Census report on Chinese urological surgeons

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Abstract  Objective: To grasp the general situation of Chinese urological surgeons and the status quo of their scientific research, work and training, thus providing valuable recommendations for urological talent team construction in future.

Methods: The survey respondents were the urological surgeons, who held the Certificate of Medical Practitioner in the People’s Republic of China, whose scope of practice was confined to urological surgery. The urological surgeons involved in the project completed an online questionnaire survey. All the data were collected through the internet.

Results: There were a total of 18,981 urological surgeons in China in 2015, of whom 15,875 from 2,602 hospitals participated in this project, with a mean age of 39.64 years old. In 2015, 1,949,631 cases of surgery were performed, including 493,723 cases of open surgery, 1,146,444 cases of endoscopic/laparoscopic surgery (robot-assisted laparoscopic surgery were excluded), 6,259 robot-assisted surgery and other types of urological surgery. Besides, Chinese urological surgeons published 1,358 monographs as well as 14,558 academic papers, and also obtained 2,064 scientific funds in 2015. A total of 92,122 person-time participated in academic conferences. Urological surgeons with higher educational degrees as well as higher academic titles and from Eastern China or higher-level hospitals had more opportunities to participate in further education and training.

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Conclusion: This is the very first census conducted through internet on urological surgeons’ multiple aspects. After analyzing and summarizing the data collected, the Census could improve the quality of urological diseases diagnosis and treatment in China.

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1. Introduction

The Census Report on Chinese Urological Surgeons (hereinafter referred to as the Census) aims to grasp the general situation of the medical staff providing urological diseases diagnosis and treatment services in China, to launch in-depth investigation of the status quo of urological surgeons’ scientific research, work and training, and to establish a database of Chinese urological surgeons.

Since China entered the ageing society at the turn of the century [1], the health condition of the elderly has been a growing public concern. By 2010, the population over 60 years old had reached 13.32% of the total population in China [2], accompanied by consequently rising demand for health staff and services. To improve the quality and safety of medical services, the Census provides decision-making basis for the formulation of policy on quality control and for the talent team construction for urological diseases diagnosis and treatment.

2. Methods

2.1. Study population

A urological surgeon refers to as a surgeon (1) who holds the Certificate of Medical Practitioner in the People’s Republic of China and (2) whose scope of practice is confined to urological surgery.

2.2. Questionnaire design

The questionnaire consists of the following four sections, general situation (including the total number and basic characteristics of urological surgeons, the highest education degree, academic title, etc.), hospitals, surgery (including open, laparoscopic and robot-assisted surgery), research achievements (including the publication of monographs and academic papers, obtainment of scientific research fund and participation in academic conferences) and training situation (vocational education, professional skills training and laparoscopy/endoscopy training).

2.3. Data collection

The Census covered 15,875 urological surgeons from 2,602 hospitals in 22 provinces, four municipalities, five autonomous regions and Xinjiang Production and Construction Corps (excluding the Hong Kong Special Administrative Region, the Macau Special Administrative Region and Taiwan Province). All the data were collected through the internet directly from every urological surgeon who participated in the project.

A project leader and a liaison officer were appointed in each province and municipality. The project leader was responsible for organizing and coordinating the tasks in his or her area of responsibility, while the liaison officer worked as an assistant to the project leader in advancing the work.

2.4. Census timeline

The Census was first proposed by Academician Yinghao Sun and Academician Yinglu Guo in February 2015. Having been prepared and organized by professional experts and relevant personnel, the project was launched in Chengdu, Sichuan Province in July 2015. The liaison officers from all provinces and municipalities were trained uniformly in December 2015, in order to carry out the Census under unified standards. The information report was on a pilot stage from December 2015 to January 2016 and officially started reporting from February to September in 2016. After that, reported information was preliminarily collected and analyzed. Further verification and supplement work were proceeded from October to December in 2016. Data were summarized and analyzed from December 2016 to December 2017 and the writing work of the Census report was finished in 2018 (Fig. 1).

3. Results

3.1. General situation

3.1.1. Urological surgeons

The results of the Census showed that up to 2015, there were 18,981 urological surgeons in total in China, of whom 15,875 were enrolled in the project, with a mean age of 39.64 years old. Among them, 15,569 were male (98.1%) and 306 were female (1.9%). As for the education background, 6,673 held the postgraduate degree (42.0%), 8,610 held the undergraduate degree (54.2%), and 592 held the junior college degree or below (3.7%). In terms of academic titles, 2,526 were entitled chief doctor (15.9%), 4,231 were associate chief doctor (26.7%), 5,629 were attending doctors (35.5%), and the rest 3,489 were resident doctors (22.0%).
3.1.2. Geographic distribution
According to the feedback of the Census, on the national scale (excluding Hong Kong, Macao and Taiwan, the same hereinafter), Guangdong occupied the largest proportion of the total number of urological surgeons (11.5%) and Tibet shared the smallest proportion (0.1%).

Beijing (38.43), Yunnan (23.63), Shanghai (20.82), Guangdong (20.39) and Chongqing (19.06) ranked top of the list in the number of urological surgeons per million population. Comparatively, Guizhou possessed the least urological surgeons per million population (1.37), followed by Jiangxi (4.29) and Tibet (5.03) (Table 1).

### Table 1
The number of urological surgeons in each province or municipality (sorted by number of urological surgeons per 1 000 000 population) [3].

| Province or municipality | Number of urological surgeons | Constituent ratio (%) | Number of urological surgeons (Per 10⁶ population) | Total population (×10⁶) | Gross regional domestic product (×10⁹ RMB) |
|--------------------------|-------------------------------|-----------------------|-----------------------------------------------|------------------------|-------------------------------------------|
| Beijing                  | 827                           | 4.4                   | 38.43                                        | 21.52                  | 21 330.83                                 |
| Yunnan                   | 1 114                         | 5.9                   | 23.63                                        | 47.14                  | 12 814.59                                 |
| Shanghai                 | 505                           | 2.7                   | 20.82                                        | 24.26                  | 23 567.70                                 |
| Guangdong                | 2 187                         | 11.5                  | 20.39                                        | 107.24                 | 67 809.85                                 |
| Chongqing                | 570                           | 3.0                   | 19.06                                        | 29.91                  | 14 262.60                                 |
| Zhejiang                 | 1 046                         | 5.5                   | 18.99                                        | 55.08                  | 40 173.03                                 |
| Shanxi                   | 688                           | 3.6                   | 18.86                                        | 36.48                  | 12 761.49                                 |
| Henan                    | 1 742                         | 9.2                   | 18.46                                        | 94.36                  | 34 938.24                                 |
| Qinghai                  | 104                           | 0.5                   | 17.84                                        | 5.83                   | 2 303.32                                  |
| Inner Mongolia           | 441                           | 2.3                   | 17.60                                        | 25.05                  | 17 770.19                                 |
| Hunan                    | 1 185                         | 6.2                   | 17.59                                        | 67.37                  | 27 037.32                                 |
| Ningxia                  | 103                           | 0.5                   | 15.56                                        | 6.62                   | 2 752.10                                  |
| Shaanxi                  | 569                           | 3.0                   | 15.07                                        | 37.75                  | 17 689.94                                 |
| Hubei                    | 848                           | 4.5                   | 14.58                                        | 58.16                  | 27 379.22                                 |
| Tianjin                  | 219                           | 1.2                   | 14.44                                        | 15.17                  | 15 726.93                                 |
| Shandong                 | 1 333                         | 7.0                   | 13.62                                        | 97.89                  | 59 426.59                                 |
| Liaoning                 | 573                           | 3.0                   | 13.05                                        | 43.91                  | 28 626.58                                 |
| Hainan                   | 112                           | 0.6                   | 12.40                                        | 9.03                   | 3 500.72                                  |
| Hebei                    | 872                           | 4.6                   | 11.81                                        | 73.84                  | 29 421.15                                 |
| Anhui                    | 691                           | 3.6                   | 11.36                                        | 60.83                  | 20 848.75                                 |
| Heilongjiang             | 407                           | 2.1                   | 10.62                                        | 38.33                  | 15 039.38                                 |
| Gansu                    | 273                           | 1.4                   | 10.54                                        | 25.91                  | 6 836.82                                  |
| Jilin                    | 278                           | 1.5                   | 10.10                                        | 27.52                  | 13 803.14                                 |
| Jiangsu                  | 705                           | 3.7                   | 8.86                                         | 79.6                   | 65 088.32                                 |
| Guangxi                  | 400                           | 2.1                   | 8.41                                         | 47.54                  | 15 672.89                                 |
| Fujian                   | 259                           | 1.4                   | 6.81                                         | 38.06                  | 24 055.76                                 |
| Xinjiang                 | 153                           | 0.8                   | 6.66                                         | 22.98                  | 9 273.46                                  |
| Sichuan                  | 518                           | 2.7                   | 6.36                                         | 81.4                   | 28 536.66                                 |
| Tibet                    | 16                            | 0.1                   | 5.03                                         | 3.18                   | 920.83                                    |
| Jiangxi                  | 195                           | 1.0                   | 4.29                                         | 45.42                  | 15 714.63                                 |
| Guizhou                  | 48                            | 0.3                   | 1.37                                         | 35.08                  | 9 266.39                                  |
| **Total**                | **18 981**                    | **100.0**             | **13.95 (average)**                          | **1362.46**            | **684 349.40**                            |

**Figure 1** Census timeline.
3.1.3. Age distribution
Among the urological surgeons who participated in the project, 46.0% were between 30 and 39 years old, 30.0% were between 40 and 49 years old, and only 0.2% were under 20 years old, which varied imperceptibly among different provinces and municipalities (Table 2).

3.1.4. Education background
With the progress of the society and the development of medical education, there have been an increasing number of well-educated talents among the urological surgeons in China. Through the investigation of the composition and distribution of the highest academic degrees of urological surgeons in China, the following data were obtained. The proportion of the undergraduate degree was 54.2%, which was higher than that of the graduate degree (42.0%), and the junior college degree and below accounted for 3.7%. The distribution of the highest academic degrees varied from provinces and municipalities. Shanghai (81.4%), Beijing (71.1%) and Liaoning (58.7%) ranked top 3 in the proportion of graduate degree, higher than any other provinces or municipalities in China (Table 3).

3.2. Academic title
Based on the results of the Census, the composition of academic titles of the urological surgeons was acquired. The data revealed that attending doctors account for the highest proportion (35.5%) of the total urological surgeons, followed by associate chief doctors (26.7%) and resident doctors (22.0%). Chief doctors sat at the very top of the talents pyramid, only taking up the smallest percentage (15.9%). The distribution pattern of urological surgeons’ academic titles resembled each other in all the provinces and municipalities. Chief doctors shared the highest proportion in Liaoning (25.3%) and Heilongjiang (24.9%), the lowest in Tibet (7.1%).

3.3. Hospitals

3.3.1. Total number
Among 25,860 hospitals in China [4], 2,602 hospitals (10.06%) possessed the department of urology and were

| Province or municipality | 18–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70+ | Surgeons, n |
|--------------------------|-------|-------|-------|-------|-------|-------|-----|-------------|
| Beijing                  | 8     | 32    | 267   | 241   | 112   | 11    | 0   | 671         |
| Tianjin                  | 0     | 17    | 85    | 68    | 34    | 10    | 0   | 214         |
| Hebei                    | 2     | 28    | 340   | 207   | 114   | 8     | 1   | 700         |
| Shanxi                   | 0     | 34    | 207   | 147   | 110   | 6     | 1   | 505         |
| Inner Mongolia           | 0     | 26    | 168   | 127   | 51    | 5     | 1   | 378         |
| Liaoning                 | 0     | 43    | 191   | 156   | 73    | 4     | 0   | 467         |
| Jilin                    | 0     | 11    | 126   | 75    | 39    | 4     | 0   | 255         |
| Heilongjiang             | 3     | 24    | 144   | 120   | 49    | 3     | 2   | 345         |
| Shanghai                 | 0     | 20    | 216   | 170   | 67    | 10    | 2   | 485         |
| Jiangsu                  | 0     | 39    | 239   | 140   | 84    | 9     | 5   | 516         |
| Zhejiang                 | 2     | 96    | 458   | 272   | 119   | 18    | 10  | 975         |
| Anhui                    | 0     | 81    | 287   | 161   | 91    | 9     | 0   | 629         |
| Fujian                   | 0     | 37    | 102   | 74    | 23    | 4     | 1   | 241         |
| Jiangxi                  | 0     | 21    | 71    | 45    | 16    | 2     | 1   | 156         |
| Shandong                 | 3     | 77    | 529   | 266   | 156   | 14    | 3   | 1,048       |
| Henan                    | 2     | 68    | 648   | 356   | 231   | 26    | 12  | 1,343       |
| Hubei                    | 1     | 51    | 320   | 211   | 77    | 14    | 2   | 676         |
| Hunan                    | 0     | 106   | 533   | 358   | 92    | 14    | 2   | 1,052       |
| Guangdong                | 3     | 187   | 906   | 552   | 329   | 31    | 5   | 2,013       |
| Guangxi                  | 2     | 29    | 144   | 88    | 18    | 2     | 0   | 283         |
| Hainan                   | 1     | 6     | 44    | 23    | 22    | 4     | 1   | 101         |
| Chongqing                | 0     | 43    | 165   | 116   | 49    | 5     | 0   | 378         |
| Sichuan                  | 0     | 33    | 197   | 92    | 47    | 7     | 1   | 377         |
| Guizhou                  | 0     | 6     | 22    | 9     | 2     | 0     | 0   | 39          |
| Yunnan                   | 2     | 88    | 458   | 329   | 104   | 11    | 0   | 992         |
| Tibet                    | 0     | 1     | 7     | 5     | 1     | 0     | 0   | 14          |
| Shaanxi                  | 0     | 25    | 214   | 158   | 52    | 5     | 1   | 455         |
| Gansu                    | 0     | 18    | 89    | 68    | 24    | 2     | 0   | 201         |
| Qinghai                  | 0     | 4     | 39    | 38    | 9     | 1     | 0   | 91          |
| Ningxia                  | 1     | 2     | 42    | 33    | 16    | 2     | 0   | 96          |
| Xinjiang                 | 0     | 13    | 49    | 56    | 8     | 0     | 0   | 126         |
| Total                    | 30    | 1,266 | 7,307 | 4,761 | 2,219 | 241   | 51  | 15,875      |
able to carry out the urological surgery. The proportion of Guangdong (21.67%), Henan (21.25%), Yunnan (21.13%), Hunan (15.32%) and Chongqing (13.63%) ranked highest on the list. As contrast, the proportion of Guizhou (0.66%), Sichuan (3.09%) and Xinjiang (3.42%) were smallest (Supplementary table 1 and Fig. 2).

3.3.2. Classification of hospitals
Public hospitals in China are classified into three levels, as tertiary, secondary and primary hospitals and these three levels are further divided into Grade A, B and C [5]. For instance, Tertiary Grade-A hospitals are the top comprehensive hospitals in China, serving as medical hubs radiating to multiple cities and even provinces [6].

Based on the information collected, 2,404 hospitals (92.4%) of 2,602 were public hospitals, which accorded with national circumstances, followed by 11 joint venture hospitals (0.4%) and 148 private hospitals (5.7%). With the deepening of the medical reform and in China, the situation may possibly be changed in the near future. Among these public hospitals, Secondary Grade-A hospitals (1,222, 47.0%) were the most. Other 817 were Tertiary Grade-A hospitals (31.4%). In addition, 2,490 hospitals were comprehensive hospitals and 112 were specialized hospitals (Supplementary table 2–3, Fig. 3).

3.4. Surgery
3.4.1. Total amount
In 2015, in total 1,949,631 cases of surgery were performed by urological surgeons. Totally 273,800 cases (14.0%) were performed in Guangdong, 181,195 (9.3%) were in Henan, 139,143 cases (7.1%) in Hunan, 133,495 (6.8%) in Zhejiang, 132,810 (6.8%) in Yunnan and 110,571 (5.7%) in Shandong. Only 979 cases (0.05%) were performed in Tibet.

After taking the total number of urological surgeons in each province and municipality into account, the mean amount of surgery performed per urological surgeon in 2015 was

| Province or municipality | High school | Junior college | Undergraduate | Postgraduate |
|-------------------------|------------|----------------|----------------|--------------|
| Beijing                 | 1          | 5              | 188            | 477          |
| Tianjin                 | 0          | 12             | 80             | 122          |
| Hebei                   | 1          | 38             | 427            | 234          |
| Shanxi                  | 0          | 14             | 297            | 194          |
| Inner Mongolia          | 0          | 15             | 251            | 112          |
| Liaoning                | 1          | 10             | 182            | 274          |
| Jilin                   | 0          | 13             | 116            | 126          |
| Heilongjiang            | 1          | 8              | 150            | 186          |
| Shanghai                | 0          | 1              | 89             | 395          |
| Jiangsu                 | 1          | 5              | 292            | 218          |
| Zhejiang                | 2          | 19             | 494            | 460          |
| Anhui                   | 0          | 12             | 414            | 203          |
| Fujian                  | 0          | 4              | 130            | 107          |
| Jiangxi                 | 1          | 6              | 75             | 74           |
| Shandong                | 0          | 28             | 443            | 577          |
| Henan                   | 4          | 81             | 809            | 449          |
| Hubei                   | 0          | 15             | 305            | 356          |
| Hunan                   | 2          | 32             | 710            | 361          |
| Guangdong               | 2          | 87             | 1,146          | 778          |
| Guangxi                 | 0          | 4              | 148            | 131          |
| Hainan                  | 0          | 4              | 47             | 50           |
| Chongqing               | 0          | 15             | 203            | 160          |
| Sichuan                 | 0          | 9              | 188            | 180          |
| Guizhou                 | 0          | 3              | 33             | 3            |
| Yunnan                  | 1          | 77             | 767            | 147          |
| Tibet                   | 0          | 3              | 9              | 2            |
| Shaanxi                 | 2          | 13             | 259            | 181          |
| Gansu                   | 0          | 18             | 130            | 53           |
| Qinghai                 | 0          | 6              | 74             | 11           |
| Ningxia                 | 0          | 1              | 62             | 33           |
| Xinjiang                | 0          | 15             | 92             | 19           |
| Total                   | 19         | 573            | 8,610          | 6,673        |

Figure 2: Proportion of hospitals with department of urology among all the hospitals in China in each province or municipality.
was calculated. A urological surgeon needed to perform 164.8 and 161.3 cases of surgery in Sichuan and Shanghai, which were most in China, while a urological surgeon in Qinghai and Shanxi performed 58.6 and 50.2 cases of surgery respectively in 2015.

Most cases of surgery were performed in Tertiary Grade-A hospitals, which accounted for 57.5% of total, followed by Secondary Grade-A hospitals (27.0%) (Tables 4 and 5, Fig. 4).

### 3.4.2. Open surgery

In 2015, in total 493,723 cases of open surgery were performed. Among these surgery, 59,307 cases were performed in Guangdong, 53,673 were in Henan, 34,367 cases in Zhejiang, 29,780 in Yunnan, and 28,132 in Shandong. Meanwhile, 260,149 cases and 151,586 cases were performed in Tertiary Grade-A and Secondary Grade-A hospitals, respectively. Open surgeries accounted for 40.58% of the total cases in Eastern China, 40.14% in Middle China and 43.77% in Western China (Table 6).

### 3.4.3. Laparoscopic surgery (excluding robot-assisted surgery)

In 2015, 249,860 cases of laparoscopic surgery were performed. In detail, 28,845 cases were performed in Guangdong, 25,360 were in Henan, 21,982 cases in Zhejiang, 21,057 in Shandong, 15,433 in Beijing, and 190,187 cases were performed in Tertiary Grade-A and Secondary Grade-A hospitals, respectively. Laparoscopic surgeries accounted for 40.32% of the total cases in Eastern China, 39.18% in Middle China and 42.93% in Western China (Table 7).

### Table 4  Cases of surgery performed in each province or municipality in 2015.

| Province or municipality | Cases of surgery | Proportion (%) |
|--------------------------|-----------------|----------------|
| Beijing                  | 71,408          | 3.7            |
| Tianjin                  | 15,609          | 0.8            |
| Hebei                    | 66,208          | 3.4            |
| Shanxi                    | 34,563          | 1.8            |
| Inner Mongolia           | 26,651          | 1.4            |
| Liaoning                 | 44,361          | 2.3            |
| Jilin                     | 19,366          | 1.0            |
| Heilongjiang              | 38,012          | 1.9            |
| Shanghai                 | 81,455          | 4.2            |
| Jiangsu                  | 71,038          | 3.6            |
| Zhejiang                 | 133,495         | 6.8            |
| Anhui                    | 60,404          | 3.1            |
| Fujian                   | 33,528          | 1.7            |
| Jiangxi                  | 20,004          | 1.0            |
| Shandong                 | 110,571         | 5.7            |
| Henan                    | 181,195         | 9.3            |
| Hubei                    | 87,187          | 4.5            |
| Hunan                    | 139,143         | 7.1            |
| Guangdong                | 273,800         | 14.0           |
| Guangxi                  | 46,015          | 2.4            |
| Hainan                   | 9,442           | 0.5            |
| Chongqing                | 58,953          | 3.0            |
| Sichuan                  | 85,373          | 4.4            |
| Guizhou                  | 6,389           | 0.3            |
| Yunnan                   | 132,810         | 6.8            |
| Tibet                    | 979             | 0.1            |
| Shaanxi                  | 50,751          | 2.6            |
| Gansu                    | 21,327          | 1.1            |
| Qinghai                  | 6,099           | 0.3            |
| Ningxia                  | 8,391           | 0.4            |
| Xinjiang                 | 15,104          | 0.8            |
| Total                    | 1,949,631       | 100.0          |

### Table 5  Cases of surgery performed per urological surgeon in 2015.

| Province or municipality | Number of urological surgeons | Cases of surgery | Cases of surgery performed per urological surgeon |
|--------------------------|-------------------------------|------------------|--------------------------------------------------|
| Sichuan                  | 518                           | 85,373           | 164.8                                            |
| Shanghai                 | 505                           | 81,455           | 161.3                                            |
| Guizhou                  | 48                            | 6,389            | 133.1                                            |
| Fujian                   | 259                           | 33,528           | 129.5                                            |
| Zhejiang                 | 1,046                         | 133,495          | 127.6                                            |
| Guangdong                | 2,187                         | 273,800          | 125.2                                            |
| Yunnan                   | 1,114                         | 132,810          | 119.2                                            |
| Hunan                    | 1,185                         | 139,143          | 117.4                                            |
| Guangxi                  | 400                           | 46,015           | 115.0                                            |
| Henan                    | 1,742                         | 181,195          | 104.0                                            |
| Chongqing                | 570                           | 58,953           | 103.4                                            |
| Hubei                    | 848                           | 87,187           | 102.8                                            |
| Jiangxi                  | 195                           | 20,004           | 102.6                                            |
| Jiangsu                  | 705                           | 71,038           | 100.8                                            |
| Xinjiang                 | 153                           | 15,104           | 98.7                                             |
| Heilongjiang              | 407                           | 38,012           | 93.4                                             |
| Shaanxi                  | 569                           | 50,751           | 89.2                                             |
| Anhui                    | 691                           | 60,404           | 87.4                                             |
| Beijing                  | 827                           | 71,038           | 86.3                                             |
| Hainan                   | 112                           | 9,442            | 84.3                                             |
| Shandong                 | 1,333                         | 110,571          | 82.9                                             |
| Ningxia                  | 103                           | 8,391            | 81.5                                             |
| Gansu                    | 273                           | 21,327           | 78.1                                             |
| Liaoning                 | 573                           | 44,361           | 77.4                                             |
| Hebei                    | 872                           | 66,028           | 75.9                                             |
| Tianjin                  | 219                           | 15,099           | 71.1                                             |
| Jilin                     | 278                           | 19,366           | 69.7                                             |
| Tibet                    | 16                            | 979              | 61.2                                             |
| Inner                    | 441                           | 26,651           | 60.4                                             |
| Mongolia                 |                               |                  |                                                  |
| Qinghai                  | 104                           | 6,099            | 58.6                                             |
| Shanxi                   | 688                           | 34,563           | 50.2                                             |
cases were performed in Tertiary Grade-A hospitals (Table 7).

### 3.4.4. Robot-assisted surgery

Up to 2015, 6,259 cases of robot-assisted surgery had been launched in 16 provinces or municipalities in China, especially in the eastern region. In detail, 2,259 cases (36.1%) were performed in Shanghai, which was far ahead of others. 1,174 (18.8%) were performed in Zhejiang, 950 (15.2%) were in Beijing, 547 (8.7%) were in Sichuan, 410 (6.6%) were in Hubei and 200 (3.2%) in Henan (Table 8).

### 3.5. Research achievements

#### 3.5.1. Monograph

In 2015, a total of 1,358 monographs were published by urological surgeons, who worked as the editors-in-chief of 404 monographs and participated in the compilation of 1,016 monographs. The urological surgeons from Hebei (176), Henan (134), Beijing (130), Shandong (125) and Shanghai (120) published more monographs than any other provinces or municipalities. Chief doctors (474) and surgeons with a postgraduate degree (952) published the most monographs, followed by attending doctors (422) and surgeons with an undergraduate degree (397) (Table 9).

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**Table 6** Cases of open surgery performed in each province or municipality in 2015.

| Province or municipality | Cases of open surgery, n |
|--------------------------|--------------------------|
| Beijing                  | 8,179                    |
| Tianjin                  | 4,493                    |
| Hebei                    | 22,551                   |
| Shanxi                   | 13,331                   |
| Inner Mongolia           | 11,461                   |
| Liaoning                 | 11,870                   |
| Jilin                    | 4,251                    |
| Heilongjiang             | 15,972                   |
| Shanghai                 | 20,597                   |
| Jiangsu                  | 26,758                   |
| Zhejiang                 | 34,467                   |
| Anhui                    | 19,569                   |
| Fujian                   | 8,467                    |
| Jiangxi                  | 2,436                    |
| Shandong                 | 28,132                   |
| Henan                    | 53,673                   |
| Hubei                    | 17,434                   |
| Hunan                    | 27,253                   |
| Guangdong                | 59,307                   |
| Guangxi                  | 9,897                    |
| Hainan                   | 2,311                    |
| Chongqing                | 10,442                   |
| Sichuan                  | 15,014                   |
| Guizhou                  | 3,161                    |
| Yunnan                   | 29,780                   |
| Tibet                    | 495                      |
| Shaanxi                  | 14,881                   |
| Gansu                    | 7,479                    |
| Qinghai                  | 2,481                    |
| Ningxia                  | 2,715                    |
| Xinjiang                 | 4,866                    |
| Total                    | 493,723                  |

**Table 7** Cases of laparoscopic surgery performed in each province or municipality in 2015.

| Province or municipality | Cases of laparoscopic surgery, n |
|--------------------------|-------------------------------|
| Beijing                  | 15,433                        |
| Tianjin                  | 2,815                         |
| Hebei                    | 7,759                         |
| Shanxi                   | 3,432                         |
| Inner Mongolia           | 3,061                         |
| Liaoning                 | 7,566                         |
| Jilin                    | 3,630                         |
| Heilongjiang             | 6,068                         |
| Shanghai                 | 10,344                        |
| Jiangsu                  | 10,898                        |
| Zhejiang                 | 21,982                        |
| Anhui                    | 8,488                         |
| Fujian                   | 4,593                         |
| Jiangxi                  | 1,280                         |
| Shandong                 | 21,057                        |
| Henan                    | 25,360                        |
| Hubei                    | 12,993                        |
| Hunan                    | 10,479                        |
| Guangdong                | 28,845                        |
| Guangxi                  | 4,144                         |
| Hainan                   | 1,189                         |
| Chongqing                | 7,115                         |
| Sichuan                  | 13,430                        |
| Guizhou                  | 229                           |
| Yunnan                   | 7,163                         |
| Tibet                    | 38                            |
| Shaanxi                  | 5,812                         |
| Gansu                    | 1,839                         |
| Qinghai                  | 394                           |
| Ningxia                  | 1,003                         |
| Xinjiang                 | 1,421                         |
| Total                    | 249,860                       |
3.5.2. Academic papers
A total of 14,558 academic papers were published by urological surgeons in 2015, including 9,989 Chinese academic paper (6,905 published on Chinese core journals) and 3,119 SCI paper. Compared with the other provinces or municipalities, more academic papers were published by urological surgeons in Guangdong (1,768), Henan (1,284), Shanghai (1,176), Shandong (996) and Beijing (953) (Supplementary table 5).

3.5.3. Scientific research fund
In total, 2,064 funds were obtained by urological surgeons in 2015, including 260 at the national level, 847 at the ministerial and provincial levels, and 979 at the city level. According to geographical distribution, Guangdong (353), Shandong (159), Shanghai (147), Zhejiang (137) and Beijing (124) obtained more funds than any other provinces or municipalities in China. Chief doctors had access to most funds (844) compared with other academic titles. The associate chief doctors ranked the second, with 606 funds (Supplementary table 8).

3.5.4. Academic conference
In 2015, 93,700 person-time attended academic conferences, with 3,213 attending international conferences, 21,228 attending conferences at the national level, 35,084 at the provincial level and 34,175 at the city level. Furthermore, 2,880 conferences were held by urological surgeons all around China in 2015. Among these conferences, 407 conferences were the national level, 860 the provincial level, and 1,649 the city level (Fig. 7).

Relevant data classified by region, academic title and educational degree are shown in the Table (Supplementary table 11).

3.6. Education and training
3.6.1. Vocational education and professional skills training
Through the investigation on the 15,875 urological surgeons from 2,602 hospitals, the training situation of urological surgeons was summarized. In detail, 45.5% of the surgeons...
regularly participated in vocational education or professional skills training, and 47.9% occasionally participated. Nevertheless, there were still 6.6% urological surgeons scarcely had any access to vocational education or professional skills training (Fig. 8).

It can be concluded from the results that urological surgeons with higher educational degrees as well as higher academic titles and from Eastern China or higher-level hospitals had more opportunities to participate in further education and training (Table 10).

3.6.2. Laparoscopy/endoscopy training
Nowadays, as a revolutionary breakthrough in history of medicine, the minimally invasive surgical techniques have been extensively applied to clinical practice [5]. Laparoscopy and endoscopy, the two outstanding representatives of those techniques, have strikingly boosted the advancement of urological surgery and improved the quality of diagnosis and treatment for urological diseases. Under this circumstance, however, 61.2% urological surgeons felt lacking sufficient access to the laparoscopy and endoscopy training. Furthermore, 15.8% complained about a remarkable lack of opportunities (Supplementary table 13).

More urological surgeons in Western China (82.9%) complained about the lack of opportunity to laparoscopy/endoscopy training than those in Central (78.1%) and Eastern China (73.4%) (Table 11).

Another astonishing result was that urological surgeons from all levels of hospitals all thought they lacked enough opportunities to participate in laparoscopy and endoscopy training. The situation was relatively better in tertiary
grade-A hospitals (which mean top-class hospitals in China), where, nevertheless, still more than 70% urological surgeons thought that they did not get enough chances (Table 12).

Encouragingly, 67.5% hospitals have already set the agenda for laparoscopy and endoscopy training, while 26.4% have planned to set the agenda and 6.1% have neither set nor planned any agenda.

Through the investigation, learning from senior surgeons during surgery, learning from textbooks and learning on multi-media devices were considered as the main approaches to improve the understanding of minimally invasive surgery procedures (Table 13).

Tutorial given by senior surgeons (58.9%), regular training (54.2%), short-term further training (1–3 months) (48.8%), practice on stimulators or animals (45.1%), long-term further training (1–6 months) (36.8%) and online videos (35.1%) were voted as the best ways to improve the minimally invasive surgical techniques (Supplementary table 14).

4. Discussion

Notwithstanding the number of hospitals and licensed (assistant) doctors in China has also increased from 16 318 in 2000 to 31 056 in 2017, and from 2 075 843 in 2000 to 3 390 034 in 2017, respectively [7]. The demand for healthcare workforce and medical resource also keep rocketing up.

In 2015, the crude mortality rate of diseases of genitourinary system ranked tenth in urban area and ninth in rural area [8] and the estimated new genitourinary cancer cases occupied around 5% of total new cancer cases in China [9]. According to our investigation, the number of urological surgeons per 10^6 population in each province or municipality varied from 38.43 to 1.37, with the average number of 13.95. Even though reporting bias may exist during the collecting process, the urologist-to-population ratio was far lower than that in USA (from 93.9 to 23.5, with the average number of 37.2). Intriguingly, the mean age of Chinese urological surgeons was much lower than that of USA urological surgeons (39 years vs. 55 years). The female urological surgeons in USA accounted for approximately 8% of the US urologic workforce in 2015 [10], meanwhile the percentage was 1.9% in China.

There was an unbalanced geographical distribution of urological surgeons in China. As comparison, more than a quarter of surgical respondents practiced in the rural or regional area of Australia or New Zealand, and half of them were working full-time [11]. It should not be ignored that the urological surgeons in Western China lacked the enough
Herein we would like to propose the following recommendations:

(1) Urological surgeons in Western China and primary hospitals indeed needed more chances to participate in laparoscopy and endoscopy training.

(2) The percentage of open surgery in Western China was higher than that in other areas in China. Hence the laparoscopic and endoscopic surgery should be encouraged in Western China.

(3) The quality control system of urological surgery should be strengthened by applying information.

Table 10  The variables influencing the frequency of Chinese urological surgeons’ participation in vocational education and professional skills training.

| Parameters                                | Regularly, n (%) | Occasionally, n (%) | Rarely, n (%) | Total, n |
|-------------------------------------------|------------------|---------------------|--------------|----------|
| Levels of hospitals                       |                  |                     |              |          |
| Tertiary Grade-A                          | 4 572 (52.8)     | 3 637 (42.0)        | 450 (5.2)    | 8 659    |
| Tertiary Grade-B                          | 871 (43.2)       | 1 004 (49.9)        | 139 (6.9)    | 2 014    |
| Secondary Grade-A                         | 1 547 (34.4)     | 2 557 (56.8)        | 398 (8.8)    | 4 502    |
| Secondary Grade-B                         | 142 (31.0)       | 265 (57.9)          | 51 (11.1)    | 458      |
| Primary                                   | 25 (30.9)        | 49 (60.5)           | 7 (8.6)      | 81       |
| Others                                    | 65 (40.4)        | 87 (54.0)           | 9 (5.6)      | 161      |
| Academic titles                           |                  |                     |              |          |
| Chief doctor                              | 1 720 (68.1)     | 734 (28.1)          | 72 (2.9)     | 2 526    |
| Associate chief doctor                    | 2 100 (49.6)     | 1 927 (45.5)        | 204 (4.8)    | 4 231    |
| Attending doctor                          | 2 177 (38.7)     | 3 025 (53.7)        | 427 (7.6)    | 5 629    |
| Resident doctor                           | 1 225 (35.1)     | 1 913 (54.8)        | 351 (10.1)   | 3 489    |
| Highest educational degrees               |                  |                     |              |          |
| High school or below                      | 6 (31.6)         | 12 (63.2)           | 1 (5.3)      | 19       |
| Junior college                            | 189 (33.0)       | 312 (54.5)          | 72 (12.6)    | 573      |
| Undergraduate                             | 3 494 (40.6)     | 4 489 (52.1)        | 627 (7.3)    | 8 610    |
| Postgraduate                              | 3 533 (52.9)     | 2 786 (41.8)        | 354 (5.3)    | 6 673    |
| Geographic distribution                   |                  |                     |              |          |
| Eastern                                   | 3 820 (51.4)     | 3 188 (42.9)        | 423 (5.7)    | 7 431    |
| Central                                   | 2 165 (43.2)     | 2 495 (49.8)        | 354 (7.1)    | 5 014    |
| Western                                   | 1 237 (36.1)     | 1 916 (55.9)        | 277 (8.1)    | 3 430    |
| Total                                     | 7 222 (45.5)     | 7 599 (47.1)        | 1 054 (6.6)  | 15 875   |

Table 11  Feedback of Chinese urological surgeons from different regions on current situation of laparoscopy/endoscopy training.

| Geographic distribution | Remarkably insufficient, n (%) | Insufficient, n (%) | Sufficient, n (%) |
|-------------------------|-------------------------------|---------------------|------------------|
| Eastern                 | 1 007 (13.5)                 | 4 451 (59.9)        | 1 973 (26.6)     |
| Central                 | 804 (16.0)                   | 3 112 (62.1)        | 1 098 (21.9)     |
| Western                 | 691 (20.1)                   | 2 149 (62.7)        | 590 (17.2)       |
| Total                   | 2 502 (15.8)                 | 9 712 (61.2)        | 3 661 (23.1)     |

Table 12  Feedback of Chinese urological surgeons from different levels of hospitals on current situation of laparoscopy/endoscopy training.

| Levels of hospitals | Sufficient, n (%) | Insufficient, n (%) | Remarkably insufficient, n (%) |
|---------------------|-------------------|---------------------|--------------------------------|
| Tertiary Grade-A    | 2 589 (29.9)      | 5 040 (58.2)        | 1 030 (11.9)                 |
| Tertiary Grade-B    | 363 (18.0)        | 1 315 (65.3)        | 336 (16.7)                   |
| Secondary Grade-A   | 619 (13.7)        | 2 933 (65.1)        | 950 (21.1)                   |
| Secondary Grade-B   | 58 (12.7)         | 275 (60.0)          | 125 (27.3)                   |
| Primary             | 11 (13.6)         | 52 (64.2)           | 18 (22.2)                    |
| Others              | 21 (13.0)         | 97 (60.2)           | 43 (26.7)                    |
| Total               | 3 661             | 9 712               | 2 502                         |
based methods to effectively prevent medical accidents. Unified standard and effective measures should be established.

Limitations still existed in the Census due to the self-reported and unvalidated data.

5. Conclusion

This is the very first Census that launches an in-depth nationwide investigation on urological surgeons’ multiple aspects through internet, including general situation, research achievements, training and work status, etc. After analyzing and summarizing the data collected, the Census could improve the quality of urological diseases diagnosis and treatment in China.

Author contributions

Study design and organization: Yinghao Sun, Yinglu Guo. Implementation: Liqun Zhou, Junhua Zhang. Data acquisition: Linhui Wang, Nianzeng Xing. Data analysis: Qian Zhang, Xiuzhong Hu. Critical revision of the manuscript: Yinghao Sun.

Conflicts of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajur.2019.12.002.

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Table 13 Approaches to improve the understanding of minimally invasive surgery procedures.

| Approaches                  | Number | Constituent ratio (%) |
|-----------------------------|--------|-----------------------|
| Senior surgeons during surgery | 10 062 | 63.4                  |
| Textbooks                   | 6 555  | 41.3                  |
| Multi-media devices         | 3 783  | 23.8                  |
| Stimulators or animals      | 10 155 | 64.0                  |