Original Article

JHSMR Journal of Health Science and Medical Research

Negotiations on Drug Prices in China and Health Insurance Sustainability: Retrospective and Future Trends

Siyan Zhou, M.S.[1,2,5], Lin Wang, M.S.[1,2,5], Quanzhi Wei, M.S.[2,4], Mu Yan, B.S.[3], Jian Yang, M.S.[1,2,5]

[1]School of Pharmaceutical Sciences & Yunnan Provincial Key Laboratory of Pharmacology for Natural Products, Kunming Medical University, Kunming, Yunnan 650500, China.

[2]Yunnan Provincial Center for Drug Policy Research, Kunming, Yunnan 650500, China.

[3]The First Clinical Medical College, Kunming Medical University, Kunming, Yunnan 650500, China.

[4]The Third Clinical Medical College, Kunming Medical University, Kunming, Yunnan 650500, China.

[5]College of Modern Biomedical Industry, Kunming Medical University, Kunming, Yunnan 650500, China.

Received 10 October 2024 ● Revised 5 February 2025 ● Accepted 17 February 2025 ● Published online 11 June 2025

Abstract:

Objective: This study examines the drug price negotiation process in China from 2017 to 2023, with a particular focus on its impact on drug pricing, especially for innovative therapies, and its influence on healthcare affordability and the sustainability of the health insurance system.

Material and Methods: Data were sourced from public reports and official announcements by the National Healthcare Security Administration (NHSA). A mixed-method approach was employed, combining quantitative analysis of price reductions, success rates, and healthcare expenditure with qualitative insights into policy challenges, focusing on high-cost treatments like oncology drugs and innovative therapies.

Results: From 2017 to 2023, price negotiations led to average reductions of 50-62%, with oncology drugs experiencing a maximum price reduction of 94%. The efficiency of negotiations improved significantly, with a success rate of 85% by 2023. These reductions enhanced access to costly treatments, particularly cancer therapies, but rising demand for innovative treatments continued to strain the healthcare budget. The inclusion of more high-cost therapies in the National Reimbursement Drug List (NRDL) further contributed to the growth in expenditure. Additionally, the proportion of domestically produced drugs in negotiations increased from 39% in 2021 to 69% in 2023, reflecting efforts to enhance self-sufficiency.

Conclusion: Negotiations on drug prices in China have effectively reduced drug prices and improved access to critical therapies, such as innovative and life-saving treatments. However, ongoing demand for innovative treatments poses

Contact: Jian Yang, M.S.
School of Pharmaceutical Sciences & Yunnan Provincial Key Laboratory of Pharmacology for Natural Products, Kunming Medical University, Kunming, Yunnan 650500, China.
E-mail: hamars@126.com

J Health Sci Med Res
doi: 10.31584/jhsmr.20251222
www.jhsmr.org

challenges to the financial sustainability of the health insurance system. Further improvements in value-based pricing and regulatory frameworks are needed to maintain affordability and foster innovation.

Keywords: drug price negotiations, healthcare affordability, health insurance sustainability, innovative therapies, oncology drugs

Introduction

Negotiations on drug prices have played an increasingly important role in controlling healthcare costs globally[1]. In countries like the United States and European Union member states, such negotiations are typically supported by rigorous health technology assessments (HTA) and value-based pricing models[2]. These methods aim to align drug prices with their clinical efficacy and economic value, ensuring that healthcare systems can afford to provide essential medications without sacrificing innovation[3]. In particular, oncology drugs, biologics, and treatments for rare diseases have been central to price negotiations, where the cost of innovation often translates to high financial burdens for healthcare providers and patients[4].

In China, negotiations on drug prices were formalized with the establishment of the National Healthcare Security Administration (NHSA) in 2018. Since then, price negotiations have emerged as a key strategy in managing the cost of healthcare while improving access to high-value drugs, particularly innovative therapies[5]. The National Reimbursement Drug List (NRDL) has become the primary tool for controlling which drugs are covered by insurance and under what conditions[6]. Several studies, such as those conducted by Zhang and Chen (2017), highlight the considerable success of this system, with price reductions frequently exceeding 50%[7]. Cancer treatments, in particular, have seen price drops of up to 70%, making previously unaffordable therapies accessible to a much broader segment of the population[8].

The introduction of price negotiations in China has been met with both praise and criticism. On one hand, the significant price reductions achieved through these negotiations have made life-saving therapies available to millions of patients who would otherwise be unable to afford them[9]. On the other hand, the long-term sustainability of these price reductions is uncertain. As demand for innovative treatments continues to grow, maintaining low prices without compromising the profitability of pharmaceutical companies, who need funds to invest in research and development (R&D), remains a challenge[10]. Several international studies have underscored the risk of de-incentivizing pharmaceutical innovation if prices are reduced too drastically, especially in areas where drug development costs are particularly high, such as in oncology and precision medicine[11].

Furthermore, the literature emphasizes that while price reductions improve immediate access to drugs, the broader impact on healthcare budgets and system sustainability must be considered[12]. In their comparative study of price negotiation frameworks across different countries, Liu et al. (2021) found that while China's centralized negotiation process is highly efficient in achieving rapid price reductions, it faces challenges in incorporating value-based assessments that ensure prices reflect the true clinical and economic value of the drugs[13]. Internationally, countries like the U.K. have developed more sophisticated models for pricing innovative therapies, which account for long-term patient outcomes, cost-effectiveness, and budget impact, areas where China's system could potentially improve[14].

Another critical aspect explored in the literature is the balancing act between cost containment and fostering pharmaceutical innovation. Studies from developed markets suggest that pricing models, which emphasize clinical value and cost-effectiveness, provide a clearer framework for negotiations and help preserve the incentives for drug innovation[15]. In China, the focus has largely been on immediate cost reductions, which, while effective in the short term, may lead to tensions between the government and pharmaceutical companies in the long run, particularly when it comes to novel therapies that require significant investment[16].

This study aims to analyze the outcomes of negotiations on drug prices in China from 2017 to 2023, focusing on their impact on drug prices, healthcare budgets, and patient access. It hypothesizes that these negotiations reduce healthcare expenditures and improve access to therapies, thereby supporting health insurance fund stability. The analysis emphasizes direct financial effects, such as cost reductions and affordability improvements, while recognizing that broader factors, like demographic changes and economic trends, are beyond the study's scope. Additionally, it aims to explore the challenge of balancing cost reduction with fostering pharmaceutical innovation and compares China's experience with international practices in order to evaluate its negotiation framework.

Material and Methods

Data collection

This study employed a comprehensive data collection strategy, utilizing diverse and reliable sources to ensure accurate insights into negotiations on drug prices and their impact on China's healthcare system. Primary data were sourced from public reports and official announcements by the National Healthcare Security Administration (NHSA), including healthcare expenditure reports, negotiation success rate publications, and drug catalog adjustment announcements. Additional information was obtained from major media outlets such as Xinhua News, People's Daily, and CCTV News, as well as online platforms including NHSA's official website and databases like Yaozh.com. To evaluate the effects of negotiations on drug prices, quantitative indicators such as price reduction percentages and negotiation success rates were extracted from healthcare databases and market research reports. By integrating these diverse sources, the study ensured a robust and well-rounded understanding of the socio-economic impacts and long-term trends associated with negotiations on drug prices in China.

Analytical methods

This study employed both quantitative and qualitative analytical methods to comprehensively evaluate negotiations on drug prices and their broader implications. Quantitative methods were used to assess price reductions, negotiation success rates, and the financial impact on healthcare budgets. The percentage reduction in drug prices was calculated using the following formula:

(1) Price Reduction (%) = [(Price Before Negotiation – Price After Negotiation) ⁄ Price Before Negotiation] × 100

Negotiation success rates were calculated as:

(2) Negotiation Success Rate (%) = (Number of Successfully Negotiated Drugs ⁄ Total Number of Drugs Proposed for Negotiation) × 100

In this study, a linear regression model was employed to analyze trends in healthcare fund income, expenditure, and surplus ratios. The model was chosen due to its suitability for time-series data and its ability to handle multiple independent variables while maintaining interpretability. Diagnostic tests such as the Durbin-Watson statistic were conducted to check for autocorrelation, and variables with high variability were log-transformed for

improved variance stability. Residual analysis confirmed the assumptions of homoscedasticity and normality were met. Additionally, outliers were addressed, and interaction terms were included to capture potential dependencies among variables. These adjustments ensured the effective application of the linear regression model in identifying trends in healthcare fund dynamics.

(3) Linear Regression Model Formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon$$

Where:

Y: Dependent variable (e.g., healthcare fund income, expenditure, or surplus ratio)

X_1, X_2, ..., X_n: Independent variables (e.g., negotiation outcomes, healthcare policies, demographic factors)

β_0: Intercept term

β_1, β_2, ..., β_n: Regression coefficients for independent variables

ε: Error term

(4) Log-Transformation for Normality and Variance Stabilization:

$$log(Y) = \beta_0 + \beta_1 log(X_1) + \beta_2 log(X_2) + ... + \beta_n log(X_n) + \varepsilon$$

(5) Durbin-Watson Statistic Formula:

$$DW = \sum[(e_i - e_{i-1})^2] / \sum[e_i^2]$$

Where:

e_i: Residual for observation i

e_{i-1}: Residual for observation i-1

Qualitative methods included reviewing policy documents, negotiation strategies, and case studies to evaluate the socio-economic impacts and policy implications of negotiations on drug prices. The analysis identified systemic challenges, such as balancing cost reduction with innovation and the lack of systematic evaluation of negotiation outcomes. A comparative analysis benchmarked China's pricing strategies against international practices, focusing on differences in negotiation mechanisms and their impact on affordability and innovation. Insights from secondary sources complemented quantitative findings, providing a comprehensive policy context.

Study design

The study was designed to assess the outcomes of negotiations on drug prices across different drug categories, focusing on both innovative therapies like cancer treatments and generic drugs. A longitudinal approach was taken, analyzing data from 2017 to 2023 to capture changes over time in pricing outcomes, healthcare expenditures, and the financial sustainability of the health insurance system. This approach allowed for the examination of both short-term price reductions and their long-term impacts on healthcare budgets, including trends in the resident and employee health insurance funds. The design also incorporated the comparison of negotiated drug pricing with international practices to contextualize China's approach within the global healthcare framework.

Methodological challenges

The study faced several methodological challenges. Data heterogeneity was a key issue, given the diverse sources of information used. Ensuring consistency and comparability across datasets required rigorous data validation to ensure alignment of with findings. Another challenge was potential bias in industry and government reports, which may reflect the interests of stakeholders involved in pharmaceutical pricing negotiations. To mitigate these biases, findings were cross-referenced with independent sources, and a critical perspective was maintained throughout the analysis. Despite these challenges, the study's comprehensive approach to data collection and analysis ensured a robust evaluation of the outcomes and long-term sustainability of negotiations on drug prices in China's healthcare system.

Results

Price reduction outcomes in negotiations on drug prices in China (2017–2023)

From 2017 to 2023, drug price negotiations in China consistently resulted in significant price reductions, improving the accessibility of essential treatments for the population. During this period, the average price reduction ranged between 50% and 62%, with a notable peak occurring in 2020 and 2021, when reductions reached the highest level of 62%. This peak reflects the concentrated efforts of the Chinese government to lower the cost of critical therapies, particularly in high-demand areas such as oncology, where immune checkpoint inhibitors and targeted cancer therapies were prioritized for price cuts. These reductions were crucial in alleviating the financial burden on patients while expanding access to critical life-saving treatments.

Data supports this upward trend in price reductions, showing that the highest reductions surged from 70% in 2017 to 94% in 2021 and 2022, before slightly decreasing to 92% in 2023. The average reductions also displayed a significant increase, rising from 14% in 2017 and stabilizing around 60% after 2021, which indicates improved negotiation efficiency across the pharmaceutical industry (Figure 1A).

Success rates of negotiations on drug prices (2017–2023)

The success rate of negotiations on drug prices in China began at 82% in 2017 and peaked at 94% in 2018, reflecting significant improvements in the negotiation process. As companies increasingly recognized the benefits of being included in the National Reimbursement Drug List (NRDL), participation rose substantially. However, in 2019, the success rate dropped to 50%, likely due to stricter conditions or resistance from companies.

After this decline, the success rate steadily recovered to 73% in 2020, 79% in 2021, and 85% in 2023. The National Healthcare Security Administration (NHSA) enhanced communication and streamlined discussions, encouraging greater participation from pharmaceutical companies. This rising success rate highlights the balance achieved between reducing drug prices and maintaining incentives for company participation, supporting affordable healthcare and sustainable market conditions (Figure 1B).

Impact of negotiations on drug prices on healthcare budget and catalog adjustments (2004–2023)

Negotiations on drug prices have significantly reduced drug prices, but their impact on China's healthcare budget remains complex, influenced by rising demand for innovative therapies and an aging population. While lower prices eased some financial pressures, the demand for costly therapies, particularly for chronic diseases and oncology, continues to drive high healthcare expenditures. Advanced treatments and the growing needs of an aging population sustain spending levels despite falling individual drug prices.

Figure 1C shows changes in the drug catalog composition from 2004 to 2023. Regular drug entries dominated earlier years, peaking in 2004 and 2009 with over 400 additions. From 2017, negotiated entries rose sharply, especially after oncology drug negotiations began in 2018. Regular entries declined after peaking in 2017, and removed entries surged in 2019, reflecting efforts to eliminate outdated or less cost-effective drugs.

Regular drug entries mainly include generic drugs, essential medicines, and treatments for common or chronic diseases. Evaluated for clinical efficacy, cost-effectiveness, and alignment with public health priorities, these drugs generally meet pricing benchmarks and do not require negotiation for inclusion in the National Reimbursement Drug List (NRDL).

While price negotiations lower per-unit costs, the inclusion of high-cost therapies offsets some savings. The

growing trend of negotiated entries since 2019 reflects rising demand for advanced treatments. Additional strategies, such as demand control and optimizing treatment alternatives, are needed in order to manage healthcare costs effectively (Table 1).

Table 1 Historical adjustments of healthcare insurance admission types and versions (2000–2023)

Year	Admission type	Version
2000	Regular admission	Version 1
2004	Regular admission	Version 2
2009	Regular admission	Version 3
2017	Regular + negotiated admission	Version 4
2018	Special negotiation for oncology drugs	Version 4 Supplement
2019	Regular + negotiated admission	Version 5
2020	Regular + negotiated admission	Version 6
2021	Regular + negotiated admission	Version 7
2022	Regular + negotiated admission	Version 8
2023	Regular + negotiated admission	Version 9

Distribution of newly negotiated non-catalog drugs (2021–2023)

Between 2021 and 2023, there has been a notable shift in the distribution of newly negotiated non-catalog drugs in China, with a growing emphasis on domestic drug production. The data, represented in both the table and chart, illustrates a steady increase in the proportion of domestic drugs being negotiated into the healthcare system. In 2021, domestic drugs accounted for 39% of the newly negotiated non-catalog drugs, a proportion that increased to 50% in 2022 and further to 69% in 2023. This indicates a clear trend towards prioritizing local drug manufacturers, potentially driven by government policies aimed at boosting domestic production capacity and reducing dependence on imported medicines.

In contrast, the share of imported drugs fluctuated during the same period. Starting at 26% in 2021, imported drugs saw a peak of 43% in 2022, before dropping to 36% in 2023. This decline suggests a possible shift in focus towards fostering self-sufficiency in the pharmaceutical sector, while still maintaining a significant, albeit reduced, reliance on imported therapies (Figure 1D).

Price reduction trends for newly negotiated non-catalog western medicines across disease categories (2019–2022)

Figure 2A presents the price reduction trends for newly negotiated non-catalog Western medicines across multiple disease categories from 2019 to 2022. Table 2 illustrates that these reductions represent the percentage decrease from the original price before negotiation, highlighting the effectiveness of the negotiation process in making high-cost treatments more affordable. Oncology drugs maintained relatively high reductions, starting at 64% in 2019 and peaking at 70% in 2020, before settling at 57% in 2022. Immune system drugs followed a similar pattern, with reductions increasing from 50% in 2019 to 68% in 2021, and slightly dropping to 62% in 2022. Cardiovascular system drugs showed a gradual increase in reductions, reaching 80% in 2022. Digestive and metabolic drugs exhibited some fluctuations, decreasing to 51% in 2021 but achieving a peak reduction of 70% in 2022. In contrast, anti-infective and respiratory system drugs displayed greater volatility, with anti-infective drugs peaking at 68% in 2021 and ending at 61% in 2022, while respiratory system drugs reached a high of 88% in 2021 but declined sharply to 51% in 2022. Musculoskeletal system drugs achieved the largest reduction of 94% in 2021, though this decreased to 56% by 2022. Overall, the data indicate that while many categories experienced significant price reductions, the extent and consistency of these reductions varied across different therapeutic areas (Table 2).

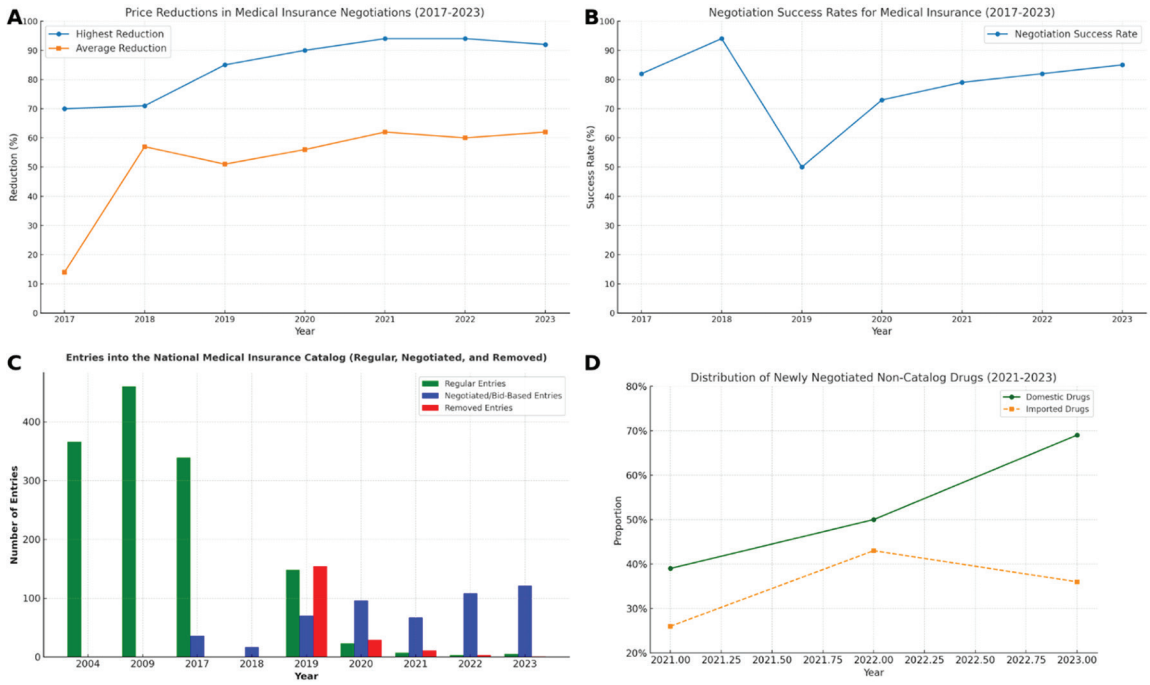

Figure 1 (A) Highest and average reductions in medical insurance negotiation prices (2017–2023) (B) Negotiation success rates by year (2017–2023) (C) Trends in regular, negotiated, and removed entries in the national medical insurance catalog (2004–2023) (D) Distribution of newly negotiated non-catalog drugs (2021–2023)

Table 2 Price reduction of newly negotiated non-catalog western medicines by disease area (2019–2022)

Disease category	2019	2020	2021	2022
Oncology	64%	70%	64%	57%
Immune system drugs	50%	60%	68%	62%
Digestive and metabolic drugs	56%	62%	51%	70%
Anti-infective drugs	67%	52%	68%	61%
Blood and hematopoietic organs	41%	60%	70%	62%
Cardiovascular system drugs	53%	67%	65%	80%
Sensory organ drugs	55%	45%	79%	65%
Respiratory system drugs	63%	73%	88%	51%
Nervous system drugs	76%	66%	63%	60%
Musculoskeletal system drugs	NaN	80%	94%	56%
Urogenital system drugs and sex hormones	NaN	69%	NaN	NaN
Contrast agents	75%	57%	50%	NaN
Systemic hormone preparations	NaN	23%	NaN	NaN
Others	69%	NaN	75%	37%

Trends in sales of negotiated drugs in China's medical insurance system (2018–2022)

The sales trends of negotiated drugs in China's medical insurance system between 2018 and 2022 reveal key insights into the market's dynamics. In 2018, negotiated drugs reached sales of 8.1 billion RMB, which peaked in 2020 at 54.2 billion RMB before declining to 35.3 billion RMB by 2022. For drugs negotiated in 2019, there was a significant increase in sales, particularly in 2021, where sales surged to 89.4 billion RMB. However, this figure also saw a decrease in 2022, falling to 71.9 billion RMB. Drugs negotiated in 2020 exhibited more consistent growth, with sales increasing year-over-year, culminating at 59.8 billion RMB in 2022. Meanwhile, the 2021 negotiated drugs, though starting with minimal sales in 2019, showed exponential growth by 2022, reaching 29.5 billion RMB. Overall, these

trends highlight the evolving impact of negotiated pricing on drug accessibility and affordability in the Chinese medical insurance market, with fluctuations reflecting both market maturity and policy impacts over time (Figure 2B).

Trend analysis of the national health insurance fund's income, expenditure, and yearly balance (2018–2023) based on predictive modeling

The analysis of the National Health Insurance Fund's income, expenditure, and yearly balance from 2018 to 2023 reveals key trends impacting its financial sustainability. From 2018 to 2022, income rose steadily from 21,384 billion to 30,922 billion RMB, peaking in 2022. In 2023, income slightly declined to 26,188 billion RMB. Predictive modeling estimates income will rise to 28,542 billion RMB in 2024 (y= 1354.43x–2710541.43), showing a moderate but steady increase over time.

Expenditures followed a similar pattern, rising from 17,822 billion RMB in 2018 to 30,922 billion RMB in 2022, before dropping to 22,531 billion RMB in 2023. The model predicts a rise to 24,153 billion RMB in 2024 (y=1621.71x–3253806.38). Notably, the steeper increase in expenditures compared to income suggests rising financial pressure on the fund.

The yearly balance fluctuated, peaking at 6,325 billion RMB in 2022 but declining to 3,656 billion RMB in 2023. The model forecasts a slight recovery to 4,389 billion RMB in 2024 (y=274.69x–550734.49). However, if expenditures continue to rise faster than income, the fund's long-term stability could be at risk. Continued monitoring and policy adjustments will be essential to ensure financial sustainability (Table 3, Figure 2C).

Trend analysis and forecast of the number and ratio of insured members in China's employee medical insurance system (2013–2025)

The analysis of China's employee medical insurance system from 2013 to 2025 reveals steady growth in both active and retired insured members. The number of active insured members increased from 205.01 million in 2013 to 266.04 million in 2022, while retired insured members grew from 69.42 million to 96.39 million over the same period. This growth highlights the expansion of healthcare coverage as more individuals join the system.

However, the active-to-retired ratio declined from 2.95 in 2013 to 2.76 in 2022, indicating that the retiree population is growing faster than the active workforce. To analyze this trend, a linear regression model was applied, predicting that the ratio will decline further to approximately 2.71 by 2025 (y=–0.015x+33.39), with an R^2 value of 0.542, indicating moderate predictive accuracy. While alternative models, such as polynomial and exponential regression, were explored during preliminary testing, they did not significantly improve predictive accuracy or alignment with observed trends. The linear regression model was ultimately selected for its simplicity, interpretability, and ability to effectively capture the data's overall characteristics and trends. As the proportion of retirees increases relative to active employees, the system is expected to face growing financial pressure. The declining ratio highlights potential

Table 3 National health insurance fund income, expenditure, and yearly balance (2018–2023)

Year	2018	2019	2020	2021	2022	2023 (up to October)
National health insurance fund income (in billions)	21,384	24,421	24,846	28,728	30,922	26,188
National health insurance fund expenditure (in billions)	17,822	20,854	21,032	24,043	30,922	22,531
National health insurance fund yearly balance (in billions)	3,562	3,567	3,814	4,684	6,325	3,656

challenges in maintaining sustainability, as a larger retiree population could strain the system's resources. This trend underscores the need for policy reforms to address the changing demographic landscape and ensure the long-term viability of the employee medical insurance system (Table 4, Figures 3a and 3b).

Table 4 Surplus ratios of employee and resident health insurance funds and structure of employee insurance participants (2013–2023)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Active insured members (millions)	205.01	210.41	213.62	217.20	222.88	233.08	242.24	254.29	261.06	266.04
Retired insured members (millions)	69.42	72.55	75.31	78.12	80.34	83.73	87.00	90.26	93.24	96.39
Active to retired ratio	2.95	2.90	2.84	2.78	2.77	2.78	2.78	2.82	2.80	2.76

Note: This table reflects the number of active and retired insured members in China's employee medical insurance system from 2013 to 2022, along with the active-to-retired ratio over the same period.

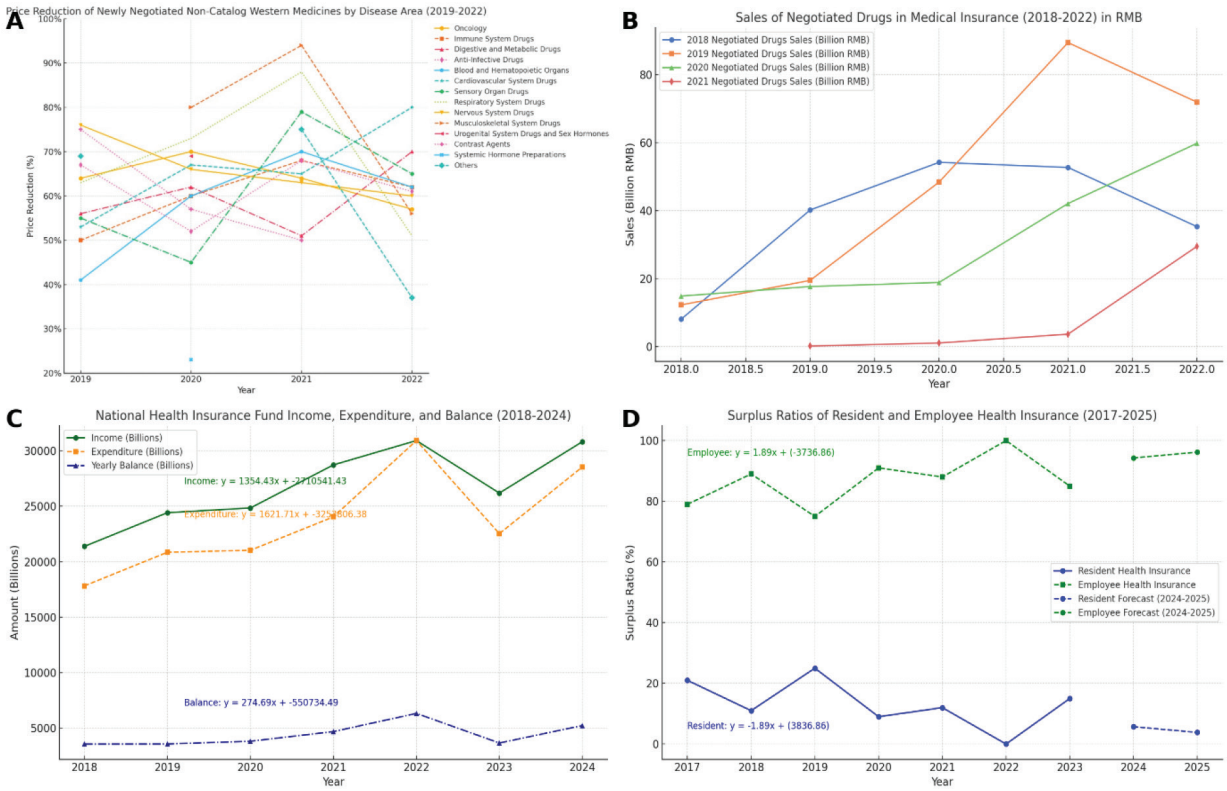

Figure 2 (A) Price reduction of newly negotiated non-catalog western medicines by disease area (2019–2022) (B) Percentage increase in sales of negotiated drugs in medical insurance (2018–2022) in RMB (C) National health insurance fund income, expenditure, and balance (2018–2023) (D) Trend and forecast of surplus ratios for resident and employee health insurance funds (2017–2025)

Trend and forecast of surplus ratios for resident and employee health insurance funds (2017–2025)

Figure 2D shows the trend and forecast of surplus ratios for resident and employee health insurance funds from 2017 to 2025. The surplus ratio for resident health insurance shows a fluctuating decline, reaching 0% in 2022, with a slight recovery forecasted to be 10.3% by 2025 (y=–1.89x+3836.86). In contrast, the surplus ratio for employee health insurance has steadily increased, reaching 100% in 2022, and is expected to remain stable at 95.3% in 2025 (y=1.89x–3736.86).

The merging of urban and rural health insurance into the resident health insurance system in 2018 added complexities to fund management. In the first 10 months of 2023, the resident health insurance fund recorded a deficit of 69.078 billion RMB, while the surplus came solely from employee health insurance. This deficit is partly due to the mismatch in the timing of income and expenditures, with resident contributions collected in the previous year and disbursements made monthly throughout the current year.

While employee health insurance remains financially stable, the resident health insurance fund faces greater volatility, emphasizing the need for better cash flow management to ensure long-term sustainability. Future adjustments may be required to align fund inflows and outflows more effectively, particularly for the resident insurance system.

Forecast and trend analysis of China's commercial health insurance market (2012–2025)

Figure 4 presents the market size of China's commercial health insurance from 2012 to 2025, with a forecast for 2025 based on a linear regression model. The historical data show a consistent upward trend, reflecting the rapid growth of the commercial health insurance market. The regression model used to forecast the 2025 value is represented by the equation: y=897.47x–1805456.95, where y is the projected market size in billions, and x is the year. This equation suggests that for every additional year, the market size increases by approximately 897.47 billion RMB. The model projects that the market size will reach approximately 10,567 billion RMB by 2025. The R^2 value of 0.975 indicates that the model explains 97.5% of the variance in the market size data, demonstrating a strong fit. Alternative models, such

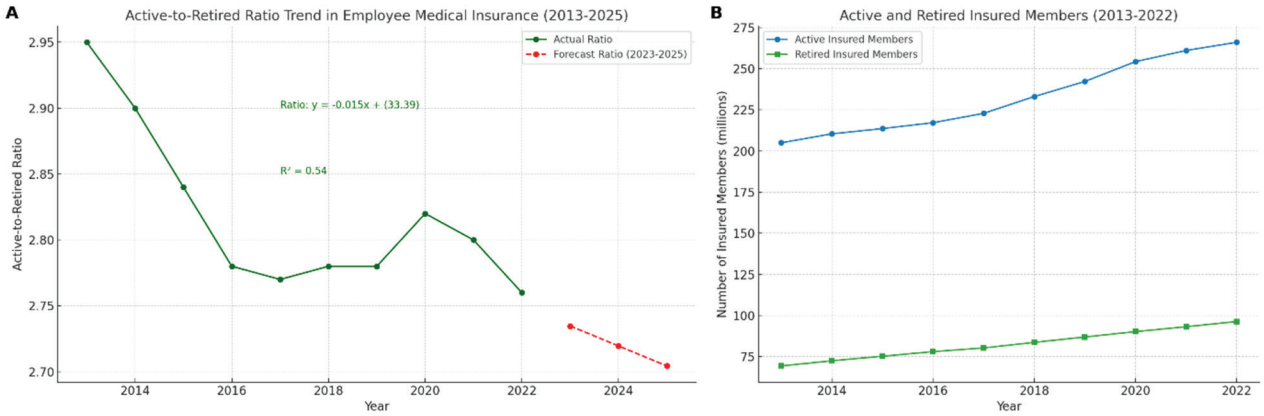

Figure 3 (A) Active-to-retired ratio trend in China's employee medical insurance system (2013–2025) (B) Active and retired insured members in China's employee medical insurance system (2013–2022)

as polynomial and time-series regressions, were explored but offered no significant improvement in accuracy. The linear regression model was ultimately selected for its simplicity, strong predictive accuracy, and clear alignment with observed trends, effectively capturing the data's characteristics within the study's timeframe. The strong upward trend underscores the growing importance of commercial health insurance in China's healthcare system, driven by increased demand for private healthcare services and expanding insurance coverage. However, the gradual decline in the growth rate suggests a maturing market as the industry reaches higher levels of penetration.

Discussion

The trends observed in the 2017-2023 negotiations on drug prices provide significant insights into the effectiveness and sustainability of China's healthcare system reforms[17]. The price reductions, averaging 50% to 62% and peaking at 94% for certain therapies like oncology drugs, reflect the Chinese government's successful efforts in making essential treatments affordable. These price cuts have alleviated the financial burden on patients while expanding access to life-saving treatments[18]. However, the stabilization of price reductions at around 61.7% in recent years suggests a shift towards a more sustainable approach, balancing affordability with the need to incentivize pharmaceutical innovation. This balance is crucial as continued innovation depends on pharmaceutical companies' ability to invest in research and development, ensuring the system remains effective in the long term[19].

The improvement in success rates, rising from 67% in 2017 to 85% in 2023, illustrates the refinement of the negotiation process and the NHSA's ability to align the interests of pharmaceutical companies with public healthcare goals. The temporary dip in success rates in 2019 can be attributed to early challenges in reaching agreements

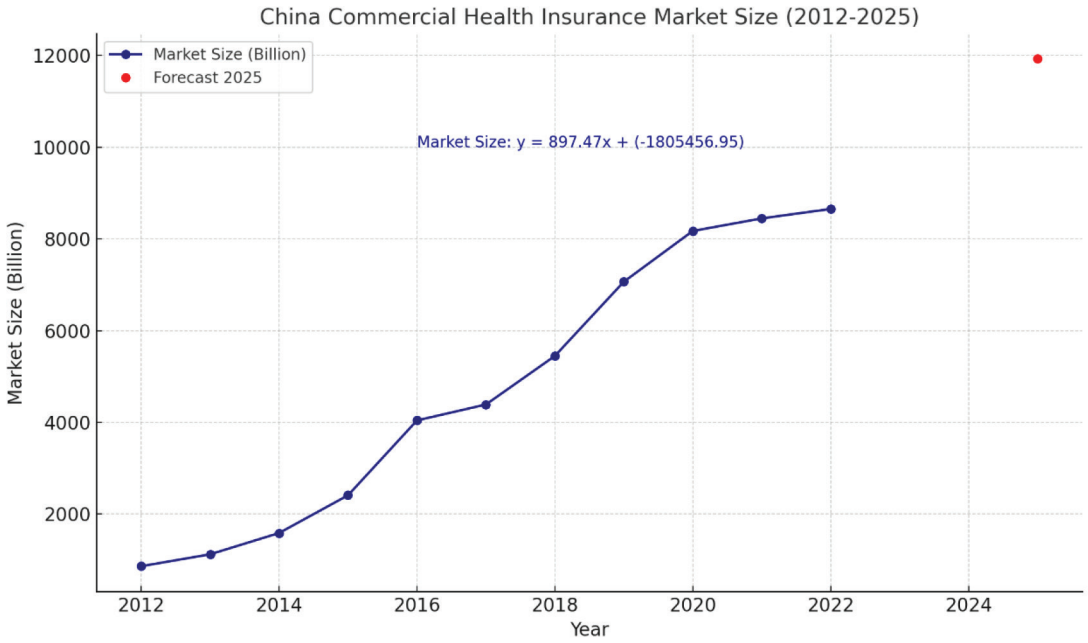

Figure 4 China commercial health insurance market size (2012-2025)

with companies over steep price cuts[20]. However, the increase in success from 2020 onwards reflects the growing realization by pharmaceutical companies of the benefits of being included in the National Reimbursement Drug List (NRDL). This inclusion has not only increased participation but also enhanced access to more affordable medications, contributing to a more sustainable healthcare system[21].

However, while price negotiations have been effective in reducing individual drug costs, the broader impact on healthcare budgets remains complex. The growing demand for innovative, high-cost therapies, particularly in oncology and chronic diseases, continues to exert upward pressure on healthcare spending[22]. The catalog adjustments from 2004 to 2023, with the increasing number of negotiated drug entries, show that the inclusion of advanced treatments is crucial but offsets some of the savings achieved through price cuts[23]. The spike in removed entries in 2019 also highlights the government's ongoing efforts to phase out outdated or less cost-effective treatments in order to manage costs effectively[24].

Furthermore, the broader systemic challenges impacting healthcare fund sustainability extend beyond drug price negotiations. For example, the inclusion of innovative therapies, while essential for improving health outcomes, has introduced higher baseline costs, which the savings from price negotiations alone cannot fully offset[25]. Demographic shifts, such as an aging population, have also intensified financial strain by increasing the demand for chronic disease management and expensive treatments. These systemic pressures underscore the need for comprehensive reforms to balance affordability, accessibility, and innovation in healthcare funding[26]. While this study lacks specific data on the share of innovative therapies like oncology drugs in total drug expenditures, existing literature underscores their significant financial impact on healthcare systems. Optimizing pricing and reimbursement strategies for high-cost therapies is crucial for financial sustainability.

The emphasis on domestic drug production from 2021 to 2023 reflects China's strategic push toward self-sufficiency in pharmaceutical manufacturing. The proportion of domestic drugs in the negotiated list rose from 39% in 2021 to 69% in 2023, reducing reliance on imported drugs and promoting the development of the local pharmaceutical industry[27]. This shift toward supporting domestic innovation not only strengthens the healthcare sector's resilience but also ensures that essential therapies are readily available to meet rising demand, even in the face of global supply chain disruptions[28].

In terms of healthcare fund sustainability, the analysis of the National Health Insurance Fund's income, expenditure, and yearly balance from 2018 to 2023 reveals growing financial pressures. Although income rose consistently until 2022, the decline in 2023, coupled with rising expenditures, highlights the potential risks to the long-term financial stability of the system[29]. The inclusion of high-cost therapies, particularly innovative treatments for chronic diseases and oncology, has significantly contributed to this expenditure growth. While these therapies expand access, their financial impact underscores the need for detailed analysis to guide effective policymaking. Predictive modeling for 2024 indicates that while income is expected to recover slightly, expenditures will continue to rise, driven by the inclusion of more high-cost therapies[30]. For example, oncology drugs, which represent a growing share of reimbursed treatments, are expected to contribute disproportionately to healthcare spending.

The financial performance of the employee and resident health insurance funds highlights contrasting challenges.

NHSA reports reveal substantial reductions in patient out-of-pocket expenses. The 2024 NRDL negotiations alone are projected to lessen the burden on patients by over 500 billion RMB. Furthermore, since the NRDL's inception, cumulative patient cost reductions exceed 8,800 billion RMB,

demonstrating the significant impact of comprehensive cost-containment strategies. These strategies encompass not only drug price negotiations but also expanded insurance coverage and increased government subsidies[31]. This multifaceted approach underscores the NHSA's commitment to improving healthcare affordability and accessibility.

The employee health insurance system remains relatively stable due to higher contribution rates and lower utilization among younger, healthier populations. In contrast, the resident health insurance fund recorded a 69.078 billion RMB deficit in the first 10 months of 2023, reflecting significant financial strain that necessitates structural reforms. Addressing this imbalance requires tailored policies to meet the unique demands of each system. The financial strain is further exacerbated by the mismatch between income and expenditure trends in health insurance funds. For instance, the resident health insurance fund recorded a deficit of 69.078 billion RMB in the first 10 months of 2023, underscoring the urgency for improved cash flow management and structural adjustments to ensure fund stability[32]. Addressing these issues will require the adoption of systemic reforms, such as value-based pricing frameworks, more efficient revenue collection mechanisms, and stricter demand-side management to curb unnecessary treatments and reduce waste[33].

The trend analysis of insured members in the employee medical insurance system from 2013 to 2025 further illustrates the financial strain. The decline in the active-to-retired ratio, projected to drop to 2.71 by 2025, suggests that the system will face increasing pressure as the retiree population grows faster than the active workforce. This demographic shift underscores the need for comprehensive reforms to ensure that healthcare funds can support an aging population without compromising the affordability and accessibility of medical treatments[34].

Moreover, the fluctuating surplus ratios of the resident and employee health insurance funds reflect the financial challenges posed by the timing mismatch between income and expenditure. The deficit in the resident health insurance fund in recent years, particularly the 69.078 billion RMB deficit recorded in the first 10 months of 2023, underscores the need for improved cash flow management[35]. While the employee health insurance fund remains stable, the volatility of the resident fund suggests that policy adjustments are required to better align fund inflows and outflows, ensuring long-term financial sustainability[36].

To ensure the long-term sustainability of China's healthcare system, addressing the challenges posed by rising expenditures on high-cost therapies, an aging population, and the need for continued pharmaceutical innovation requires a comprehensive and holistic approach. While drug price negotiations in China have effectively reduced costs and expanded access to essential therapies[37], these measures alone are insufficient to counterbalance the financial pressures facing the system. Future strategies must include value-based pricing frameworks to optimize expenditures, stricter demand-side management to curb unnecessary treatments, and improved cash flow management to stabilize fund operations[38]. Additionally, ongoing evaluations of the financial impact of high-cost therapies will be crucial to guiding evidence-based policymaking. Continued support for domestic pharmaceutical innovation, coupled with comprehensive policy reforms, is essential in order to strike a balance between affordability, innovation, and financial sustainability. These systemic reforms will ensure that China's healthcare system can meet the growing healthcare demands of its population while maintaining long-term stability[39].

While the long-term goal remains system integration, the current separation of residential health insurance (RHI) and employee healthcare plans (EHP) reflects their distinct financing and coverage mechanisms. RHI focuses on rural and urban non-employed populations, funded by government subsidies and individual contributions,

while EHP serves employees through employer-based contributions. NHSA reports highlight the overall financial stability of these systems, supported by policies to manage costs and expand access. However, factors like drug price reductions and increased healthcare utilization could pose risks to the RHI fund's sustainability. The NRDL negotiations alone are projected to lower patient out-of-pocket costs by over 500 billion RMB, with cumulative reductions exceeding 8,800 billion RMB. While beneficial for patients, these measures increase financial pressure on the RHI fund[40]. To ensure the RHI fund's long-term viability, potential countermeasures include adjusting individual and government contribution rates, improving fund management efficiency, and leveraging fiscal support. Strengthening coordination between RHI and EHP systems may also help alleviate the financial strain and improve overall healthcare equity. These proactive measures will allow the RHI program to maintain affordability and accessibility for the population.

The inclusion of commercial health insurance (CHI) projections is crucial for understanding China's evolving healthcare financing landscape. Recent NHSA announcements highlight the expanding role of CHI within the multi-tiered "1+3+N" system, complementing the national residential (RHI) and employee (EHP) plans by addressing coverage gaps for specialized or high-cost treatments. This reflects a strategic shift towards a more diversified healthcare financing model that can better meet the varied needs of the population. The NHSA's reports on the robust financial health of the national fund, including a 2024 surplus, further demonstrate the system's capacity to support this complementary approach without compromising the stability of the core social insurance programs. Initiatives like the expanded National Reimbursement Drug List (NRDL) and the new Category C formulary directly aim to mitigate healthcare expenditure burdens, showcasing a holistic commitment to providing both basic coverage and improved access to innovative treatments. Analyzing CHI within this broader policy context provides a more comprehensive understanding of how multiple financing mechanisms work in tandem to reduce patient costs and build a more sustainable, resilient healthcare system.

This study focused on the direct impacts of negotiations on drug prices, such as cost containment and affordability improvements, using a quantitative approach. While findings support the hypothesis that price negotiations reduce costs and improve access to therapies, systemic factors—such as demographic shifts, rising healthcare demand, and aging populations—were beyond this study's scope but are crucial for future research. Future studies should integrate quantitative and qualitative methods in order to explore the relationship between systemic variables and price negotiations, providing insights into health insurance sustainability and addressing demographic and economic challenges, while collecting expenditure data on high-cost therapies, like oncology drugs, in support of evidence-based policymaking and resource allocation.

Conclusion

Negotiations on drug prices in China from 2017 to 2023 significantly reduced drug prices and expanded access to essential medicines, with oncology therapies seeing the greatest impact. These negotiations improved affordability for patients while demonstrating the potential for collaboration between the government and pharmaceutical companies. Despite these successes, the rising demand for high-cost innovative therapies and the aging population pose challenges to the financial sustainability of healthcare funds. To address these issues, future efforts should focus on integrating value-based pricing frameworks, optimizing catalog adjustments to prioritize cost-effective therapies, and implementing strategies to stabilize healthcare fund income and expenditures.

Ethics approval of the research

This study did not involve human or animal subjects, or the collection of sensitive personal data. All data were sourced from publicly available information, so no ethics approval was required.

Author contributions

Z.S.: Conceptualization, Methodology, Writing – Original Draft, Supervision; Q.W.: Data Curation, Writing – Original Draft; L.W.: Data Analysis; M.Y.: Validation, Methodology; J.Y.: Supervision, Funding Acquisition, Project Administration, Writing – Review and Editing, Final Approval of Version to Be Published. All authors have read and agreed to the published version of the manuscript.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Supplementary materials

Not applicable

Acknowledgement

We are deeply grateful to all those who have provided support and guidance throughout the course of this research. We would like to extend our sincere appreciation to the scholars and professionals whose expertise has been invaluable in shaping the direction of this study.

Funding sources

This research was supported by several funding sources: [1] The 2023 Research Project on Education and Teaching of Kunming Medical University, Course: Clinical Pharmacokinetics, Project Number 2023-JY-Y-090; [2] Undergraduate Teaching Quality and Reform Project of Kunming Medical University, 2024 (Course: Clinical Pharmacokinetics, Project No. 2024KCSZSFXM022); [3] The First-Class Discipline Team of Kunming Medical University (Pharmaceutical Policy Research and Practice Team, Project No. 2024XKTDPY21); [4] The project titled "Exploring the Establishment of a Model Modern Biomedical Industry College: A Study on Undergraduate Educational Reform in Yunnan Province", Project Number JG2023001. The funding agencies did not participate in the design, data collection, analysis, interpretation of the data, or writing of the manuscript.

Conflict of interest

The authors declare no conflict of interest related to this study.

References

1. Liu GG, Wu J, He X, Jiang Y. Policy updates on access to and affordability of innovative medicines in china. Value Health Reg Issues 2022;30:59–66. doi: 10.1016/j.vhri.2021.12.003.
2. Kaltenboeck A, Bach PB. Value-based pricing for drugs: theme and variations. JAMA 2018;319:2165–6. doi: 10.1001/jama.2018.4871.
3. Vogler S, Paris V, Panteli D. Ensuring access to medicines: How to redesign pricing, reimbursement and procurement?. Geneva, Switzerland: World Health Organization, Regional Office for Europe; 2018.
4. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021;71:209-49.
5. Tang M, Song P, He J. Progress on drug pricing negotiations in China. Biosci Trends 2020;13:464–8. doi: 10.5582/bst.2019.01339.
6. Guan X, Liang H, Xue Y, Shi L. An analysis of China's national essential medicines policy. J Public Health Policy 2011;32:305-19.
7. Zhang Y, Chen Z, Li J. The current status of treatment for colorectal cancer in China: a systematic review. Medicine 2017;96:e8242.

8. Cao W, Chen HD, Yu YW, Li N, Chen WQ. Changing profiles of cancer burden worldwide and in China: a secondary analysis of the global cancer statistics 2020. Chin Med J 2021;134:783–91.
9. Diao Y, Li M, Huang Z, Sun J, Chee YL, Liu Y. Unlocking access to novel medicines in China – a review from a health system perspective. Risk Manag Healthc Policy 2019;12:357–67.
10. Peng Yunjia. "Difficult to enter the hospital" for medical insurance drugs? "Dual channel" Liangjian enters the hospital for the "last mile". [homepage on the Internet]. Beijing: Xinhua News Agency; 2021. [cited 2022 Jun 20]. Available from: http://www.gov.cn/xinwen/2021-05/10/content_5605635.htm
11. Chen W, Jiang Z, Shao Z, Sun Q, Shen K. An economic evaluation of adjuvant trastuzumab therapy in HER2-Positive early breast cancer. Value Health 2009;12:S82–4.
12. National Medical Security Administration. Announcement of the national medical security administration on publishing the "national medical insurance drug catalog adjustment work plan in 2021" and "national medical insurance drug catalog adjustment application guidelines". [homepage on the Internet]. Beijing: National Healthcare Security Administration; 2021 [cited 2023 May 01]. Available from: http://www.nhsa.gov.cn/art/2021/6/30/art_62_5386.html
13. Li G, Liu Y, Xie C, Zhou Q, Chen X. Characteristics of expedited programmes for cancer drug approval in China. Nat Rev Drug Discov 2021;20:416. doi: 10.1038/d41573-021-00080-0.
14. Salas-Vega S, Shearer E, Mossialos E. Relationship between costs and clinical benefits of new cancer medicines in Australia, France, the UK, and the US. Soc Sci Med 2020;258:113042. doi: 10.1016/j.socscimed.2020.113042.
15. Liu Y, Zhang N, Xie C, Jiang Y, Qin Y, Zhou L, et al. Evolution of drug regulations and regulatory innovation for anticancer drugs in China. Acta Pharm Sin B 2022;12:4365–77. doi: 10.1016/j.apsb.2022.08.004.
16. Zhu H, Zhu J, Zhou Y, Shan L, Li C, Cui Y, et al. Impact of the national reimbursement drug list negotiation policy on accessibility of anticancer drugs in China: an interrupted time series study. Front Public Health 2022;10:921093. doi: 10.3389/fpubh.2022.921093.
17. Fang W, Xu X, Zhu Y, Dai H, Shang L, Li X. Impact of the national health insurance coverage policy on the utilisation and accessibility of innovative anti-cancer medicines in China: an interrupted time-series study. Front Public Health 2021;9:714127. doi: 10.3389/fpubh.2021.714127.
18. Villa F, Tutone M, Altamura G, Antignani S, Cangini A, Fortino I, et al. Determinants of price negotiations for new drugs. The experience of the Italian Medicines Agency. Health Policy 2019;123:595–600.
19. Moye-Holz D, van Dijk JP, Reijneveld SA, Hogerzeil HV. The impact of price negotiations on public procurement prices and access to 8 innovative cancer medicines in a middle-income country: the case of Mexico. Value Health Reg Issues 2019;20:129–35.
20. Zhang Y, Wushouer H, Han S, Fu M, Guan X, Shi L, et al. The impacts of government reimbursement negotiation on targeted anticancer medication price, volume and spending in China. BMJ Glob Health 2021;6. doi: 10.1136/bmjgh-2021-006196.
21. The National Healthcare Security Administration. Interim measures for the administration of use of drugs covered by the basic medical insurance [homepage on the Internet]. Beijing: National Healthcare Security Administration; 2020 [cited 2022 Jun 14]. Available from: http://www.gov.cn/zhengce/zhengceku/2020-08/04/content_5532409.htm
22. Vokinger KN, Hwang TJ, Grischott T, Reichert S, Tibau A, Rosemann T, et al. Prices and clinical benefit of cancer drugs in the USA and Europe: a cost–benefit analysis. Lancet Oncol 2020;21:664–70. doi: 10.1016/S1470-2045(20)30139-X.
23. Kovic B, Jin X, Kennedy SA, Hylands M, Pedziwiatr M, Kuriyama A, et al. Evaluating progression-free survival as a surrogate outcome for health-related quality of life in oncology: a systematic review and quantitative analysis. JAMA Intern Med 2018;178:1586–96. doi: 10.1001/jamainternmed.2018.4710.
24. Zhang J. Application and approval of cancer drugs in China: acceleration should be kept in progress. AME Med J 2018;3:57–7.
25. Kovic B, Jin X, Kennedy SA, Hylands M, Pedziwiatr M, Kuriyama A, et al. Evaluating progression-free survival as a surrogate outcome for health-related quality of life in oncology: a systematic review and quantitative analysis. JAMA Intern Med 2018;178:1586–96. doi: 10.1001/jamainternmed.2018.4710.
26. Vallano A, Pontes C. Escalating costs of innovative medicines: perspective and proposals. Front Public Health 2024;12:1449707. doi: 10.3389/fpubh.2024.1449707.
27. Li M, Diao Y, Ye J, Sun J, Jiang Y.The public health insurance coverage of novel targeted anticancer medicines in China-in favor of whom? A retrospective analysis of the insurance claim data. Front Pharmacol 2021;12:778940.

28. Diao Y, Qian J, Liu Y, Zhou Y, Wang Y, Ma H, et al. How government insurance coverage changed the utilization and affordability of expensive targeted anti-cancer medicines in China: an interrupted time-series study. J Glob Health 2019;9:020702.
29. Zhang B, Ding J, Chen Y, Wei L. Research on the policy motivation and implementation model of "dual channel" management mechanism for national reimbursement negotiation drugs. World Clin Drugs 2021;42:9.
30. Russo P, Marcellusi A, Zanuzzi M, Carletto A, Fratto ME, Favato G, et al. Drug prices and value of oncology drugs in Italy. Value Health 2021;24:1273–8. doi: 10.1016/j.jval.2021.04.1278.
31. National Healthcare Security Administration. Press conference: safeguarding people's health and empowering economic development. [homepage on the Internet]. Beijing: National Healthcare Security Administration; 2025. [cited 2025 Feb 5]. https://www.nhsa.gov.cn/art/2025/1/17/art_14_15491.html
32. National Healthcare Security Administration. Statistical bulletin on the development of medical insurance in 2023. [homepage on the Internet]. Beijing: Economic Observer; 2024 [cited 2025 Jun 6]. Available from: http://www.eeo.com.cn/2024/0420/653838.shtml
33. Huang Y. China's emerging welfare crisis [homepage on the Internet]. Beijing: Think Global Health; 2024 [cited 2025 Jun 6]. Available from: https://www.thinkglobalhealth.org/article/chinas-emerging-welfare-crisis
34. Gregson N, Sparrowhawk K, Mauskopf J, Paul J. Pricing medicines: theory and practice, challenges and opportunities. Nat Rev Drug Discov 2005;4:121–30. doi: 10.1038/nrd1633.
35. Li T, Li X. Does structural deceleration happen in China? Evidence from the effect of industrial structure on economic growth quality. Natl Account Rev 2020;2:155–73. doi: 10.3934/NAR.2020009.
36. Si L, Xu L, Chen M, Jan S. Using strategic price negotiations to contain costs and expand access to medicines in China. BMJ Glob Health 2020;5:e002256.
37. Henry Ntarmah A, Kong Y, Kobina Gyan M. Banking system stability and economic sustainability: a panel data analysis of the effect of banking system stability on sustainability of some selected developing countries. Quant Financ Econ 2019;3:709–38. doi: 10.3934/QFE.2019.4.709.
38. Jiang J, Zhang X. Social transition and health inequality in China: an age-period-cohort analysis. Public Health 2020;180:185–95. doi: 10.1016/j.puhe.2019.08.025.
39. Bloomberg News. China pledges key reforms to revamp nation's medical system [homepage on the Internet]. NYC: Bloomberg; 2024 [cited 2025 Jun 6]. Available from: https://www.bloomberg.com/news/articles/2024-06-06/china-pledges-key-reforms-to-revamp-nation-s-medical-system
40. National Healthcare Security Administration. Press conference: safeguarding people's health and empowering economic development [homepage on the Internet]. Beijing: National Healthcare Security Administration; 2025 [cited 2025 Feb 5]. Available from: https://www.nhsa.gov.cn/art/2025/1/17/art_14_15491.html