Postprint: A Study on the Pediatric Physician Workforce Shortage in Jiangsu from an Integrated Supply-Demand Perspective

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Abstract

Background: Given the particularity of the child population and recent adjustments to fertility policies, the development of the pediatrician workforce has become increasingly important. However, current research on pediatrician shortages is predominantly qualitative, with a notable lack of quantitative studies. Objective: To establish a multi-angle demand forecasting model for comprehensive analysis of pediatrician shortages in Jiangsu, providing references for advancing children' s health development during Jiangsu' s '14th Five-Year Plan' period and accelerating the construction of a new-era pediatric workforce. Methods: Based on the '2018 Jiangsu Provincial Health Service Survey Analysis Report' , relevant indicators of pediatric medical services in Jiangsu for 2018 were obtained. Utilizing the '2019 Jiangsu Statistical Yearbook' and basic pediatric data from various cities in Jiangsu sourced from the Jiangsu Provincial Health Statistics Information Center database, and employing SPSS 24.0 analysis software, a multi-angle demand forecasting model was constructed from supply-demand perspectives to comprehensively analyze the shortage of pediatricians in Jiangsu. Results: The pediatrician workforce in Jiangsu is characterized by a relatively high proportion of female physicians, predominantly young and middle-aged practitioners, mainly undergraduate educational background, a reasonably structured professional title system, and majority having over 20 years of work experience. Integrating the basic status of Jiangsu' s pediatrician workforce with supply-demand perspectives, the shortage of pediatricians in Jiangsu is 18,300, with an average shortage of 1,500 physicians across the 13 prefecture-level cities. Conclusion: Pediatric diagnosis and treatment resources are insufficient to meet demand, with high physician workload; the gender and professional title structure of the pediatrician workforce is imbalanced; and the special practice environment leads to increased professional risks. It is necessary to strengthen talent cultivation and recruitment policies,

consolidate professional foundations, and explore a new management model of 'Internet + Medical Consortium' .

Full Text

Analysis of the Shortage of Pediatrician Workforce in Jiangsu from the Integrated Perspective of Supply and Demand

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Abstract

Background: Given the unique healthcare needs of children and recent adjustments to birth policies, the development of pediatrician teams has become increasingly critical. However, most existing research on pediatrician shortages remains qualitative, with quantitative studies being notably scarce. **Objective:** This study establishes a multi-perspective demand forecasting model to comprehensively analyze the shortage of pediatricians in Jiangsu Province, providing evidence to support children' s health development during the "14th Five-Year Plan" period and accelerate the construction of a modern pediatric workforce. **Methods:** Relevant indicators of pediatric medical services in Jiangsu for 2018 were obtained from the *2018 Jiangsu Provincial Health Service Survey and Analysis Report*, supplemented by data from the *2019 Jiangsu Provincial Statistical Yearbook* and the Jiangsu Provincial Health Statistics Information Center database. Using SPSS 24.0, multi-perspective demand forecasting models were developed from both supply and demand viewpoints to conduct a comprehensive analysis of pediatrician shortages across the province. **Results:** The pediatrician workforce in Jiangsu exhibited a high proportion of female physicians, predominantly young and middle-aged practitioners, with bachelor' s degrees as the main educational background and a relatively reasonable professional title structure. Most physicians had over 20 years of work experience. Integrating both supply and demand perspectives, Jiangsu Province faces a shortage of approximately 18,300 pediatricians, with an average shortage of 1,500 physicians across its 13 prefecture-level cities. **Conclusion:** Pediatric healthcare resources are insufficient to meet demand, resulting in high workloads for physicians. The workforce shows structural imbalances in gender and professional titles, while

the unique practice environment elevates professional risks. Strengthening talent cultivation and recruitment policies, consolidating professional foundations, and exploring new management models such as "Internet + medical consortiums" are urgently needed.

Keywords: Pediatricians; Supply and demand; Talent shortage; Predictive model; Jiangsu

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Children have long been a priority population in China' s healthcare agenda. In 2022, despite a declining birth rate for three consecutive years, China recorded 9.56 million newborns, and children remain a vital demographic component. The Seventh National Population Census revealed that individuals aged 0–14 years constitute 17.95% of China' s total population, representing a 1.35 percentage point increase from 2010. In Jiangsu Province alone, this age group numbers 12.89 million, accounting for 15.21% of the provincial population. Child health is intrinsically linked to family wellbeing and population quality, and serves as a comprehensive indicator of a nation' s social, economic, cultural, and healthcare development levels.

The substantial child population and society' s aspirations for a better quality of life generate enormous demand for pediatric healthcare services, the fulfillment of which depends entirely on the quantity and quality of the pediatrician workforce. However, China has long suffered from a shortage of pediatric medical resources. Policy adjustments to birth regulations have further increased demand for neonatal safety and child healthcare, making the pediatrician shortage more acute and presenting new challenges for child health initiatives. Current research on pediatrician shortages remains predominantly qualitative, with quantitative analyses severely lacking. This study addresses this gap by establishing multi-angle calculation models to quantitatively assess pediatrician shortages in Jiangsu from an integrated supply-demand perspective, providing evidence to advance children' s health during the "14th Five-Year Plan" period and accelerate the development of a modern pediatric workforce. Given the significant impact of the COVID-19 pandemic on pediatric emergency and inpatient services since late 2019, which would compromise data validity, this analysis employs 2018 pediatric data from Jiangsu Province as the foundation for model calculations.

Methods

Data Sources

Data were derived from the *2018 Jiangsu Provincial Health Service Survey and Analysis Report*, which provided key pediatric healthcare indicators: a two-week prevalence rate of 13.90%, two-week consultation rate of 9.26%, hospitalization rate of 5.08%, unmet consultation rate of 33.33%, and unmet hospitalization rate of 10.78%. The *2019 Jiangsu Provincial Statistical Yearbook* and the Jiangsu

Provincial Health Statistics Information Center database supplied basic pediatric statistics for each city (Table 1). In 2018, Jiangsu had 5,728 pediatricians, 35.0533 million annual pediatric outpatient visits, and 1.0319 million pediatric discharges. According to the *2018 Jiangsu Provincial Health and Family Planning Development Statistical Bulletin*, the average length of stay was 9.1 days, physicians averaged 2.6 inpatient days per day, and 9.01 outpatient visits per day, with 250 working days per year.

Model Construction

Supply Perspective Model The supply-side model calculates total pediatrician demand based on current outpatient and inpatient service volumes, assuming physicians work at average provincial productivity levels.

Formula 1: $D_{sup} = D_1 + D_2$
This calculates total pediatrician demand from the supply perspective, where D_{sup} represents total demand, and D_1 and D_2 represent outpatient and inpatient physician demand, respectively.

Formula 2: $D_1 = \frac{S_1}{\omega \times \rho \times k}$
Where S_1 is annual pediatric outpatient visits, ω is annual working days, ρ is daily outpatient visits per physician, and k is the workload adjustment coefficient (typically 80%), representing the proportion of work time dedicated to direct medical services.

Formula 3: $D_2 = \frac{Pop \times d}{\gamma \times \beta \times k}$
Where Pop is pediatric discharges, d is average length of stay, γ is annual inpatient days per physician, and β is daily inpatient days per physician.

The shortage from the supply perspective (ΔD) is calculated as: $\Delta D = D_{sup} - D_0$, where D_0 is the existing number of physicians. These formulas constitute the supply-side shortage calculation model.

Demand Perspective Model The demand-side model estimates total pediatrician requirements based on population health needs, incorporating both current demand and potential unmet needs.

Formula 4: $D_{dem} = D_3 + D_4 = D_{3.1} + D_{3.2} + D_{4.1} + D_{4.2}$
This calculates total required pediatricians from the demand perspective, comprising outpatient and inpatient needs. Each component includes both current demand and potential demand from individuals who should but do not receive care. D_{dem} is total demand; D_3 and D_4 are outpatient and inpatient needs; $D_{3.1}$ and $D_{3.2}$ are current and potential outpatient needs; $D_{4.1}$ and $D_{4.2}$ are current and potential inpatient needs.

Formula 5: $D_3 = \frac{Pop_1 \times Ro \times 26}{\omega \times \rho \times k} + \frac{Pop_1 \times Re \times Rn \times 26}{\omega \times \rho \times k}$
Where Pop_1 is the 0–14 year-old population, Ro is the two-week consultation rate, Re is the two-week prevalence rate, Rn is the unmet consultation rate, and 26 is the constant converting two-week rates to annual figures.

Formula 6: $D_4 = \frac{Pop_1 \times Rh \times d}{\gamma \times \beta \times k} + \frac{Pop_1 \times Rh \times Rhn \times d}{\gamma \times \beta \times k}$
Where Rh is the hospitalization rate and Rhn is the unmet hospitalization rate.

The demand-side shortage is: $\Delta D = D_{dem} - D_0$. These formulas constitute the demand-side shortage calculation model. All calculations were performed using SPSS 24.0.

Results

Basic Characteristics of Jiangsu' s Pediatrician Workforce

The pediatrician workforce in Jiangsu comprised 63.90% female physicians, predominantly young and middle-aged (mostly 35–54 years old). Educational attainment was primarily at the bachelor's level, followed by master's and associate degrees. The professional title structure approximated an "olive shape,"with a ratio of senior, associate senior, intermediate, and junior titles of 2:3:5.6:2, aligning with WHO recommendations for health technical personnel. Most physicians had over 20 years of work experience (Table 2).

Supply Perspective Shortage

Applying Formulas 1–3 with data from Table 1, the supply-side analysis revealed a shortage of 26,500 pediatricians in Jiangsu Province. The cities with the most severe shortages were Suzhou, Xuzhou, and Nanjing (Table 3).

Demand Perspective Shortage

Using Formulas 4–6 and data from Table 1, the demand-side shortage was calculated under two workload scenarios: (1) standard workload of 9.01 visits/day based on the provincial statistical bulletin, and (2) actual workload of 24.48 visits/day derived from Table 1 data.

Standard Workload Scenario Under standard workload, Jiangsu required 29,477 pediatricians (22,000 outpatient and 7,400 inpatient), indicating a shortage of 23,800 physicians. Cities with the most acute shortages were Xuzhou, Yancheng, Suqian, and Suzhou (Table 4).

Actual Workload Scenario Under actual workload, Jiangsu required 15,758 pediatricians (8,100 outpatient and 7,600 inpatient), yielding a shortage of 10,000 physicians. Xuzhou, Yancheng, and Suqian showed the greatest deficits (Table 5).

Integrated Supply-Demand Perspective

Synthesizing both perspectives, Jiangsu' s pediatrician shortage ranges from 10,000 to 26,500 physicians, with an average shortage of 18,300. The average shortage across the 13 prefecture-level cities is 1,500 physicians (Table 6).

Discussion

Different Perspectives Reflect Distinct Analytical Logic

The integrated analysis framework reveals different shortage estimates based on analytical perspective. The supply-side model assumes constant patient demand and calculates requirements if all physicians worked at average provincial productivity levels. The demand-side model based on actual workload represents the lower bound of shortage estimates, reflecting current physician productivity. The upper bound may derive from either the supply-side model or the demand-side model using standard workload, depending on whether the city experiences patient inflow or outflow and its pediatric service capacity.

Using Nanjing as an example (Table 6), the actual-workload demand model suggests a minimum shortage of 350 physicians if current patient volumes persist and productivity matches provincial averages. The standard-workload demand model indicates a shortage of 1,478 physicians, while the supply-side model shows a maximum shortage of 3,523 physicians. As Nanjing' s pediatric services rank among the province' s best, attracting numerous out-of-area patients, the supply-side estimate appropriately represents the upper bound of its shortage range.

Structural Imbalances in the Pediatrician Workforce

Jiangsu' s pediatrician workforce exhibits structural imbalances. The gender distribution is heavily skewed toward female physicians, which may hinder talent attraction. Educational attainment shows only 13.06% hold master' s degrees or higher, indicating a shortage of high-level talent and room for improvement in overall educational qualifications.

Unique Practice Environment Elevates Professional Risks

Pediatricians face greater doctor-patient relationship challenges and more complex practice environments compared to other specialties. The predominant "6+1" family structure (six adults caring for one child) creates crowded, noisy clinical settings where resource scarcity exacerbates conflicts. Pediatrics, often called the "silent specialty," involves treating children who cannot effectively communicate their symptoms, increasing the risk of misdiagnosis and conflict with families' high treatment expectations. The special practice environment, combined with high professional risks, adversely affects pediatrician recruitment and retention.

Urgent Need for Expanded Training and Enhanced Capacity

In 2018, Jiangsu' s new births reached 744,900. This study reveals a shortage of approximately 18,300 pediatricians. In 2020, Jiangsu had only 0.81 pediatricians per 1,000 children aged 0–14, falling short of the provincial "14th Five-Year Plan" target of 0.85. Nationally, pediatricians comprise merely 4.1% of China' s

4.288 million physicians, while the 0–14 age group represents 17.5% of the population—an enormous supply-demand disparity. Consequently, each pediatrician bears a workload nearly double the national average, carrying immense societal expectations under severe resource constraints.

Recommendations

4.1 Strengthen Top-Level Design for Talent Cultivation and Recruitment

Government should provide policy and financial support to improve pediatrician training and recruitment systems. This includes establishing early warning management systems, regularly publishing shortage talent directories, encouraging qualified private capital to establish pediatric specialty hospitals, and exploring preferential policies for recruitment and professional promotion.

Medical schools must enhance pediatric teaching resources, establish dedicated pediatric programs, and innovate talent development mechanisms. For example, implementing separate admissions for undergraduate pediatrics students with broad initial training followed by specialized clinical skill development can produce professionals with solid clinical foundations, stable career commitments, and specialized pediatric expertise.

4.2 Consolidate the Professional Foundation of Pediatricians

On one hand, strengthen vocational quality education to enhance clinical knowledge and practical skills mastery, standardize residency training and certification systems to fundamentally ensure service quality and reduce diagnostic errors. On the other hand, emphasize professional ethics education and interpersonal communication skills to foster empathy and communication abilities that build harmonious doctor-patient relationships.

4.3 Explore "Internet + Medical Consortium" Alliance Models

Medical consortiums or specialty alliances offer effective short-term solutions to pediatrician shortages. During the COVID-19 pandemic, "Internet +" healthcare demonstrated significant effectiveness in pediatric services. Building on this experience, regional universal health information platforms can facilitate 专科 alliances based on principles of collaborative development and mutual benefit. These alliances enable information sharing, remote medical assistance, tiered diagnosis and treatment, and allow physicians to practice effectively across institutions and locations. This approach optimizes existing pediatrician resources, alleviates severe shortages in some areas, promotes equal access to basic healthcare, and reduces difficulties in accessing medical services.

Author Contributions

JI Wenzhou was responsible for data compilation, analysis, and manuscript writing. HUANG Longyi assisted with data analysis. XU Aijun supervised data collection. ZHAO Xia conceptualized the study, revised the manuscript, and provided quality control, assuming overall responsibility for the paper.

Conflict of Interest

The authors declare no conflicts of interest.

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