Postprint: A Study on the Current Status of Equity in General Practitioner Resource Allocation in China

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Abstract

Background: In recent years, the state has attached great importance to the construction of general practitioner teams and primary healthcare service systems. The government has introduced numerous policies and proposed significant reform initiatives to innovate training and incentive mechanisms for general practitioners and improve the general practitioner training system.

Objective: To analyze and evaluate the equity of general practitioner resource allocation in China, and to provide theoretical support for the scientific and equitable distribution of general practitioner resources.

Methods: In June 2022, data were extracted from the China Health and Family Planning Statistical Yearbooks (2017–2021), China Health Statistics Yearbooks (2017–2021), and China Statistical Yearbooks (2017–2021) for the period 2016–2020, including the number of general practitioners, number of physicians registered in general practice, number of physicians with general practitioner training certificates, number of general practitioners per 10,000 population, and number of licensed (assistant) physicians at the national, provincial, and regional (eastern, central, and western) levels, as well as gross domestic product, regional gross domestic product, and year-end total population data for each province from 2016–2020. Provincial land area data were extracted from the National Conditions section of the Chinese Government website. The Lorenz curve and Gini coefficient were used to analyze the equity of general practitioner resource allocation in China, while the Theil index was employed to examine disparities in general practitioner resource allocation across the eastern, central, and western regions.

Results: The number of general practitioners in China increased from 209,083 in 2016 to 408,820 in 2020, representing a 95.53% increase compared to 2016.

In 2020, general practitioners accounted for 10.01% (408,820/4,085,689) of licensed (assistant) physicians, with 2.9 general practitioners per 10,000 population. The Gini coefficients for general practitioner resource allocation in China from 2016–2020 were 0.235, 0.231, 0.225, 0.177, and 0.157 based on population distribution; 0.178, 0.170, 0.161, 0.147, and 0.136 based on economic distribution; and 0.722, 0.726, 0.729, 0.714, and 0.707 based on geographic distribution. The curvature of the Lorenz curves for population and economic dimensions was less pronounced than that for the geographic dimension. The Theil index for the population dimension decreased from 0.047 in 2016 to 0.020 in 2020, the economic dimension Theil index decreased from 0.022 to 0.013, and the geographic dimension Theil index decreased from 0.482 to 0.428.

Conclusion: Over the past five years, the number of general practitioners in China has increased rapidly, with general practitioners becoming an important component of the licensed (assistant) physician workforce and the registration rate of general practitioners gradually increasing. Although the total quantity of general practitioner resources has continued to grow, the ratio of general practitioners per 10,000 population remains suboptimal, and significant disparities persist in general practitioner resource allocation across different regions. The equity of general practitioner resource allocation based on geographic dimension is considerably poorer compared with that based on population and economic dimensions.

Full Text

Preamble

Fairness in the Distribution of General Practitioner Resources in Mainland China

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【Abstract】
Background
In recent years, China has attached great importance to strengthening the development of the general practitioner (GP) workforce and primary care service system. To innovate the incentive mechanism for GP training and employment and improve the training system for GPs, the government has also promulgated a series of policies and put forward major reform measures involving many aspects.

Objective

To analyze and evaluate the fairness of distribution of general practitioner (GP) resources in China, and to provide theoretical support for scientific and equitable allocation of GP resources.

Methods

In June 2022, data were extracted from the *China Health and Family Planning Statistical Yearbook* and *China Health Statistical Yearbook* (2017–2021 editions), including the number of GPs, number of people registered as general medicine professionals, number of people who obtained the General Practitioner Certificate after training, number of GPs per 10,000 population, and number of practicing (assistant) physicians at the national, provincial, and regional (eastern, central, and western) levels from 2016 to 2020. Data on gross domestic product, gross regional product, and year-end total population for each province from 2016–2020 were sourced from the *China Statistical Yearbook* (2017–2021). The total land area of each province was extracted from the National Conditions column of the Chinese government website (http://www.gov.cn/guoqing/index.htm). The Lorenz curve and the Gini coefficient were used to analyze the fairness in the distribution of GP resources. The Theil index was used to analyze differences in the distribution of GP resources in eastern, central and western China.

Results

The number of GPs in China increased from 209,083 in 2016 to 408,820 in 2020, showing a growth rate of 95.53%. In 2020, the proportion of GPs among all practicing (assistant) physicians reached 10.01% (408,820/4,085,689), and the number of GPs per 10,000 population was 2.9. The Gini coefficients measuring demographic, economic, and geographical distribution inequalities of GP resources were 0.235, 0.178, 0.722, respectively for 2016; 0.231, 0.170 and 0.726, respectively for 2017; 0.225, 0.161 and 0.729, respectively for 2018; 0.177, 0.147 and 0.714, respectively for 2019; and 0.157, 0.136, and 0.707, respectively, for 2020. Overall, the Lorenz curve measuring the inequality in the distribution of GP resources by demographics or economy had lower degree of curvature than that by geography. A reduction was found in Theil index measuring unequal demographic, economic or geographical distribution of GP resources in 2020 compared with that in 2016 (from 0.046 to 0.020; from 0.022 to 0.013; from 0.482 to 0.428).

Conclusion

During the five years, the distribution of GP resources in China presented the following features: the number of GPs increased rapidly and became an important part of the workforce of practicing (assistant) physicians, the registration rate of GPs gradually increased, and the total GP resources showed a continuous growth. However, the ratio of GPs per 10,000 population was still unsatisfactory, with great inter-region differences in the distribution of GP resources. The equity of GP resource distribution by geography was more unsatisfactory than by demographics or economy.

[Key words] General practitioner; Distribution of resources; Lorenz curve;

Gini coefficient; Theil index; Health equity

Introduction

Health resources refer to the aggregate of various production factors consumed by society in the process of providing medical services, including human, material, financial, technical, and information resources. Health resources constitute the material foundation for maintaining residents' health, and their allocation can affect population health status [1-2]. Ensuring fairness in health resource allocation is a principle that must be followed in the process of allocating health resources, and it is also a challenge that every country/region must face in the reform process of health resource allocation [3], which is of great significance for promoting social justice and equity.

The report of the 19th National Congress of the Communist Party of China explicitly proposed strengthening the development of the general practitioner workforce and primary care service system. The General Office of the State Council also issued the *Opinions on Reforming and Improving the Incentive Mechanism for General Practitioner Training and Employment*, which put forward many major reform measures from multiple aspects centered on innovating the incentive mechanism for GP training and employment and improving the GP training system [4]. As composite clinical talents, "gatekeepers" of residents' health, and practitioners of integrated medical and preventive care [5], GPs are committed to providing accessible, comprehensive, coordinated, and continuous basic medical and public health services at the primary level [6-7]. The fairness of GP resource allocation is an objective reflection of the scientific and rational degree of health (primary-level) investment by national/regional health administrative departments, and it is also an important indicator for measuring the development status of health services in a country or region [8-10]. Currently, many scholars have studied the fairness of GP resource allocation in China, but the methods used are relatively single and the perspectives are limited, which may lead to significant discrepancies between research results and actual conditions [11-13]. This study adopts the Gini coefficient and Theil index to evaluate the current status of fairness in GP resource allocation in China from three dimensions—population, geography, and economy—using data from statistical yearbooks. By drawing Lorenz curves to visually demonstrate the trends in fairness of GP resource allocation in China, this study aims to scientifically and rationally evaluate the current status of fairness in GP resource allocation in China and provide theoretical support for promoting the healthy and high-quality development of general practice and primary health services.

Methods

1.1 Data Sources and Extraction

In June 2022, data were extracted from the *China Health and Family Planning Statistical Yearbook* and *China Health Statistical Yearbook* (2017–2021 editions), including the number of GPs, number of people registered as general medicine professionals, number of people who obtained the General Practitioner Certificate after training, number of GPs per 10,000 population, and number of practicing (assistant) physicians at the national, provincial, and regional (eastern, central, and western) levels from 2016 to 2020. Data on gross domestic product, gross regional product, and year-end total population for each province from 2016–2020 were sourced from the *China Statistical Yearbook* (2017–2021). The total land area of each province was extracted from the National Conditions column of the Chinese government website (http://www.gov.cn/guoqing/index.htm). According to the health regional division method used in the *China Health Statistical Yearbook* [14-15], China (excluding Hong Kong Special Administrative Region, Macao Special Administrative Region, and Taiwan Province) was divided into three major regions: eastern, central, and western. The eastern region includes 11 provinces: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. The central region includes 8 provinces: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. The western region includes 12 provinces: Inner Mongolia, Chongqing, Guangxi, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. The number of GPs per square kilometer was calculated for China and each region from 2016–2020.

1.2 Evaluation of Fairness in GP Resource Allocation

The Gini coefficient, Lorenz curve, and Theil index were used to analyze the fairness of GP resource allocation from three dimensions: population, geography, and economy. Calculations of the Gini coefficient and Theil index were performed using Python 3.0 software.

1.2.1 Gini Coefficient and Lorenz Curve

(1) The Gini coefficient, proposed by Italian scholar Corrado Gini in 1912, is an indicator used to evaluate the degree of distribution equilibrium [16]. A specific quantity of population/total land area/gross product is sorted from low to high according to the number of GPs and divided into n groups. Assuming that the cumulative number of GPs in groups 1 to i accounts for a proportion w_i of the total number of GPs, the Lorenz curve will pass through points (i/n, w_i). Defining $w\_0 = 0$ and $w\_n = 1$ yields n+1 points on the Lorenz curve for i = 0, 1, 2, ..., n. The area under the Lorenz curve is then integrated using the trapezoidal rule, and the area of the right triangle is calculated. The Gini coefficient = $A/(A+B)$ = 1-2B,

where A is the area between the actual GP distribution curve and the absolute equality curve of GP distribution, and B is the area to the lower right of the actual distribution curve. The Gini coefficient ranges from 0 to 1, where <0.2 indicates high equality, 0.2–0.6 indicates relative equality, and >0.6 indicates a huge disparity. (2) The Lorenz curve reflects the level of fairness in resource allocation through its degree of curvature; greater curvature indicates poorer fairness [17]. Based on the cumulative percentage of GPs calculated during the Gini coefficient computation, Lorenz curves for population, geography, and economic dimensions were drawn.

1.2.2 Theil Index The Theil index is a commonly used indicator for examining unfairness in resource allocation; higher values represent greater unfairness. The Theil index was used to analyze differences in GP resource allocation among China's eastern, central, and western regions [18]. The Theil index can be decomposed into two components: within-group Theil index and between-group Theil index. This study analyzed and calculated the annual Theil index, within-group Theil index, and between-group Theil index by dimension to measure the contribution of within-group and between-group differences to the unfairness of GP resource allocation among eastern, central, and western regions [19]. The Theil index calculation formula is:

$$T_{\text{total}} = \sum_{i=1}^{I} P_i \log\left(\frac{P_i}{Y_i}\right) \quad (1)$$

$$T_{\text{within}} = \sum_{i=1}^{I} P_i \sum_{j=1}^{J} \frac{P_{ij}}{P_i} \log\left(\frac{P_{ij}}{Y_{ij}}\right) \quad (2)$$

$$T_{\text{total}} = T_{\text{between}} + T_{\text{within}} \quad (3)$$

Where I represents the three major health regions, J represents China's 31 provinces, P_i is the population/total land area/gross product of region i, Y_i is the number of GPs in region i; $P\_\{ij\}$ is the population/total land area/gross product of province j in region i, and $Y\_\{ij\}$ is the number of GPs in province j of region i.

1.3 Statistical Methods

SPSS 25.0 and Excel 2019 software were used for data processing and statistical analysis. Count data were expressed as relative numbers. Descriptive analysis was conducted on the number of GPs, number of people registered as general medicine professionals, number of people who obtained the General Practitioner Certificate, number of GPs per 10,000 population, and number of GPs per square kilometer at the national/provincial/regional levels from 2016–2020.

Results

2.1 Basic Information on China's GP Workforce, 2016–2020

In 2020, the total number of GPs in China was 408,820, representing a 95.53% increase from 209,083 in 2016 and a 32.41% increase from 308,740 in 2018. From 2016–2020, the average annual growth rate of GPs in China was 18.25%. After five years of development, the proportion of GPs who obtained training certificates and registered as general medicine professionals increased from 37.13% (77,631/209,083) to 62.59% (255,867/408,820), indicating that the phenomenon of low registration rates has been somewhat improved [20]. In 2020, the proportion of GPs among all practicing (assistant) physicians reached 10.01% (408,820/4,085,689), and the number of GPs per 10,000 population was 2.9 (see Table 1). In 2016, the number of GPs, number of registered general medicine professionals, number of people with GP training certificates, and number of GPs per 10,000 population across provinces ranged from 202–25,162, 130–9,721, 72–16,347, and 0.61–4.04, respectively. In 2020, these figures ranged from 730–49,628, 547–37,816, 183–11,812, and 1.78–5.86, respectively (see Table 2).

2.2 GP Resource Allocation Status in Different Regions, 2020

In 2020, the number of GPs in the eastern region accounted for 50.84% (207,862/408,820) of China's total GP workforce. The eastern region had the highest proportion of GPs among practicing (assistant) physicians at 11.21% (207,862/1,854,494), while the central and western regions had proportions of 8.97% (106,306/1,185,189) and 9.05% (94,652/1,046,006), respectively. The eastern region had the highest number of GPs per 10,000 population at 3.43, while the central and western regions had similar figures of 2.53 and 2.47, respectively. Overall, the GP-to-population ratio in all three regions remained at a relatively low level (see Table 3).

2.3 Analysis of Fairness in GP Resource Allocation in China, 2016–2020

2.3.1 Lorenz Curves and Gini Coefficients for GP Resource Allocation, 2016–2020 The Gini coefficients for GP resource allocation in China from 2016–2020 were 0.235, 0.231, 0.225, 0.177, and 0.157 for the population dimension; 0.178, 0.170, 0.161, 0.147, and 0.136 for the economic dimension; and 0.722, 0.726, 0.729, 0.714, and 0.707 for the geographical dimension. By plotting the trend of Gini coefficients across population, economic, and geographical dimensions from 2016–2020 (Figure 1 [Figure 1: see original paper]), it can be observed that Gini coefficients in all three dimensions showed a downward trend, with more pronounced declines in the population and economic dimensions, indicating faster improvement in fairness levels of GP resource allocation in these dimensions. From 2016–2020, Gini coefficients for population and economic dimensions remained below the warning value (0.400) [21], while those for the geographical dimension exceeded 0.700, far above the warning value, indicat-

ing a huge disparity in GP resource allocation across geographical dimensions. By examining the Lorenz curves for GP resource allocation from 2016–2020 (Figure 2 [Figure 2: see original paper]), it is also evident that the population and economic dimension curves showed less curvature, while the geographical dimension curve showed the greatest curvature and deviated furthest from the absolute fairness line [22].

2.3.2 Theil Index for GP Resource Allocation in Eastern, Central, and Western China, 2016–2020 From 2016–2020, the Theil indices across the three dimensions ranked from high to low as follows: geographical dimension, population dimension, and economic dimension. The population dimension Theil index decreased from 0.046 to 0.020 over the five-year period, the economic dimension Theil index decreased from 0.022 to 0.013, and the geographical dimension Theil index decreased from 0.482 to 0.428. From 2016–2020, the region with the largest internal differences in GP resource allocation was the eastern region. Unfairness in GP resource allocation in population and economic dimensions mainly originated from within-region differences, while unfairness in the geographical dimension primarily stemmed from between-region differences (see Table 4).

Discussion

3.1 Continuously Promote Steady Growth in GP Numbers and Improve GP Resource Allocation Levels to Achieve "Steady Progress"

China's basic public health services started relatively late compared with developed countries [23]. From 2016–2018, the registration rate of GP training certificate holders in China was below 40%, meaning that most doctors who obtained GP training certificates did not choose to work as GPs. However, the GP registration rate has significantly improved in recent years, reaching over 60% in 2020. In 2020, the proportion of GPs among practicing (assistant) physicians reached 10.01%, and the number of GPs per 10,000 population was 2.9. The GP system has been widely established worldwide. By comparison, France has 1.6 GPs per 1,000 population, the United States has 1.0 per 1,000, and Australia has 1.4 per 1,000 [24], indicating that China still has substantial room for improvement in GP training and utilization. The allocation of primary-level GP resources and the establishment of related systems are closely related to a country's health system, national economic development status, government political will, and population health level [25].

Against the backdrop of sustained and rapid economic development, continuous advancement of the Healthy China Initiative, deepening of medical and health system reform, and strengthened efforts in GP training, utilization, and development, the total GP resources in China have continued to increase, nearly doubling within five years, and the number of GPs has entered a period of rapid growth. However, the problem of insufficient total GP resources in China persists, and the number of GPs per 10,000 population remains at a low level.

Moreover, Chinese GPs face challenges such as heavy workloads, high stress, and low income [26-27]. As China's population aging situation becomes increasingly severe, the elderly population will experience "blowout" growth, and the burden of chronic diseases will become increasingly heavy, adding to the work pressure on GPs [28]. Therefore, measures such as implementing existing policies and providing financial incentives (e.g., giving priority to GPs when selecting training candidates and strengthening salary incentives for GPs undergoing training [29]) should be adopted to improve the dilemmas faced in GP training and utilization and comprehensively enhance the attractiveness of the GP profession. While creating a favorable development environment for GPs by promoting medical consortiums, tiered diagnosis and treatment systems, and high-quality development of family doctor contract services, efforts should focus on narrowing regional internal differences in GP resource allocation, promoting local economic development, and taking measures tailored to local conditions to improve and implement policies and mechanisms related to GP training, utilization, and development, thereby ensuring sustainable development of GP resources in China [30].

3.2 Optimize Intra-regional Resource Allocation and Strive to Improve Fairness in GP Resource Allocation in Western China

According to the Lorenz curves for GP resource allocation in China from 2016–2020, GP resource allocation in China approached absolute fairness levels in population and economic dimensions but remained far from absolute fairness in geographical dimensions. In 2020, the Gini coefficients for GP resource allocation in population and economic dimensions were both below 0.200, which is closely related to the intensive introduction of GP training, utilization, and development policies across regions and the country's increasing emphasis on primary-level healthcare in recent years [31]. However, the Gini coefficient for geographical dimension exceeded the warning value by a large margin, reaching 0.700. The results of this study show that in 2020, the number of GPs in the eastern region accounted for 50.84% (207,862/408,820) of China's total GP workforce, a proportion higher than the combined share of GPs in central and western regions [32]. Due to its superior geographical location, smaller area, and advantages in total economic output and population size (demand for medical services), the eastern region has higher numbers of GPs, GPs per 10,000 population, and GPs per square kilometer than the central and western regions.

According to the Theil index, from 2016–2020, the ranking of dimensions from high to low was geographical dimension, population dimension, and economic dimension. The region with the largest internal differences in GP resource allocation was the eastern region. Unfairness in GP resource allocation in population and economic dimensions mainly originated from within-region differences, while unfairness in geographical dimension primarily stemmed from between-region differences. The western region has a vast territory, sparse population, and large service radius of primary-level medical and health institutions. Cou-

pled with relatively harsh working conditions and scarce health resources, these factors have led to slow growth in the number of GPs in western China [33].

Therefore, the government should maintain policy orientation, continuously increase financial investment to support GP training and development in western regions; allocate GP resources fairly, scientifically, and rationally according to different regions' economic development levels and population densities and in combination with regional population, economic, and geographical indicators to meet the health service needs of residents in remote and economically underdeveloped areas; appropriately tilt policies and health resource allocation toward central and western regions; and encourage remote areas in central and western regions to leverage internet advantages and fully utilize "online diagnosis and treatment" and "smart healthcare" models to improve the "difficulty in accessing medical care" caused by insufficient GP resources [34]. Simultaneously, more incentive policies are needed to increase GP registration rates in central and western regions, enhance GPs' willingness to remain in these areas, promote the transformation of "specialist physicians" to "general practitioners" in central and western regions, and attract more general practice graduates to practice in these regions. Policies should cover salary, employment management, career development and promotion, subsidies, and allowances [35]. Only by implementing these policies effectively can we promote the development of general practice and provide guarantees for improving the fairness of GP resource allocation.

This study has several limitations. (1) It evaluated the fairness of GP resource allocation in China based on the assumption of resource homogeneity, but there are obvious differences in service quality and capabilities among different GPs, meaning that theoretical fairness does not imply absolute fairness. (2) The study only evaluated fairness in GP resource allocation from a provincial perspective across population, economic, and geographical dimensions, leaving room for improvement in the accuracy and precision of research results. (3) Higher economic development levels in a region correspond to higher cultural and living standards among residents, which may lead to increased demand for general practice services, but the study did not explore the relationship between residents' cultural and living standards and fairness in GP resource allocation. Future research should incorporate more influencing factors and use more accurate and reasonable methods to evaluate and analyze GP resource allocation in China.

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References

[1] ZHU B, HSIEH C W, ZHANG Y. Incorporating spatial statistics into examining equity in health workforce distribution: an empirical analysis in the Chinese context[J]. International Journal of Environmental Research and Public Health, 2018, 15(7): 1309. DOI: 10.3390/ijerph15071309.

[2] SONG X, WEI Y, DENG W, et al. Spatio-temporal distribution, spillover effects and influences of China's two levels of public healthcare resources[J]. International Journal of Environmental Research and Public Health, 2019, 16(4): 582. DOI: 10.3390/ijerph16040582.

[3] ZHANG Liang, HU Zhi. Health Service Management [M]. Beijing: People's Medical Publishing House, 2018: 36-48.

[4] WU Ning, CHENG Mingyang, YAN Lina, et al. Report on the Development of General Practitioner Training in China (2018)[J]. Chinese General Practice, 2018, 21(10): 1135-1142. DOI: 10.3969/j.issn.1007-9572.2018.10.001.

[5] Editorial Department. Guidelines on Establishing the General Practitioner System Issued by the State Council[J]. Chinese Journal of Nursing, 2011, 46(9): 857.

[6] THEODORAKIS P N, MANTZAVINIS G D, RRUMBULLAKU L, et al. Measuring health inequalities in Albania: a focus on the distribution of general practitioners[J]. Human Resources for Health, 2006, 4(1): 1-9. DOI: 10.1186/1478-4491-4-5.

[7] YANG L, CHENG J. Analysis of inequality in the distribution of general practitioners in China: evidence from 2012 to 2018[J]. Primary Health Care Research & Development, 2022, 23: e59. DOI: 10.1017/S1463423622000408.

[8] YU Q, YIN W, HUANG D, et al. Trend and equity of general practitioners' allocation in China based on the data from 2012—2017[J]. Human Resources for Health, 2021, 19(1): 1-16. DOI: 10.1186/s12960-021-00561-8.

[9] WU J. Measuring inequalities in the demographical and geographical distribution of physicians in China: generalist versus specialist[J]. International Journal of Health Planning and Management, 2018, 33(4): 860-879. DOI: 10.1002/hpm.2539.

[10] WU B, GONG H, LUO Z. Number, distribution, and predicted needed number of general practitioners in China[J]. Family Medicine and Community Health, 2018, 6(3): 154-159. DOI: 10.15212/FMCH.2018.0120.

[11] ZHANG Dingjie, CHEN Jiaying, LIU Kehui, et al. Study on the Equity and Spatial Distribution Characteristics of General Practitioner Resource Allocation

in China from 2012 to 2020[J]. Soft Science of Health, 2022, 36(12): 46-52. DOI: 10.3969/j.issn.1003-2800.2022.12.010.

[12] ZHANG Jinchi, SONG Jia, MA Dongping, et al. Study on the Equity of General Practitioner Resource Allocation in China from 2015 to 2019[J]. Chinese Journal of Hospital Statistics, 2022, 29(2): 130-135. DOI: 10.3969/j.issn.1006-5253.2022.02.011.

[13] FU Yingjie, WANG Jian, MENG Yan, et al. Study on the Development Trend and Equity of General Practitioners in China[J]. Chinese General Practice, 2020, 23(1): 7-13. DOI: 10.12114/j.issn.1007-9572.2019.00.787.

[14] YU Fang, ZHENG Yanling, YANG Tingting, et al. Analysis of Current Status and Influencing Factors of Job Satisfaction of General Practitioners in Eastern, Central and Western China[J]. Modern Preventive Medicine, 2019, 46(16): 3015-3019.

[15] ZHAO Min, YUAN Xiao. Current Status, Influencing Factors and Optimization Strategies of Secondary Vocational Education Teacher Structure in Eastern, Central and Western China[J]. Education and Vocation, 2021, 999(23): 75-81. DOI: 10.13615/j.cnki.cn11-3315/g4.2021.23.012.

[16] XU Jingju, HUANG Jingwen, LI Wei, et al. Study on the Equity of General Practitioner Resource Allocation in Shandong Province[J]. Modern Preventive Medicine, 2021, 48(8): 1408-1412.

[17] WANG Yuanyuan, LIU Weiwei, WANG Xiaoli. Study on the Allocation Status and Equity of General Practitioners in China from 2012 to 2015[J]. Chinese General Practice, 2017, 20(31): 3850-3854, 3859. DOI: 10.3969/j.issn.1007-9572.2017.31.004.

[18] QIAO Guanhua, LIAO Peng, JIA Jinzhong, et al. Study on the Equity of General Practitioner Allocation in China[J]. Chinese General Practice, 2020, 23(13): 1606-1610. DOI: 10.12114/j.issn.1007-9572.2020.00.074.

[19] LIU Chu, YIN Aitian. Study on the Equity of General Practitioner Allocation in China: Based on Gini Coefficient and Theil Index[J]. Chinese Health Economics, 2017, 36(1): 49-52. DOI: 10.7664/CHE20170113.

[20] HUANG Dongmei, YIN Wenqiang, YU Qianqian, et al. Comparative Analysis of Current Status of General Practitioner Resources and "2020 Policy Goals" in China[J]. Chinese Health Economics, 2017, 36(10): 51-55. DOI: 10.7664/CHE20171013.

[21] HE Maihong, WANG Lin, HE Jia, et al. Study on the Trend of Equity in Health Resource Allocation in China[J]. Chinese Journal of Social Medicine, 2013, 30(2): 83-85. DOI: 10.3969/j.issn.1673-5625.2013.02.004.

[22] ZHOU Lingli, WANG Heping, XIE Long, et al. Analysis of Current Status and Equity of General Practitioner Resource Allocation in China[J].

Chinese General Practice, 2017, 20(19): 2311-2315. DOI: 10.3969/j.issn.1007-9572.2017.19.004.

[23] GAO Lijun, WU Qunhong, HAO Yanhua, et al. Enlightenment of General Practitioner Training Models in Developed Countries for China[J]. Continuing Education, 2014, 28(1): 58-59. DOI: 10.13981/j.cnki.cn11-3315/g4.2014.01.005.

[24] LI Shujie, ZHANG Hairui, ZHU Lina, et al. Study on Current Status and Influencing Factors of Work Stress and Job Satisfaction of General Practitioners[J]. Chinese General Practice, 2015, 18(4): 387-390. DOI: 10.3969/j.issn.1007-9572.2015.04.008.

[25] SHI Cuicui. The Necessity of Training Community General Practitioners[J]. Chinese Journal of Coal Industry Medicine, 2013, 16(1): 153-155. DOI: 10.11723/mtgyyx.1007-9564.201301093.

[26] HARRIS M, WAINWRIGHT D, WAINWRIGHT E. What influences young doctors in their decision-making about general practice as a possible career? A qualitative study[J]. Education for Primary Care, 2020, 31(1): 15-23. DOI: 10.1080/14739879.2019.1697967.

[27] HIRSCH O, ADARKWAH C C. The issue of burnout and work satisfaction in younger GPs: a cluster analysis utilizing the HaMEdSi study[J]. International Journal of Environmental Research and Public Health, 2018, 15(10): 2190. DOI: 10.3390/ijerph15102190.

[28] FRENK J, CHEN L, BHUTTA Z A, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world[J]. Lancet, 2010, 376(9756): 1923-1958. DOI: 10.1016/S0140-6736(10)61854-5.

[29] TAM Y H, LEUNG J Y Y, NI M Y, et al. Training sufficient and adequate general practitioners for universal health coverage in China[J]. BMJ, 2018, 362: k3128. DOI: 10.1136/bmj.k3128.

[30] VAN GREUNENINGEN M, BATENBURG R S, VAN DER VELDEN L F J. The accuracy of general practitioner workforce projections[J]. Human Resources for Health, 2013, 11(1): 1-8. DOI: 10.1186/1478-4491-11-31.

[31] XU Xiaofang, LI Wenjin, TANG Limin, et al. Study on the Efficiency of Health Resource Allocation in China: Based on Three-Stage DEA Model[J]. Health Economics Research, 2021, 38(6): 23-27. DOI: 10.14055/j.cnki.33-1056/f.2021.06.026.

[32] MI Yuqing, ZHANG Jiping, LIU Yiyun, et al. Study on General Practitioner Resource Allocation and Equity in China[J]. Chinese Health Service Management, 2019, 36(9): 661-663, 668.

[33] HU Weiping, YANG Jing, XU Runlong, et al. Study on the Equity of General Practitioner Resource Allocation in Mainland China[J]. Chinese General Practice, 2015, 18(22): 2628-2631. DOI: 10.3969/j.issn.1007-9572.2015.22.003.

[34] JIE Chunchun, ZHOU Dian, TIAN Di, et al. Research on the Integrated Development Model of Teleconsultation and Online Diagnosis and Treatment Based on Symbiosis Theory[J]. Chinese Hospital Management, 2022, 42(7): 64-67.

[35] LIAN S, CHEN Q, YAO M, et al. Training pathways to working as a general practitioner in China[J]. Family Medicine, 2019, 51(3): 262-270. DOI: 10.22454/FamMed.2019.329090.

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Note: Figure translations are in progress. See original paper for figures.