europe had a anaesthesiologists density of >20 per 100 000,⁶ and China should have 280 000 anaesthesia providers.

Furthermore, the specific data of the anaesthesia workforce in many provinces of China are not well known. We sought to conduct a survey to explore the current status of the anaesthesia provision, infrastructure and human resources in the Heilongjiang Province, China. The present study provides reference data for a long-term strategic plan for anaesthesiology development, healthcare reform and discipline construction in the province and the whole country.

METHODS

Study design and participants

This article adheres to the applicable Enhancing the Quality and Transparency of Health Research guidelines. Given that no patient identifiers were collected and there was a lack of risk of harm to patients, the requirement for written informed consent was waived by the Ethical Review Committee of Harbin Medical University Cancer Hospital. The questionnaires were developed by the

members of the Youth Professional Committee of the Heilongjiang Association of Anaesthesiologists. This study is a cross-sectional observational study including all hospitals in the Heilongjiang Province. The questionnaires were administered to hospitals and anaesthesiologists in 13 counties in the Heilongjiang Province (figure 1).

To better understand the anaesthesia provision, infrastructure and resources in the Heilongjiang Province, China, two separate sets of questionnaires were used in this study: the department version (online supplemental material 1) and the individual version (online supplemental material 2). The department version was designed to be completed by the department chair of anaesthesiology or a designated person at each hospital surveyed. The information in the department version includes the proportion of hospitals with a department of anaesthesiology; the number of anaesthesiologists, the gender distribution, assistant anaesthesiologists and anaesthetic nurses; the proportion of anaesthesiologists in hospitals of different levels, including tertiary hospitals, secondary hospitals, primary hospitals and ungraded hospitals; the proportion of anaesthesiologists in hospitals of different types, including general hospitals and specialised hospitals; the proportion of anaesthesiologists in hospitals of different structural characteristics, including public hospitals and private hospitals; the number of operation rooms and beds in recovery rooms; and the number of anaesthesia cases per anaesthesiologist per year. The individual version was developed and administered to the participating anaesthesiologists working in the Heilongjiang Province. The information in the individual version includes age; the distribution of technical titles among anaesthesiologists, including resident physician, attending physician, associate chief physician and chief physician; and the working hours and the career satisfaction of the anaesthesiologists, which were rated as quite satisfied, be basically satisfied, unsatisfied and very dissatisfied.

The questionnaires were distributed and collected from June 2018 to July 2018. Paper questionnaires and telephone interviews were used in this survey. The investigation consisted of three phases (figure 2). First, 606 copies of the department questionnaire were returned, among which 173 hospitals had anaesthesiology departments and 433 hospitals had no anaesthesiology departments. In addition, 1106 copies of individual questionnaires were returned. During the second investigative phase, 370 department questionnaires were returned, among which 156 hospitals had anaesthesiology departments and 214 hospitals had no anaesthesiology departments. During the third investigative phase, 147 department questionnaires were returned, of which 76 hospitals had anaesthesiology departments and 71 hospitals had no anaesthesiology departments.

Anaesthesia setup

The hospitals are graded to primary, secondary and tertiary hospitals, based on the functions, facilities and

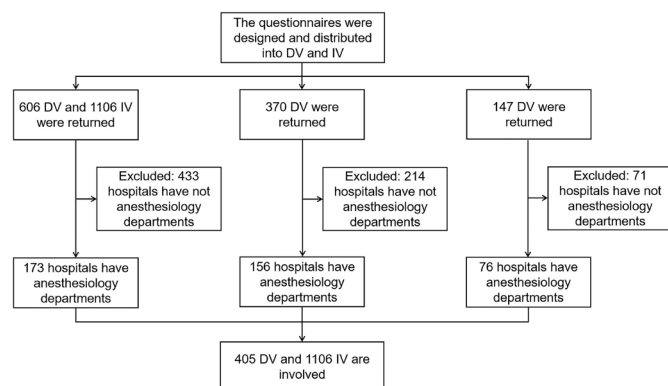


Figure 2 The research flow chart of this study. DV, department version; IV, individual version.

technical strength in accordance with the Hospital Grading Management Standards of China. Surgery in China is divided into four grades (grade 1: simple, grade 4: most complex) according to the degree of difficulty. Tertiary hospitals provide anaesthesia services for third and fourth grade operations. Secondary hospitals provide anaesthesia services for second and third surgeries. Primary hospitals provide anaesthesia services for first and second surgeries. In case of emergency, medical institutions can go beyond the level of surgery. The ungraded hospitals are the hospitals with no graded information available or not officially graded. The specialised hospitals include eye hospitals, ear, nose and throat hospitals, cancer hospitals, children's hospitals, chest hospitals, cardiac hospitals, and gynaecology and obstetrics hospitals, etc. The anaesthesiologists in this article refer to consultant anaesthesiologists including attending physicians, associate chief physicians and chief physicians who can independently complete various anaesthesia and guide subordinate anaesthesiologists. The responsibility of consultant anaesthetists is same in the tertiary, secondary and primary hospitals. The standard training period for resident physicians to become an attending anaesthesiologist is generally 3 years. It is about 5 years for an attending anaesthesiologist to become an associate chief physician or for an associate chief physician to become a chief physician. The anaesthetic nurses are mainly responsible for the management of anaesthetic supplies and anaesthetic drugs, the maintenance of anaesthesia equipment, anaesthesia recording, the nursing of patients during anaesthesia and in the post anaesthesia care unit, and procedures such as tracheal intubation and arteriovenous puncture under the supervision of the consultant anaesthesiologists. The nurses are not allowed to practice anaesthesia independently, even in places where there are few consultants.

Statistical analysis

Standard descriptive statistics were used to summarise the data. Basic characteristics are presented as the percentage for categorical variables. All the analyses were descriptively displayed as percentages or numbers.

Patient and public involvement statement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

A total of 1123 hospitals in the Heilongjiang Province were involved in our study.

The proportion of hospitals with anaesthesiology departments and the number of anaesthesiologists, assistant anaesthesiologists and anaesthetic nurses in the Heilongjiang Province

The numbers of anaesthesiologists, assistant anaesthesiologists and professional nurses are shown in [table 1](#). In total, 405 hospitals had anaesthesiology departments, and the proportion was 36.06%. The total number of anaesthesiologists was 2406. The ratio of male to female is 1.09:1. The numbers of assistant anaesthesiologists and anaesthetic nurses were 175 and 409, respectively.

The percentage of anaesthesiologists in hospitals of different levels, types and structural characteristics in the Heilongjiang Province

The percentages of anaesthesiologists in hospitals of different levels, types and structural characteristics are shown in [table 2](#). The 56.60% of anaesthesiologists in the Heilongjiang Province were present in tertiary hospitals, 40.15% in secondary hospitals and 3.25% in primary hospitals and ungraded hospitals. Anaesthesiologists were present in 83.55% of generalised hospitals and 16.45% of specialised hospitals. Anaesthesiologists were present in 91.20% of public hospitals and 8.80% of private hospitals.

The number of operation rooms, beds in recovery rooms and the number of anaesthesia cases per anaesthesiologist per year in the Heilongjiang Province

The operating room configuration, recovery room configuration and workload in different regions are shown in [table 3](#). The total number of operating rooms is 2041, and the total number of beds in recovery rooms is 543 in the Heilongjiang Province. The total number of hospitals without recovery rooms is 211 among the 1123 hospitals in the Heilongjiang Province. The number of anaesthesia cases per anaesthesiologist per year is 326.86 in the Heilongjiang Province.

The age and distribution of technical titles in the Heilongjiang Province

The age and distribution of technical titles are shown in [table 4](#). The number of anaesthesiologists age ≥ 46 was 265 (24.03% of all). The number of anaesthesiologists age 36–45 was 461 (41.80% of all). The number of anaesthesiologists age 25–35 years was 374 (33.91% of all). The number of anaesthesiologists age < 25 years was 3, and the ratio was 0.27%. The number of chief physicians was 308

Table 1 The proportion of hospitals with anaesthesiology departments and the number of anaesthesiologists, assistant anaesthesiologists and professional nurses

District	The number of hospitals with anaesthesiology department	The number of hospitals participating in the survey	Proportion of hospitals with anaesthesiology department (%)	Number of anaesthesiologists	Number of assistant anaesthesiologists	Number of professional nurses
Daqing	27	124	21.77	210	12	45
Daxinganling	7	28	25.00	22	2	2
Harbin	112	306	36.60	875	69	175
Hegang	15	53	28.30	64	8	26
Heihe	25	48	52.08	90	1	5
Jixi	15	64	23.44	93	1	6
Ja Musi	32	81	39.51	175	14	16
Mudanjiang	44	90	48.89	212	15	51
Qitaihe	9	28	32.14	44	7	4
Qiqihaer	43	126	34.13	257	24	16
Shuangyashan	16	43	37.21	119	5	31
Suihua	36	78	46.15	151	14	16
Yichun	24	54	44.44	94	3	16
Total	405	1123	36.06	2406	175	409

(13.32% of all). The number of associated chief physicians was 597 (25.81% of all). The number of attending physicians was 762 (32.94% of all). The number of resident physicians was 646 (27.93% of all).

Working hours and career satisfaction of anaesthesiologists in the Heilongjiang Province

The results of the working hours and career satisfaction of anaesthesiologists are shown in table 5. The proportion of anaesthesiologists working >12hour was 0.55%. The proportion of anaesthesiologists working 10

hours≤time≤12 hours was 22.04%. The proportion of anaesthesiologists working 8 hours≤time<10 hours was 64.30%. The proportion of anaesthesiologists working <8hours was 13.11%. The proportion of doctors who reporting being quite satisfied in the occupational satisfaction survey was 15.07%. The proportion of doctors who expressed being basically satisfied was 62.92%. The proportion of doctors who expressed being unsatisfactory was 20.18%. The proportion of doctors who were very dissatisfied was 1.83%.

Table 2 The proportion of hospitals of different levels, types and structural characteristics

District	Tertiary hospitals (%)	Secondary hospitals (%)	Primary hospitals and ungraded hospitals (%)	General hospitals (%)	Specialised hospitals (%)	Public hospitals (%)	Private hospitals (%)
Daqing	66.19	32.86	0.95	95.24	4.76	94.76	5.24
Daxinganling	36.36	63.64	0	81.82	18.18	100	0
Harbin	66.51	28.46	5.03	77.49	22.51	93.65	6.35
Hegang	62.50	35.94	1.56	50.00	50.00	84.38	15.62
Heihe	26.67	71.11	2.22	86.67	13.33	100	0
Jixi	69.89	29.03	1.08	92.47	7.53	77.42	22.58
Jamusi	65.71	31.43	2.86	82.86	17.14	97.14	2.86
Mudanjiang	44.76	46.19	9.05	76.19	23.81	94.29	5.71
Qitaihe	47.73	45.45	6.82	88.64	11.36	75.00	25.00
Qiqihaer	45.53	54.09	0.39	97.28	2.72	86.77	13.23
Shuangyashan	58.82	41.18	0	100	0	57.98	42.02
Suihua	31.08	68.92	0	77.70	22.30	99.32	0.68
Yichun	40.43	59.57	0	91.49	8.51	100	0
Average ratio	56.60	40.15	3.25	83.55	16.45	91.20	8.80

Table 3 The number of operating rooms, beds in recovery rooms and anaesthesia cases per capita per year

District	Number of operation rooms	Number of beds in recovery rooms	The number of hospitals with/ without recovery rooms	Number of anaesthesia cases per capita per year
Daqing	152	34	16/11	245.67
Daxinganling	22	7	7/0	207.41
Harbin	708	134	44/68	405.10
Hegang	57	9	5/10	238.73
Heihe	87	15	8/17	272.19
Jixi	76	12	7/8	347.04
Jamusi	198	128	24/8	311.73
Mudanjiang	150	68	25/19	312.60
Qitaihe	46	10	5/4	326.84
Qiqihaer	232	82	28/15	287.04
Shuangyashan	104	15	10/6	243.14
Suihua	121	17	9/27	307.03
Yichun	88	12	6/18	218.60
Summary	2041	543	194/211	326.86

DISCUSSION

The present study demonstrated for the first time the current status of the anaesthesia provision, infrastructure and human resources in the Heilongjiang Province, China. The number and the proportion of anaesthesiologists in the Heilongjiang Province are better than the national average of China but insufficient compared with developed countries. The structure of anaesthesiologists in hospitals of the Heilongjiang Province needs to be optimised. There is a shortage of young doctors and residents in the Heilongjiang Province. Anaesthesia resources in the Heilongjiang Province are inadequate. More recovery

rooms need to be established to improve the quality of the patient's recovery after surgery.

There were 2406 anaesthesiologists in the Heilongjiang Province. The Heilongjiang Province has a population of 47.30 million, and on average, every 100 000 people have 4.3 anaesthesiologists.⁷ However, in the populous Beijing-Tianjin-Hebei region, on average, every 100 000 people have 2.5 anaesthesiologists.⁵ In China, 4.8 anaesthesiologists serve per 100 000 people on average.⁵ In the USA and Greenland, there were 20.82 and 33.96 physician anaesthesia providers, respectively, per 100 000 people in 2018.⁸ In Portugal, there were 15.1 anaesthesiologists

Table 4 The age and distribution of technical titles in the Heilongjiang Province

Professional title	Age ≥46 years	Age 36–45 years	Age 25–35 years	Age <25 years	Chief physician (%)	Associated chief physician (%)	Attending physician (%)	Resident physician (%)
Daqing	42	78	27	0	32 (16.00)	51 (25.50)	73 (36.50)	44 (22.00)
Daxinganling	8	6	5	0	2 (9.09)	12 (54.55)	5 (22.73)	3 (13.64)
Harbin	95	184	156	1	97 (11.47)	226 (26.71)	301 (35.58)	222 (26.24)
Hegang	1	0	0	0	13 (18.84)	15 (21.74)	20 (28.99)	21 (30.43)
Heihe	4	2	1	0	13 (15.48)	19 (22.62)	19 (22.62)	33 (39.29)
Jixi	18	22	17	0	17 (20.24)	19 (22.62)	26 (30.95)	22 (26.19)
Jamusi	14	30	27	0	25 (14.88)	41 (24.40)	52 (30.95)	50 (29.76)
Mudanjiang	22	23	37	0	25 (12.76)	60 (30.61)	58 (29.59)	53 (27.04)
Qitaihe	12	6	12	0	13 (29.55)	11 (25.00)	6 (13.64)	14 (31.82)
Qiqihaer	38	77	68	2	40 (14.55)	66 (24.00)	87 (31.64)	82 (29.82)
Shuangyashan	0	1	5	0	16 (12.80)	27 (21.60)	43 (34.40)	39 (31.20)
Suihua	9	29	19	0	3 (2.31)	38 (29.23)	48 (36.92)	41 (31.54)
Yichun	2	3	0	0	12 (17.14)	12 (17.14)	24 (34.29)	22 (31.43)
Summary	265 (24.03)	461 (41.80)	374 (33.91)	3 (0.27)	308 (13.32)	597 (25.81)	762 (32.94)	646 (27.93)



Table 5 Working hours and career satisfaction of anaesthesiologists

Personal attributes	Proportion in the Heilongjiang Province (%)	Proportion in the whole country (%) ¹²
Average working hours per day		
Time <8 hours	144 (13.11)	17
8 hours≤time<10 hours	706 (64.30)	31
10 hours≤time≤12 hours	242 (22.04)	41
Time >12 hours	6 (0.55)	11
Career satisfaction		
Quite satisfied	165 (15.07)	1
Basically satisfied	689 (62.92)	29
Unsatisfied	221 (20.18)	54
Very dissatisfied	20 (1.83)	16

per 100 000 inhabitants in 2017.⁹ In Russia and the UK, these numbers were 20.91 and 17.85, respectively.⁸ Therefore, it seems that the number of anaesthesiologists in the Heilongjiang Province is greater than the national average but is far less than in developed countries. The importance of access to safe anaesthesia care was emphasised by the Lancet Commission on Global Surgery. The latest research estimates that the targeted specialist workforce density of the Lancet Commission on Global Surgery will be 20 physicians per 100 000 population by 2030.¹⁰ The number of anaesthesiologists within the specialist surgical workforce must be adequate to ensure effective leadership of anaesthesia services and delivery of care. There is a need to increase the number of anaesthesiologists in the Heilongjiang Province.

The proportion of technical titles of anaesthesiologists in the Heilongjiang Province is not coordinated, among which resident physicians only account for 27.93%, indicating that our province lacks young doctors with resident physician titles. The reason for this finding may be that such a gruelling situation can make anaesthesia unattractive and may explain why some young doctors have been reluctant to select this field as a career. Dissatisfaction with salary and low personal accomplishment are also important reasons for the lack of young people in this field.¹¹ To address these problems in the Heilongjiang Province, measures to increase the number of trained anaesthesiologists and increase the standardised training and recruitment of residents in the anaesthesiology department should be considered. The daily work of the recovery rooms is very important, which ensure the safety of surgical patients by decreasing the postoperative complications and mortality during the postsurgical recovery period. The hospitals without recovery rooms found in this study make the patients after surgery at higher risk of postoperative complications. The recovery rooms need to be established in these hospitals

to improve the recovery quality for the surgical patients after anaesthesia.

The results of a previous survey showed that 78% of the participants claimed to be 'very tired' or 'extremely tired'.¹² However, no questionnaires were used to investigate the workload of anaesthesiologists in the Heilongjiang Province. Therefore, we also calculated the annual average number of anaesthesia cases per anaesthesiologist and average working hours per day. The annual average number of anaesthesia cases per anaesthesiologist in our province is 326.86. A survey showed that the annual average number of anaesthesia cases per anaesthesiologist per year in Japan was 388.2.¹³ Therefore, the annual average number of anaesthesia cases per anaesthesiologist in the Heilongjiang Province is less than that in some developed countries.

Regarding average working hours per day, the working time of anaesthesiologists in Japan was greater than 54.4 hours per week.¹³ The RAND Corporation study of US anaesthesia workforce trends stated that anaesthesiologists worked an average of 49 hours clinically per week.¹⁴ Time constraints were also cited as the most common reason for stress among anaesthesiologists in Australia and New Zealand.¹⁵ In our study, the percentage of anaesthesiologists in our province who worked 56–70 hours per week was 64.3%, and the percentage of anaesthesiologists who worked 70–84 hours per week was 22.04%. The previously mentioned results in our study indicate that the hours of work for anaesthesiologists in the Heilongjiang Province are longer than those in Japan and other countries. Anaesthesiologists in the Heilongjiang Province have long working hours but few work cases, which may be partly related to the regressed efficiency and productivity of surgeons.¹⁶ A previous study showed that due to the regressed efficiency and productivity of surgeons, the operation time is prolonged, and operating room utilisation becomes inefficient. The previous literature also shows that improper management can also lead to low efficiency in the operating room, which leads to low anaesthesia efficiency and prolonged anaesthesia time.¹⁷ As countermeasures to reduce the working hours of anaesthesiologists and alleviate this problem, increasing the number of anaesthesiologists and adding additional posts for nurses and technicians should be considered. Under the guidance of anaesthesiologists, nurses are engaged in perioperative care, pain patient management and management of anaesthesia-related equipment, consumables, drugs and document information. We can further decrease the current pressure of anaesthesiologists by increasing the enrolment and talent training of anaesthesia majors and optimising the allocation of human resources. These steps may reduce the workload of the anaesthesiologist.

Job satisfaction is the strongest predictor of actual transmission among healthcare personnel.¹⁸ The medical literature shows that career dissatisfaction can lead to mistakes.^{19 20} Anaesthesiologists in the Beijing-Tianjin-Hebei region of China expressed a below-average level

of job satisfaction and suffered a significant degree of burnout.⁵ In total, 62.92% of anaesthesiologists in the Heilongjiang Province were basically satisfied. However, anaesthesiologists who expressed dissatisfaction accounted for 20.18%. The reason for the low job satisfaction may be that the anaesthesiologists suffer from fatigue, and the working hours remain uncontrolled. Regarding fatigue, learning to recognise fatigue and learning methods to reduce fatigue are important to prevent potential harm to the patient.²¹ A study from Sweden also has shown that uncontrolled working hours will increase the occupational pressure of anaesthesiologists, thereby reducing professional satisfaction.²² In addition, negative emotions will also reduce the professional satisfaction of anaesthesiologists. The low degree of social and medical colleagues' recognition of the anaesthesiology discipline also directly leads to the negative emotions of anaesthesiologists.²³ A survey also shows that 27.5% of anaesthesiologists believe that they do not receive sufficient respect at work.¹¹ Relatively low income is another important factor. According to a Medscape Physician Compensation Report, the average compensation was \$284 000 per year for American specialists and \$358 000 for anaesthesiologists. Physicians are among the best-paid professionals in many high-income countries. However, the situation is very different in China. Most anaesthesiologists in China earn far less than those in developed countries.⁵ As countermeasures to reduce depressive symptoms among Chinese anaesthesiologists, management of work arrangement and education of coping techniques for work stress with the purpose of improving anaesthetists' working conditions and mental health should be considered. Improvement in job satisfaction might create a positive work climate that could benefit both the quality of patient care and the profession of anaesthesiology.

LIMITATIONS

This study has some limitations. This study did not investigate working hours and job satisfaction of anaesthesia assistants and nurses. Future studies should expand on this study design, and we will design the questionnaire to investigate the related data and build a network data collection system in the future.

CONCLUSION

Our study demonstrated for the first time that the proportion of anaesthesiologists in the Heilongjiang Province, China, is better than the national average, but it is still insufficient compared with developed countries. The structure of anaesthesiologists in hospitals of Heilongjiang Province needs to be optimised. There is a shortage of young doctors and residents in the Heilongjiang Province. More recovery rooms need to be established to improve the quality of the patient's recovery after surgery.

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Contributors FH is responsible for the overall content as the guarantor, XYZ, JSZ and FH conceived the study, participated in the analysis and interpretation of the data and drafted the paper; JZ, DDY, GJ and WCY performed the analysis of the data and helped in the drafting of the paper; XSM, HW and XDL helped in the interpretation of the data; XDZ participated in the conception of the study; MJC helped in the analysis and interpretation of the data; MYZ participated in the conception of the study; XZ helped in the conception of the study, the interpretation of the data; GNW conceived the study, participated in the analysis and interpretation of the data. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Given that no patient identifiers were collected and there was a lack of risk of harm to patients, the requirement for written informed consent was waived by the Ethical Review Committee of Harbin Medical University Cancer Hospital.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. All the data supporting the findings are contained in the manuscript.

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