# Research on 2041 Cases of High Inpatient Expenditure and Influence Factors during 3 Years in a Single Center

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## Abstract

**Background:** The study was to explore the causes of high inpatient expenditure through analyzing the distribution characteristics as well as the influence factors of high inpatient expenditure cases during 3 years within a Grade-A tertiary hospital through various aspects and multiple angles, thus identifying the major influence factors for high medical expenditure to develop further research.

**Methods:** We retrospectively studied 2041 inpatient cases which cost more than RMB 100,000 Yuan per case in a Grade-A tertiary hospital from 2013 to 2015. We analyzed the compositions of the medical cost to evaluate the major factors that cause the high inpatient expenditure. All the data and materials were collected from medical record system, and the statistical methods included $t$-test, variance of analysis, and multivariate linear regression.

**Results:** The average cost of the 2,041 cases was RMB 152,173 Yuan for medicines and materials of medical costs, which respectively accounted for 33.03% and 32.32% of the total cost; and the average length of hospital stay was 28.39 days/person. Diseases of skeletal and muscular system, circulatory system, and tumor were the top three disease categories of high inpatient expenditure, which accounted for 39.00%, 33.46%, and 18.03%, respectively. Complications, criticality of the disease, gender of the patients, the occurrence of death, and the excessive length of hospital stay all had great impacts on average medical expenditure, while age, hospital infection, and surgery showed no significant impact on average medical cost.

**Conclusions:** The main factors for high inpatient expenditure included the inadequate use of high-value medicines and materials, lacking cost control measures within the hospital, the excessive length of hospital stay for inpatients, and the unnecessary treatment for the patients.

**Key words:** High Inpatient Expenditure; Influence Factors; Medical Cost

## INTRODUCTION

According to the statistics of the World Health Organization in 2014, the per capita medical expenditure of all countries showed a significant growth trend in the past 10 years. From 2000 to 2011, the per capita consumption of medical consumption of the United States increased by 96.30%, the United Kingdom 92.50%, Japan 76.20%, Australia 75.40%, Germany 60.50%, and France 56.30%. As for the case of China, the per capita medical expenses increased from USD 41 dollars in the year 2000 to USD 236 dollars in 2011, an increase of nearly five times.[1] High medical costs have caused serious economic burdens to the society as well as individuals.[2] Thus, seeking an appropriate strategy for medical cost control to reduce the expenses of medical services and to keep the coordinated development between the health care and social economy is one of the key points of health care reforms in China.[3] Since inpatient medical expenditure is a crucial

part as well as an important indicator of the overall medical cost, the research on the influence factors of medical expenses is in constant progress and development. The article aimed to analyze the distribution characteristics as well as the influence factors of high impatient expenditure cases through various aspects and multiple angles to explore the causes of high inpatient expenditure, and supply practical suggestions for strengthening inpatient expenditure management in hospitals, reducing unreasonable medical costs, regulating diagnosis and treatment behaviors, and improving medical quality.[4]

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## METHODS

### Subjects

The standard for high inpatient expenditure varies greatly between different areas and periods. By analyzing current researches combined with the standard of medical service charges in China, we set RMB 100,000 Yuan as the standard and included the inpatient cases in a Grade-A tertiary hospital during 2013–2015 that met the criteria in the research. The detailed information of the patients included the admission form, diagnoses, treatments, therapeutic results, prognoses, length of hospital stay, International Classification of Diseases (ICD)-10 codes, complications of the disease, rescues, lists of surgeries, secondary operations, and other basic information such as age, name, gender, social characteristics, departments for treatment, and total costs (including medicine cost, material cost, treatment cost, ward cost, blood transfusion cost, inspection cost, physical test cost, operation cost, and other cost);[5] all the information were extracted from the medical record system.

### Possible factors that related to high inpatient expenditure

According to the data available, we set the following 8 indexes as independent variables to identify the major factors that led to high inpatient expenditure: age, gender, length of hospital stay, death, surgery, complications of the disease, hospital infections, and admission form, while setting the total cost as the dependent variable to conduct multivariate analysis of average medical expense. Using multiple regression analysis to quantify the index and set sub-variables for polytomous variables,[6] we analyzed the impact of the major factors to inpatient medical expenditure comprehensively.

### Statistical analysis

All the data and material collected were entered into Excel 2010 software for Microsoft (Microsoft Corporation, Washington, USA), and statistical analyses were performed using SPSS 14.0 (SPSS Inc., Chicago, IL, USA). Single factor analysis of age was analyzed using nonparametric test; admission condition, hospital infection, the occurrence of rescue, complications of diseases, occurrence of death, and surgery were analyzed using $t$-test; variance of analysis (ANOVA) and multivariate linear regression were used to analyze the degree of the influence factors above. A $P < 0.05$ was considered statistically significant.

## RESULTS

### General situation of high inpatient expenditure cases

According to the statistics, 65,520 inpatients were admitted to the hospital during 2013–2015, with the average expenditure of RMB 21,556 Yuan and an average length of hospital stay of 9.94 days. A number of 2041 cases (cost more than RMB 100,000 Yuan/person) made up 3.12% of the total number of inpatients; while the total cost of the cases was RMB 31.06 million Yuan, which made up 21.99% of the total inpatient revenue of the hospital, the average cost of the cases was RMB 152,173 Yuan, with the average length of hospital stay of 28.39 days/person.

### Compositions of inpatient expenditure

The total cost of the inpatient expenditure comprised medicine costs (including cost for pharmaceutics, Chinese patent drugs, and herbal medicines), material cost (including coronary stents, stapling devices, and other materials of high values), surgery cost (mainly referring to the value of the labor of hospital staffs for operations, and cost for drugs and anesthesia in the process were not included in this item), ward cost, diagnosis cost (including cost for imaging inspections, pathological and laboratory examinations), treatment cost (including dialysis and other treatment measures), nursing cost, and other costs.[7] According to the statistics, the compositions of high inpatient expenditure during the 3 years are shown in Table 1.

### Major factors that influencing the inpatient expenditure

#### Age

As shown in Table 2, the groups aged 50–70 years were the majority of high inpatient expenditure cases. Since the inpatient expenditure was presented as nonnormal distribution, we used nonparametric test to process the data, indicating that high inpatient expenditure was not directly related to age ($\chi^2 = 13.872$, $P = 0.079$).

#### Length of hospital stay

As shown in Table 3, the average cost of each group varied greatly, and the average cost increased with the length of hospital stay.

### Table 1: Compositions of the total cost for high inpatient expenditure

| Categories | Amount ( RMB 10,000 Yuan) | Proportion (%) |
|---|---|---|
| Medicine cost | 1026 | 33.03 |
| Material cost | 1004 | 32.32 |
| Diagnosis cost | 352 | 11.34 |
| Treatment cost | 317 | 10.19 |
| Blood transfusion cost | 100 | 3.21 |
| Nursing cost | 96 | 3.11 |
| Surgery cost | 92 | 2.96 |
| Ward cost | 75 | 2.43 |
| Other cost | 44 | 1.41 |

### Table 2: Age distributions of high inpatient expenditure cases ($N = 2,041$)

| Age | Number of cases | Proportion (%) | Average expenses (RMB, Yuan) |
|---|---|---|---|
| 10–19 years | 1 | 0.05 | 277,471 |
| 20–29 years | 11 | 0.54 | 148,325 |
| 30–39 years | 33 | 1.62 | 150,093 |
| 40–49 years | 88 | 4.31 | 138,511 |
| 50–59 years | 263 | 12.89 | 143,759 |
| 60–69 years | 451 | 22.10 | 151,781 |
| 70–79 years | 939 | 46.01 | 154,378 |
| 80–89 years | 238 | 11.66 | 161,040 |
| ≥90 years | 17 | 0.83 | 170,521 |

### Characteristics of the diseases

According to the statistics from Table 4, patients of severe, emergency, and moderate conditions made up 15.33%, 42.53%, and 42.14% of 2041 cases, respectively, with the average cost of RMB 162,823 Yuan, RMB 154,132 Yuan, and RMB 146,880 Yuan, respectively. Patients with or without hospital infection were 2.11% and 97.89% of the total, and the average cost of RMB 159,191 Yuan and RMB 152,071 Yuan, respectively. Patients who experienced rescue and those without made up 27.68% and 72.32% of the total population, with the average costs of RMB 156,376 Yuan and RMB 146,512 Yuan, respectively. Patients with and without complications of the diseases made up 3.82% and 96.18% of the total, with the average costs of RMB 158,825 Yuan and RMB 148,545 Yuan, respectively. Death and non-death cases made up 3.48% and 96.52%, respectively, with the average cost of RMB 178,801 Yuan and RMB 150,667 Yuan. Cases of surgeries (among which 50 underwent the secondary operation) and those without comprised 82.61% and 17.39% of the population, with the average costs of RMB 152,682 Yuan and RMB 150,014 Yuan, respectively. Single factor analysis from Table 4 showed that admission condition, surgery, and hospital infection were not directly related to high inpatient medical expenditure, while complications of diseases, occurrence of death, and rescue showed a significant difference in medical expenses.

### Multivariate analysis of high inpatient expenditure cases

We set the indexes of age, gender, length of hospital stay, death, surgery, complications of the disease, hospital infections, and admission conditions as independent variables and the total cost as dependent variable to conduct multivariate analysis of inpatient medical expense. Results showed that complications of diseases, criticality of the disease, gender, occurrence of death, and length of hospital stay all had a great impact on inpatient medical expenditure while age, hospital infection, and surgery showed no significant impact on the inpatient medical cost. With the increased length of hospital stay by 1 day, the average inpatient expenditure was raised by RMB 1399 Yuan. The average cost for severity and emergency cases were RMB 15,942 Yuan and RMB 7864 Yuan, higher than that for cases of moderate, respectively. The results are shown in Table 5.

### Analysis of the inpatient expenditure on major disease categories

We classified all the high inpatient expenditure cases according to ICD-10.[8] As shown in Table 6, patients with diseases of skeletal and muscular system, circulatory system, and tumor comprised a large proportion of the population, which altogether accounted for 90.48% of the total, indicating that treating such diseases relatively cost higher than those of other disease categories. There were 796 cases of skeletal and muscular system diseased patients, which accounted for 39.00% of the investigated population; 683 cases of circulatory system diseased patients, accounted for 33.46% of the total; 368 cases of tumor, accounted for 18.03%; and 132 cases of respiratory system diseased patients, accounted for 6.47% of the total. As for the average cost of patients, the alimentary system diseases ranked the top, with the average cost of RMB 183,715 Yuan; respiratory

#### Table 3: Distributions of the length of hospital stay of high expenditure cases (N = 2041)

| Hospital stay | Number of cases | Proportion (%) | Average expenses (RMB, Yuan) |
|---|---|---|---|
| 0–14 days | 780 | 38.22 | 144,082 |
| 15–29 days | 705 | 34.54 | 149,328 |
| 30–44 days | 290 | 14.21 | 151,388 |
| 45–59 days | 124 | 6.08 | 167,285 |
| 60–74 days | 61 | 2.99 | 178,457 |
| 75–89 days | 35 | 1.71 | 183,913 |
| 90–104 days | 21 | 1.03 | 229,330 |
| 105–119 days | 11 | 0.54 | 201,721 |
| 120–134 days | 8 | 0.39 | 262,631 |
| ≥135 days | 6 | 0.29 | 322,020 |

#### Table 4: Characteristics of the disease related to high inpatient expenditure cases (N = 2,041)

| Factors | Level | Cases, n | Proportion (%) | Average expenses (RMB, Yuan) | Statistics | P |
|---|---|---|---|---|---|---|
| Admission condition | Severe | 313 | 15.33 | 162,823 | 2.76* | 0.08 |
| | Emergency | 868 | 42.53 | 154,132 | | |
| | Moderate | 860 | 42.14 | 146,880 | | |
| Hospital infection | No | 43 | 2.11 | 159,191 | −0.82† | 0.55 |
| | Yes | 1998 | 97.89 | 152,071 | | |
| Occurrence of rescue | No | 1476 | 72.32 | 146,512 | −2.32† | 0.03 |
| | Yes | 565 | 27.68 | 156,376 | | |
| Complications of diseases | No | 1963 | 96.18 | 148,545 | −2.29† | 0.03 |
| | Yes | 78 | 3.82 | 158,825 | | |
| Occurrence of death | No | 1970 | 96.52 | 150,667 | −5.12† | <0.01 |
| | Yes | 71 | 3.48 | 178,801 | | |
| Surgery | No | 355 | 17.39 | 150,014 | −0.43† | 0.36 |
| | Yes | 1686 | 82.61 | 152,682 | | |

*F value; †t value. The first line of each group was the control group; P: Sample group versus control group.

## Table 5: Multivariate analysis of high inpatient expenditure cases

| Variables | Regression coefficient | Standard regression coefficient | t | P |
|---|---|---|---|---|
| Prognosis | | | | |
| Cure | | | | |
| Improved | −1208 | −0.006 | −0.28 | 0.84 |
| Unhealed | 10,694 | 0.018 | 0.92 | 0.37 |
| Death | 28,134 | 0.132 | 5.84 | <0.01 |
| Admission condition | | | | |
| Moderate | | | | |
| Severe | 15,942 | 0.032 | 2.62 | 0.01 |
| Emergency | 7864 | 0.043 | 2.37 | 0.01 |
| Gender | | | | |
| Male | | | | |
| Female | −9116 | −0.036 | −2.01 | 0.04 |
| Age | −298 | −0.071 | −1.36 | 0.18 |
| Length of hospital stay | 1399 | 0.231 | 18.72 | <0.01 |
| Complications | 9512 | 0.092 | 2.18 | 0.02 |
| Hospital infection | 4534 | 0.017 | 0.97 | 0.88 |
| Surgery | −5953 | −0.019 | −0.67 | 0.11 |

The first line of Prognosis, Admission condition, and Gender groups were the control group; *P*: Sample group versus control group.

## Table 6: Classification of high average costs diseases categories

| Disease categories | Number of cases | Proportion (%) | Average costs (RMB, Yuan) |
|---|---|---|---|
| Skeletal and muscular system | 796 | 39.00 | 159,158 |
| Circulatory system | 683 | 33.46 | 145,758 |
| Tumor | 368 | 18.03 | 137,492 |
| Respiratory system | 132 | 6.47 | 179,347 |
| Hematological system | 25 | 1.22 | 142,455 |
| Alimentary system | 21 | 1.03 | 183,715 |
| Others | 16 | 0.78 | 163,805 |

system ranked the next, with the average cost of RMB 179,347 Yuan; the average cost for diseases of skeletal and muscular was RMB 159,158 Yuan, ranking the third.

## DISCUSSION

The statistical analysis of the 2041 cases of high inpatient expenditure showed that there were a number of factors for the occurrence of high medical costs that came with regularity.

First, the average length of hospital stay was relatively long of the cases. According to the study, the average length of hospital stay for the 2041 high medical expenditure patients was 28.39 days/person, while the average length of hospital stay for regular patients was 9.94 days/person. Statistics showed that the average length of hospital stay in the United States is 6.9 days/person, Australia is 7.4 days/person, and Ireland is 9.0 days/person while the average length of hospital stay for Grade-A tertiary hospital of China is 13.5 days/person.[9] Researches also showed that the excessive length of hospital stay is not entirely due to the needs of clinical diagnosis and treatment. Moreover, the phenomenon might be a large extent, results from defects of the medical management control, and low work efficiency.[10] Since the length of hospital stay is directly related to inpatient expenditure in the premise of ensuring medical quality and safety, taking various measures such as shortening length of hospital stay and speeding up the bed turnover rate will not only improve the work efficiency of the hospital, but also beneficial to the limitation of high medical expenses.

In addition, the research showed that fewer people consumed more medical resources. In the study, we found that 3.12% of the patients consumed 21.99% of the total inpatient medical expenses during 3 years. Such high costs laid heavy burdens on individuals and the society, which also demonstrated that the distribution of medical resources was not so fair.[11]

Besides, the study also revealed that the categories of diseases were concentrated among high medical costs group. Patients with diseases of skeletal and muscular system, circulatory system, and tumor made up 90.48% of the population, indicating that the diagnosis as well as treatment of those disease categories cost much more higher than that of other disease categories, which meant diagnosing and treating these diseases were more difficult and called for advanced medical technologies in the process.[12]

High mortality happened in high inpatient expenditure cases while distributed in various age groups. There were 71 death cases among the 2041 high inpatient expenditure cases, accounted for 3.48% of the group, about four times of the average mortality of the hospital. Moreover, the results also showed that high expenditure cases distributed in various age groups, indicating that elderliness was not a major influence factor for high medical expenses.

Differences in admission, death, and complications all had a great impact on medical expenses. The condition of admission, death, and complications all in some extent reflected the severity of the illnesses. Cases of acute or severe illnesses consumed more medical resources and took longer to cure and, thus, spent higher medical expenses. According to the statistics, patients in severe and emergency conditions accounted for 57.91% of the high-cost groups, patients with complications accounted for 3.82%, and rescue cases accounted for 27.68%, respectively. Comparing with the general, patients of the high costs group relatively suffered from more serious illnesses. Most of these cases were in late stage of cerebral vascular diseases, terminal cancers, and end-stage organ failures. Thus, it was not hard to understand diagnosing and treating such illnesses might cost more than regular diseases.

Last but not least, the costs for medicine and material took up a large proportion of the inpatient expenditure cases,

which caused an irrational structure of medical expenses. According to the statistics, the average costs for medicine, materials, diagnosis, and treatment of the high inpatient expenditure cases were RMB 10,260 thousand Yuan, RMB 10,040 thousand Yuan, RMB 3,520 thousand Yuan, and RMB 3,170 thousand Yuan, accounted for 33.03%, 32.32%, 11.34%, and 10.19% of the total cost, respectively. Researches showed that the average cost of medicine in developed countries was below 10.00%. While the possible reasons for high medicine and materials costs in China were high pricing, the excessive use by doctors as well as the imperfection of medical policies and so on.[13] By randomly selecting some high expenditure cases to analyze the prescriptions in depth, we found that high-class antibiotics and auxiliary therapeutic drug of high costs were involved in the therapeutic process.[14] The improper use of medicine would lead to the increase of bacterial resistance as well as the waste of medical resources, meanwhile, aggravating the burden on patients and the society. On the other hand, the fact that materials cost accounted for a larger proportion of hospital cost suggested that the hospital should strengthen its supervision on the consumption of high-value materials.[15]

Classification analyses showed that the highest proportion of medicine cost was skeletal and muscular system diseases (39.00%). Since the cost for medicine and materials took up over 60.00% of the total, it had become the primary cost for inpatient medical expenditure. By reviewing the medical records of some typical cases, we found that the application of high-level antimicrobial drugs and high adjuvant drugs in these cases was relatively common. In addition, we found that unreasonable material costs have also gradually become a serious issue in those cases, while the income for the labor of medical personnel was relatively low,[16] and the values for the technical of medical staffs cost were hardly reflected in the process. This indicated the unreasonable structure of inpatient medical expenditure.[17]

Our study had some limitations. The study was based on a single-center study due to the differences in the characteristics of the population as well as the medical situation of different areas, and the results of the study might not be applied to other medical institutions.[18] Besides, due to the accessibility of the data and information of the patients, more samples should be adopted for the generalization of the conclusion.

In conclusion, according to the research, complications of diseases, criticality of the disease, gender of the patients, death, and length of hospital stay all had a great impact on inpatient medical expenditure, while age, hospital infection, and surgery were not directly related to the average cost.[19] The main factors for high inpatient expenditure included the inadequate use of medicines and materials of high value, lacking cost control measures within the hospital, and the excessive average length of hospital stay for inpatients as well as the unnecessary treatment for the patients. Thus, it is crucial for medical administration departments

to establish strong supervision mechanisms and adopt various cost control measures to reduce inpatient medical expenditure.[20]

## Conflicts of interest

There are no conflicts of interest.

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