Hospitalization Costs and Influencing Factors for Hypertension Patients with Comorbidities and Complications in County-Level Medical Institutions of a Poverty-Stricken County in Henan Province, 2017-2019: A Postprint

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Abstract

Objective To analyze the hospitalization expenses of patients with hypertension and its comorbidities and complications in county-level medical institutions, thereby providing data support for formulating hypertension management and prevention and control strategies at the county level. Methods Data were utilized from the front pages of medical records of patients diagnosed with hypertension and its complications in county people' s hospitals and county traditional Chinese medicine hospitals from 2017 to 2019, matched with reimbursement data for hospitalization expenses of patients with hypertension and its complications from municipal and county medical insurance information systems, totaling 36,565 hospitalization cases. Statistical analysis was performed using SPSS 20.0 software. Descriptive statistics were employed to analyze hospitalization expenses, while non-parametric rank-sum test and ^{2} test were used for univariate analysis. Results From 2017 to 2019, hospitalizations due to hypertension and its complications accounted for 26.27% of total hospitalizations in county-level medical institutions. Statistically significant differences were observed in hospitalization numbers across different occupational types, marital statuses, medical insurance types (payment methods), and age groups. The average cost per hospitalization for hypertension and its comorbidities and complications was 7,354.52 yuan, 6,724.16 yuan, and 7,133.39 yuan, respectively. While average hospitalization costs and drug expenses decreased, examination fees remained unchanged, but total hospitalization expenses increased. The proportion of medical insurance reimbursement for hypertension-related hospitalizations accounted for 24.86%, 31.41%, and 33.25% of total county medical insurance reimbursement expenses, respectively, showing a year-by-year upward

trend. The proportion of patients with hypertension accompanied by complications and by both comorbidities and complications decreased, while the proportion without complications or comorbidities increased. Individuals aged 55-75 exhibited higher rates of comorbidities and complications. Non-agricultural hospitalized patients showed higher proportions of comorbidities and complications. Urban employee medical insurance patients and poverty relief patients demonstrated high proportions of complications and both comorbidities and complications. Conclusion Urgent measures are needed to strengthen standardized management of diagnosed hypertensive patients and enhance primary-level medical institutions' capacity for detection, diagnosis, and management of hypertension, thereby reducing medical and health expenditures by delaying disease progression. Special attention should be directed toward vulnerable groups to alleviate the disease burden and improve health outcomes. Comprehensive strategies should be implemented to enhance hypertension health awareness and self-management capabilities among all residents in the region.

Full Text

Analysis of Hospitalization Frequency and Inpatient Expenditures for Hypertension and Its Comorbidities/Complications at County-Level Medical Institutions in a Poverty-Stricken County in Henan Province, 2017–2019

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Abstract

Objective: To analyze hospitalization costs for hypertension and its comorbidities/complications at county-level medical institutions, providing data support for county-level hypertension management and prevention strategies.

Methods: Data were collected from the front pages of medical records at the county people' s hospital and county traditional Chinese medicine hospital from

2017 to 2019, identifying patients diagnosed with hypertension and its complications. These were matched with inpatient reimbursement data from municipal and county medical insurance information systems, yielding information on 36,565 hospitalization episodes. Statistical analysis was performed using SPSS 20.0. Descriptive statistics were used to analyze hospitalization costs, while nonparametric rank-sum tests and ^{2} tests were employed for univariate analysis.

Results: From 2017 to 2019, hospitalizations due to hypertension and its complications accounted for 26.27% of total hospitalizations at county-level medical institutions. Statistically significant differences were observed across occupation types, marital status, insurance types (payment methods), and age groups. The average cost per hospitalization for hypertension and its comorbidities/complications was ¥7,354.52, ¥6,724.16, and ¥7,133.39 for 2017, 2018, and 2019, respectively. While per-hospitalization costs and drug expenses decreased, examination fees remained stable, though total hospitalization expenditures rose substantially. Medical insurance reimbursement for hypertension-related hospitalizations represented 24.86%, 31.41%, and 33.25% of total county medical insurance expenditures, showing a year-over-year increasing trend. The proportion of patients with hypertension complicated by complications or comorbidities decreased, while the proportion without complications increased. Patients aged 55–75 had higher rates of comorbidities and complications, as did non-agricultural workers and patients covered by urban employee insurance or poverty assistance programs.

Conclusions: There is an urgent need to strengthen standardized management of diagnosed hypertension patients and improve the capacity of primary healthcare institutions to detect, diagnose, and manage hypertension. Delaying disease progression represents an effective strategy for reducing medical and health expenditures. Special attention should be paid to vulnerable populations to alleviate their disease burden and improve health outcomes. Comprehensive measures are needed to enhance hypertension awareness and self-health management capabilities among all residents.

Keywords: Medical institutions; Hypertension; Comorbidities; Complications; Hospitalization costs

Introduction

Hypertension is a clinical syndrome characterized by elevated blood pressure, with or without multiple cardiovascular risk factors, and represents a critical risk factor for cardiovascular diseases such as coronary heart disease and stroke. According to the 2017 China Cardiovascular Disease Report, China has 270 million hypertensive patients, with hypertension being the primary risk factor for stroke, myocardial infarction, and other cardiovascular diseases. Hypertension, smoking, and high-sodium diet rank as the top three risk factors contributing to disease burden in the Chinese population. In 2017, total treatment costs for

cardiovascular and cerebrovascular diseases in China reached ¥540.638 billion, ranking first among all disease categories, with coronary heart disease, primary hypertension, and cerebral infarction accounting for two-thirds of these expenditures.

Most existing research on hypertension costs has evaluated direct or indirect economic burdens from household or societal perspectives, while some studies have analyzed factors influencing costs for hospitalized patients. This study utilizes continuous, integrated data from 2017–2019 at the county level to analyze the impact of hypertension and its complications/comorbidities on county health expenditures and medical insurance costs from the perspective of hospitalized patients, providing data support for county-level hypertension management and prevention strategies.

Methods

1.1 Data Sources This project collected front-page medical record information from the county people' s hospital and county traditional Chinese medicine hospital from 2017 to 2019, extracting data on patients diagnosed with hypertension. Simultaneously, inpatient expenditure reimbursement data for hypertensive patients were obtained from municipal and county medical insurance information systems.

1.2 Data Collection Methods In the hospital information systems (HIS) of the county people' s hospital and county traditional Chinese medicine hospital, as well as the municipal and county medical insurance information systems, the first round of queries used "hypertension" as a keyword to identify patients with hypertension listed in the first through fourth diagnostic positions. The second round employed ICD-10 coding to confirm diagnoses of hypertension and its complications/comorbidities, retrieving relevant patient information from the HIS based on these confirmed diagnoses. Data were collected on urban and rural residents with diagnoses including hypertension (containing this keyword), acute myocardial infarction (STEMI, NSTEMI), heart failure, unstable angina, acute coronary syndrome, ischemic stroke, hemorrhagic stroke, TIA, lacunar infarction, cerebral infarction, chronic kidney disease, chronic renal insufficiency, renal failure, and peripheral vascular diseases including aortic dissection, lower extremity atherosclerosis, and arteritis. The two collected datasets were cross-checked to ensure comprehensive data collection.

1.3 Study Definitions Patients whose diagnoses included only "hypertension" were defined as having hypertension without comorbidities or complications. Hypertension comorbidities were defined as cases with diabetes or kidney disease in addition to hypertension. Hypertension complications included coronary heart disease, heart failure, ventricular hypertrophy, angina, myocardial infarction, cerebral hemorrhage, cerebral thrombosis, cerebral infarction, lower

extremity arteriosclerosis, and retinal arteriosclerosis. Hypertension with both comorbidities and complications referred to cases with both diabetes and/or kidney disease (comorbidities) and coronary heart disease, heart failure, or other complications.

1.4 Statistical Methods Excel 2016 was used for raw data import and cleaning, yielding 36,565 valid case records after data cleaning. The filtered valid data were precisely matched with expenditure-related data. The matched dataset was imported into SPSS 20.0 for analysis. Descriptive statistics were used to analyze hospitalization costs for the 36,565 hypertension-related hospitalizations. Non-parametric rank-sum tests were used for univariate numerical data analysis, while ^{2} analysis was used for univariate rate comparisons, with a test standard of $\alpha = 0.05$.

Results

2.1 County Health Resources The county had a permanent population of 576,100 (from the seventh national census). The number of managed hypertension patients exceeded 50,000 annually from 2017 to 2019. The number of enrollees in different insurance types increased year by year, as did the number of hospital beds, healthcare institutions, health technicians, and general practitioners. Based on the permanent population, in 2019 the county had 7.93 beds per 1,000 population (higher than the Henan provincial average of 6.64), 6.19 health technicians per 1,000 population (lower than the provincial average of 6.8), 2.83 registered nurses per 1,000 population (lower than the provincial average of 2.9), and 3.38 general practitioners per 10,000 population (higher than the provincial average of 2.36). Provincial data were obtained from the 2020 China Health Statistics Yearbook.

2.2 Comparison of Hypertension Patients with Comorbidities/Complications to Total Hospitalizations After data cleaning and integration, 36,565 valid records were obtained, including 24,666 from the county people' s hospital and 11,899 from the county traditional Chinese medicine hospital. From 2017 to 2019, county-level medical institutions admitted 36,565 hospitalization episodes for hypertension and its complications/comorbidities. The proportion of discharges due to hypertension and its complications/comorbidities accounted for 22.19%, 27.89%, and 27.80% of total county hospitalizations in 2017, 2018, and 2019, respectively. The cumulative total hospitalizations across county medical institutions over the three years was 139,169, with hypertension-related hospitalizations representing 26.27% of this total. The absolute number of hypertension-related hospitalizations increased rapidly.

From 2017 to 2019, male and female hypertension-related hospitalizations increased by 84.03% and 75.92%, respectively. No statistically significant differ-

ence was found between genders in hypertension-related hospitalizations. However, significant differences were observed across occupation types, marital status, insurance types (payment methods), and age groups ($P < 0.05$).

Although the absolute number of hypertension patients with comorbidities/complications increased from 2017 to 2019, the proportion of patients with hypertension complicated by complications or comorbidities decreased, while the proportion without complications increased. Patients aged 55–75 had higher rates of comorbidities and complications. Non-agricultural inpatients had higher rates of comorbidities and complications compared to agricultural workers. Patients covered by urban employee insurance or poverty assistance also had higher proportions of complications and comorbidities.

2.3 Medical Insurance Reimbursement Analysis for Hypertension Patients with Comorbidities/Complications From 2017 to 2019, 26,369 valid reimbursement records were collected, with 10,196 missing values. When aggregating medical insurance costs, missing values were supplemented using the series mean method after classification by urban employee insurance, urban-rural resident insurance, and poverty assistance, based on existing reimbursement ratio data. The medical insurance reimbursement data represent inferred values close to actual conditions. However, as the number of hospitalized hypertension patients increased, total hospitalization costs rose sharply, and total medical insurance reimbursement also increased. Compared with 2017, costs increased by ¥28.64 million in 2019, representing a 65.96% increase. The proportion of medical insurance reimbursement for hypertension-related hospitalizations accounted for 24.86%, 31.41%, and 33.25% of total county medical insurance expenditures, showing a year-over-year increasing trend.

Kruskal-Wallis tests were conducted on per-hospitalization costs, per-treatment costs, per-drug costs, and per-examination costs across different years. Results showed statistically significant differences in per-hospitalization costs, per-treatment costs, and per-drug costs across years ($P < 0.05$), but no significant difference in per-examination costs ($P > 0.05$). Per-hospitalization costs and per-drug costs for hypertension and its complications/comorbidities at county-level institutions decreased in 2018 and 2019 compared with 2017. Per-treatment costs increased slightly in 2019 compared with 2017 and 2018, while examination fees remained essentially unchanged from 2017 to 2019.

Friedman rank-sum tests were conducted on per-hospitalization costs, per-treatment costs, per-drug costs, and per-examination costs across different years and disease severity levels. Statistically significant differences were found in medical costs across different hypertension severity levels.

Discussion

3.1 High and Rising Proportion of Hospitalizations Due to Hypertension and Its Comorbidities/Complications From 2017 to 2019, hospitalizations due to hypertension and its comorbidities/complications accounted for 26.27% of total hospitalizations at county medical institutions. The absolute number of such hospitalizations increased by 6,824 in 2019 compared with 2017, representing a 79.54% increase. By occupation type, non-agricultural workers increased by 900 hospitalizations (70.81% increase), while rural residents increased by 6,194 hospitalizations (88.01% increase), indicating improved awareness and willingness to seek medical services among rural hypertensive patients. Regarding insurance type, urban employee insurance increased by 946 hospitalizations (116.07% increase), urban-rural resident insurance increased by 2,618 hospitalizations (37.39% increase), and poverty assistance increased by 3,167 hospitalizations (746.93% increase). The substantial increase in service utilization among poverty assistance recipients reflects the county' s vigorous poverty alleviation efforts. Across age groups, those aged 55–65 increased by 1,627 hospitalizations (81.47% increase), and those aged 65–75 increased by 1,974 hospitalizations (77.38% increase), demonstrating that hospitalizations increased significantly among those over 45 years, consistent with the age-related characteristics of hypertension.

3.2 Decreased Per-Hospitalization Costs but Increased Total Expenditures From 2017 to 2019, the average cost per hospitalization for hypertension and its comorbidities/complications was ¥7,354.52, ¥6,724.16, and ¥7,133.39, respectively. This is lower than the 2019 Henan provincial average of ¥8,662.5 per hospitalization but higher than the ¥4,399.86 average reported for other county-level public hospitals, likely because this study included costs for comorbidities and complications. Although the three-year data show statistically significant differences in per-hospitalization costs, the actual changes were modest. Per-treatment costs increased slightly, per-drug costs decreased by 17.58%, and per-examination costs remained essentially unchanged. However, as the number of hypertension-related hospitalizations increased, total hospitalization costs surged, as did total medical insurance reimbursement. Compared with 2017, health expenditures, urban-rural resident insurance reimbursements, and medical assistance funds increased by 27.98%, 27.62%, and 60.40%, respectively. When classified by disease severity, patients with hypertension without complications had the lowest per-hospitalization costs, with costs increasing significantly as comorbidities and complications increased. Patients with complications or both complications and comorbidities had per-hospitalization costs 1–2 times higher than those without complications, consistent with Wang et al.' s findings that disease severity and urban resident insurance directly affect hospitalization costs, with complicated cases costing approximately 1.9 times more than uncomplicated cases.

3.3 Declining Proportion of Patients with Complications, with Variations Across Demographics From 2017 to 2019, although the absolute number of hospitalized hypertension patients with comorbidities/complications increased, the proportion of patients with hypertension complicated by complications or comorbidities decreased. Two possible explanations exist: first, a large number of newly identified hypertensive patients were hospitalized, and the higher proportion of uncomplicated cases lowered the overall percentage of complicated cases; second, after 2–3 years of treatment, some previously uncomplicated patients achieved stable conditions, delaying progression to complications and comorbidities. Among different age groups, patients aged 55–75 had higher rates of comorbidities and complications. Non-agricultural inpatients had higher rates than agricultural workers, and patients covered by urban employee insurance or poverty assistance had higher rates than those covered by urban-rural resident insurance or self-paying patients.

Recommendations

4.1 Strengthen Standardized Management of Diagnosed Hypertension Patients Analysis of hospitalized hypertension patients in this county reveals that while per-hospitalization costs remained relatively stable, total expenditures surged due to the increasing number of hospitalized patients consuming medical resources. Strengthening management of diagnosed hypertension patients and delaying progression to multi-organ damage (heart, brain, kidneys, peripheral vessels, retina) could effectively reduce hospitalization costs. Improving primary healthcare institutions' capacity to detect, diagnose, and manage hypertension, shifting management upstream through lifestyle or pharmacological interventions, could slow hypertension progression and reduce hospitalizations, thereby decreasing medical expenditures. Rural healthcare infrastructure in this county remains weak, and primary healthcare institutions have limited capacity to manage hypertension patients, despite the large rural population with chronic diseases requiring management. In building primary healthcare service capacity, existing institutional resources should first be optimized to enhance the diagnostic and service capabilities of public health teams and family doctor contract teams. Drawing on the experience of Kaiser Permanente, community-based healthcare should prioritize proactive health management. Capacity building should encompass not only standardized diagnostic and treatment techniques but also standardized, institutionalized, and normalized long-term hypertension management. Using technical standards to promote management standards and establishing databases through standardized management can leverage digital healthcare in chronic disease management and improve hypertension control rates. Second, incentive mechanisms should be established for primary healthcare workers involved in chronic disease management, particularly by leveraging medical insurance funds. Special funds could be established to incentivize primary healthcare workers, rewarding chronic disease managers based on health

improvement outcomes among managed patients. This would promote a shift from treatment-focused care to integrated treatment and chronic disease management, ultimately reducing or delaying complications and decreasing medical costs and insurance expenditures.

4.2 Focus on Special Populations to Reduce Disease Burden Patients over 45 years of age, widowed individuals, urban employees, and poverty assistance recipients had higher proportions of complications and comorbidities. The increasing incidence of hypertension-related diseases and rising rates of comorbidities and complications, particularly among some patients without any medical insurance who pay out-of-pocket, have increased personal and family financial burdens. Special attention should be paid to these vulnerable populations in the county. For poverty assistance recipients, policy balance and early disease intervention are particularly important. Research shows that poverty assistance patients have higher total medical costs, drug costs, and treatment costs than other patients, especially self-paying patients. Because government assistance reduces their personal financial burden, these patients may be more likely to undergo comprehensive examinations, receive multiple treatments, and use better medications. Early intervention to prevent disease progression in special populations is crucial not only for improving health outcomes but also for reducing medical expenditures.

4.3 Implement Comprehensive Measures to Enhance Hypertension Awareness and Self-Management Hypertension remains an incurable disease requiring lifelong treatment, but it is entirely controllable. Disease severity and accompanying conditions are important factors affecting medical costs. Therefore, strengthening health education and effectively controlling hypertension can reduce its economic burden. Current barriers to hypertension management in China include low awareness and low control rates. In this county, hypertension awareness, treatment, and control rates remain very low. Hypertension intervention and treatment represent a long-term and arduous task. In addition to improving the standardized diagnostic and management capabilities of primary healthcare workers, the government must play an active guiding role in chronic disease management. Using hypertension as an entry point to strengthen primary healthcare services, establishing and improving infrastructure, and achieving comprehensive and sustainable chronic disease management are essential. Supportive health policies and intervention strategies should be formulated, and health education should be enhanced to gradually improve residents' correct understanding of hypertension, increase awareness of the importance of home blood pressure monitoring, improve self-health management capabilities, enhance medication adherence, and reduce salt intake, thereby fostering a sense of personal responsibility for health and recognition of hypertension' s harmful effects on individuals and families.

Limitations

Due to information system upgrades at county medical institutions in 2020, the most recent two years of inpatient data could not be collected, preventing analysis of longer-term cost trends. Because the two county-level hospitals used different inpatient numbering systems and lacked ID number matching, analysis of annual hospitalization frequency per patient was not possible. Additionally, although this study designed a sampling survey on hypertension awareness, prevalence, and treatment rates among county residents, the rural survey population was predominantly over 45 years old. Statistical analysis could not compensate for the age-related bias, and the data cannot represent hypertension awareness, treatment, and control rates among county residents over 18 years of age. Therefore, these data were not compared with Henan provincial and national data.

Author Contributions

LIU Rongmei conducted literature review, conceptualized and designed the study, performed feasibility analysis, and drafted the manuscript. MAO Yanna was responsible for overall data analysis and technical guidance. LIU Gendang and ZHAO Yukun collected and organized data. BAI Yuxi performed data organization and English revision. ZHAO Qiuping was responsible for quality control and final review, providing overall supervision and management.

Conflict of Interest

The authors declare no conflict of interest.

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