HPR119

Geographical and temporal variations in availability of national price negotiated novel anticancer drugs: a spatial statistical study based on two cross-sectional datasets in China

Ziqi Zhao, Shengwei Zhang, Tao Zheng, Shu Yang, **Ming Hu#**
West China School of Pharmacy, Sichuan University, Chengdu, China

Background and Objective

- Novel anticancer drugs (NADs), including small molecule inhibitors, antibodies, and hormones, due to patent protection and technical monopolies, the prices of NADs are often relatively high. Aiming to curb soaring drug prices, the Chinese government introduced the National Drug Price Negotiation (NDPN) policy and 71 NADs were added to the reimbursement list in 2024. However, the geographical variations in the availability of price negotiated NADs raised concerns.
- Using spatial analytical methods to analyze the geographic distribution and density of drug-providing institutions is an effective strategy the availability of medications, However, there has been few studies using GIS and spatial statistical methods to evaluate drug availability in China and current studies often fall short in considering both hospitals and retail pharmacies.
- This study aims to evaluate the availability of price-negotiated NADs across different types of drug-providing institutions and their geographical variations nationwide using spatial statistical methods and GIS, providing the latest evidence for NDPN implementation and a new perspective for research on drug availability.

Methods

- Data sources: This study used data from the National Healthcare Insurance Administration on designated hospitals and pharmacies providing national price-negotiated NADs, collected on January 1 and October 1, 2024. We also gathered population, cancer incidence, GDP per capita, and healthcare infrastructure data from official national sources to analyze drug availability and its determinants.
- The availability of NADs--Weighted supply number of drug-providing institutions (hospitals, retail pharmacies) per 1,000 cancer patients:

$$\text{The Availability} = \frac{1000 \times \sum_{j=1}^{n_{Hi}} H_{ij}}{P_i}$$

- Weighted kernel density estimation--The spatial distribution of point data :

$$f(x) = \frac{1}{n}\sum_{i=1}^{n} w_i K\left(\frac{||x - x_i||}{h}\right)$$

- The Theil index--Inequity of the availability:

$$T = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{a_i}{\bar{a}}\ln\left(\frac{a_i}{\bar{a}}\right)\right)$$

- Global Moran's Index--Spatial autocorrelation of NADs availability:

$$Global\ Moran's\ I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(a_i - \bar{a})(a_j - \bar{a})}{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}\sum_{i=1}^{n}(a_i - \bar{a})^2}$$

- Regression Analysis--Multiple linear regression model (OLS):

$$y_i = \beta_0 + \sum_k \beta_k x_{ik} + \epsilon_i$$

- Regression Analysis--Geographically weighted regression (GWR):

$$y_i = \beta_0(\mu_i, v_i) + \sum_k \beta_k(\mu_i, v_i) x_{ik} + \epsilon_i$$

Results

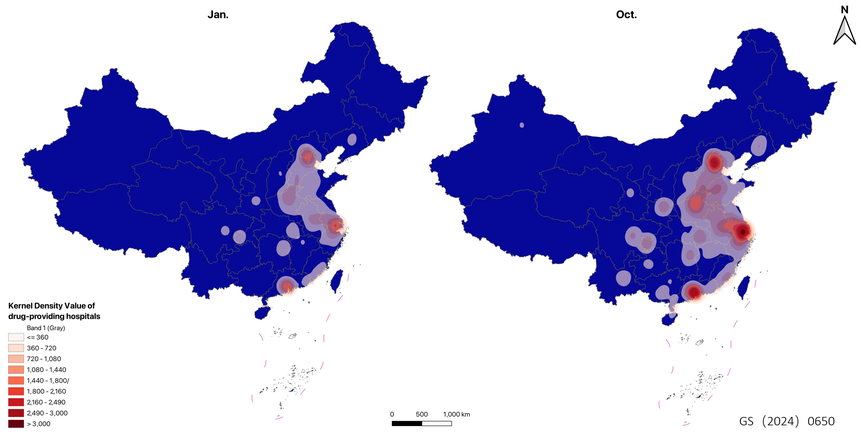

Figure 1 KDE of drug-providing institutions

- High and improved density of drug-providing institutions in the Eastern coastal areas, especially around Beijing, the Yangtze River Delta, and the Pearl River Delta; While the density shows low in western regions and the Northeast.

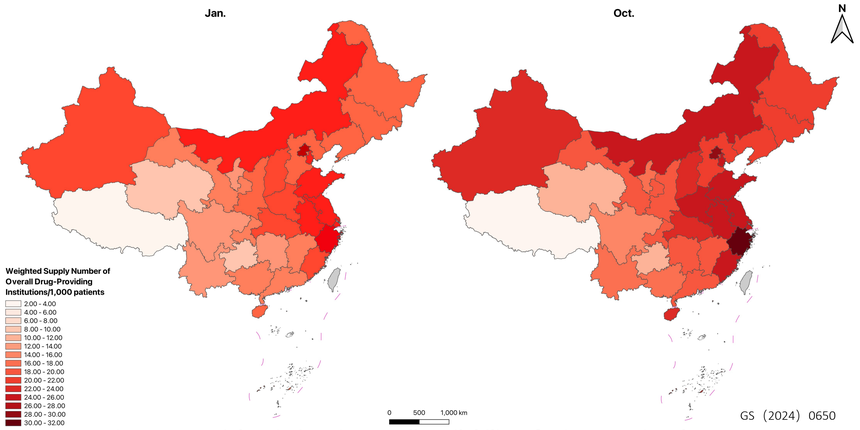

Figure 2 Spatial variations in overall availability of price negotiated NADs

- The availability demonstrate higher levels in the Eastern and central provinces, with lower in the Western provinces. Compared to January, the availability improved in October.

Table 1 The Theil index, and Global Moran's index of price-negotiated NADs availability

Availability Indicators	The Theil index	Moran's I (*p* value)
Hospital-based availability		
Jan.	0.074	0.315(p<0.01)
Oct.	0.062	0.362(p<0.001)
Retail pharmacy-based availability		
Jan.	0.092	0.104(p=0.241)
Oct.	0.093	0.103(p=0.243)
Overall availability		
Jan.	0.045	0.452(p<0.0001)
Oct.	0.044	0.453(p<0.0001)

- The Theil index is relatively low, ranging from 0.044 to 0.093, indicating that the availability of price-negotiated NADs across provinces is generally balanced. From January to October, the Theil index for hospital-based availability decreased.
- Global Moran's Index of hospital-based availability and overall availability was greater than 0, with a p-value lower than 0.01, indicating a spatial positive autocorrelation or clustering, From January to October, this spatial autocorrelation strengthened. While, this spatial autocorrelation was not pronounced in retail pharmacy-based availability(p>0.05).

Table 2 OLS results and GWR results

Dependent Variable	Independent Variable	OLS Results coef (*p* value)	GWR Results Mean coef（range）
Hospital-based availability	GDP per capita 2023		
	Jan.	0.787 (<0.0001)	0.795 (0.725 to 0.904)
	Oct.	0.833(<0.0001)	0.834(0.752 to 0.927)
	Number of Tertiary A-Grade Hospitals		
	Jan.	-0.007(0.724)	-0.014(-0.023 to 0.023)
	Oct.	-0.006(0.775)	-0.014(-0.024 to 0.024)
Retail pharmacy-based availability	GDP per capita 2023		
	Jan.	0.020(0.861)	-0.002(-0.107 to 0.198)
	Oct.	0.038 (0.808)	0.014(-0.138 to 0.293)
	Number of Chain Pharmacies		
	Jan.	0.098(<0.05)	0.084(0.078 to 0.108)
	Oct.	0.122 (<0.05)	0.107(0.087 to 0.145)
Overall availability	GDP per capita 2023		
	Jan.	0.744(<0.001)	0.726(0.554 to 0.973)
	Oct.	0.794(<0.01)	0.763(0.531 to 1.107)
	Number of Tertiary A-grade hospitals		
	Jan.	0.031(0.174)	0.020(0.000 to 0.096)
	Oct.	0.042(0.160)	0.018(-0.002 to 0.122)

- Positive, statistically significant and strengthened association between hospital-based availability and GDP per capita; between overall availability and GDP per capita; between pharmacy-based availability and the number of chain pharmacies.
- The number of tertiary A-grade hospitals has little impact on hospital-based availability, and GDP per capita has little impact on retail pharmacy-based availability (OLS, p>0.05; GWR, coefficients close to 0).

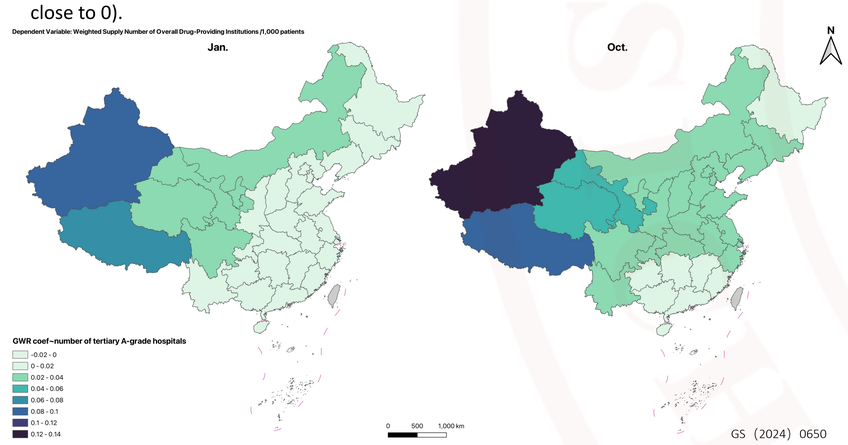

Figure 3 GWR result (Between overall availability and number of tertiary A-grade hospitals)

- Where the OLS model estimated that the association between overall availability and number of tertiary A-grade hospitals was not significant(p>0.05), the GWR model observed a positive relationship in some western provinces (coefficients >0) .

Conclusion

- The availability of price-negotiated NADs is spatially clustered in the Eastern provinces, while it is lower in the Southwest, particularly in hospitals. This distribution pattern is related to local economic development and healthcare infrastructure, and this clustering and correlation have strengthened over time after price negotiation.
- This study presents an innovative application of spatial statistics and GIS techniques. However, it is constrained by its focus on province-level analysis of drug availability and does not incorporate actual patient travel time to drug-providing institutions, which may affect the assessment of true accessibility. Future research could focus on more localized studies based on finer-grained data to provide a more precise assessment of drug accessibility.

huming@scu.edu.cn
2023224050081@stu.scu.edu.cn