

# Current Curative Expenditure of Respiratory Diseases and Its Influencing Factors—A Research Based on “System of Health Account 2011”

Ling Li

Hunan University of Chinese Medicine

Huan Zhan

Hunan University of Chinese Medicine

Xin Wang (✉ [wxinsmile@qq.com](mailto:wxinsmile@qq.com))

China Medical University <https://orcid.org/0000-0001-7591-0103>

Liangrong Zhou

Hunan University of Chinese Medicine <https://orcid.org/0000-0002-5313-995X>

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## Research

**Keywords:** Respiratory diseases, SHA2011, current curative expenditure, hospitalization expenses, influencing factor

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Current Curative Expenditure of Respiratory Diseases and Its Influencing  
Factors, A Research Based on “System of Health Account 2011”

Ling Li<sup>1</sup>, Huan Zhan<sup>1</sup>, Xin Wang<sup>2\*</sup>, Liangrong Zhou<sup>1\*</sup>

**Author details**

1.School of Humanities and Management, Hunan University of Chinese  
Medicine, Changsha, Hunan.

2.College of the Humanities and Social Sciences, China Medical  
University, Shenyang, Liaoning;

Corresponding author: Xin Wang, PhD, College of the Humanities and  
Social Sciences, China Medical University, Shenyang, Liaoning, China.

Tel: +86 18900911296; Email: wxinsmile@qq.com;

Corresponding author: Liangrong Zhou, PhD, School of Humanities and  
Management, Hunan University of Chinese Medicine, Changsha, Hunan,  
China. Tel: +86 15243676288; Email: 1443361448@qq.com.

## **Abstract**

**Background:** Respiratory disease is now the leading cause of morbidity and mortality worldwide. They simultaneously impact public health at the population level and also cause great financial distress for families . Understanding the distribution of diseases and the Current Curative Expenditure (CCE) can provide a basis for policy decisions and interventions. This study analyzed the status of respiratory diseases spending using data from “System of Health Accounts 2011” (SHA 2011) to provide health policy advice to Hunan Province, China, and insights for other more developed areas in China.

**Methods:** Data were collected by multi-stage stratified random sampling approach and the medical expenses of patients with respiratory diseases were calculated based on the SHA 2011, including the dimensions of institutional resource flow and service function. Regression analyses were conducted to identify influencing factors of hospitalization expenses. All analyses were conducted using software SPSS 25.0.

**Results:** The CCE for Respiratory diseases in 2017 was 215.42 billion Chinese yuan (CNY), accounting for 15.94% of total expenditure on health in Hunan Province, China. Children aged 0-4 and elderly aged 60-69 spent the most on the treatment for such diseases. Length of stay, age, and institution level were the three most important factors affecting hospitalization expenses.

**Conclusions:**

The CCE of respiratory diseases is extremely high, with problems related to treatment efficiency and equity. It is essential to expand health insurance coverage, establish hierarchical medical system, and reduce curative expenditure.

**Keywords:** Respiratory diseases, SHA2011, current curative expenditure, hospitalization expenses, influencing factor.

**Background:**

Respiratory diseases are the leading cause of death and disability in the world and impose a heavy social and economic burden. According to the World Bank and World Health Organization (WHO) estimates, respiratory diseases account for as much as 20% of the global burden of disease[1]. The 2013 European Lung White Book shows that Respiratory diseases account for approximately 6% of total EU health budget[2]. In recent years, the incidence of respiratory diseases has increased significantly in China due to air pollution, smoking, and aging[3]. According to China Health Statistics Yearbook 2017, respiratory diseases accounted for 11.24% of all deaths among Chinese urban residents and 12.02% among rural residents, ranking the 4<sup>th</sup> in each category. The prevalence rate among Chinese residents over 40 years old was 9.9%. In recent years, the share of hospitalizations accounted for by respiratory

diseases was the greatest of any cause and was growing fastest[4]. According to the global burden of disease study, the financial burden of respiratory diseases will be much heavier by 2020[5] and will increase its ranking in global causes of death. The rising number of patients will certainly consume more medical resources and greatly increase the national and social medical expenditure[6].

Studies on respiratory diseases expenditure and its influencing factors have been conducted globally. The data for these studies mainly came from the Medicare database and medical institution records. As most of the findings were estimated using medical records, the expenditures, including fixed assets that were not used on patients, were not excluded from the real expenditures on health care. The total consumption of goods and services purchased by individuals could not be calculated precisely. To accurately estimate the curative expenditure of respiratory diseases, there is a pressing need to establish an expenditure accounting framework that both improves the accuracy of the cost estimates and enables comparability across countries. In recent years, with significant gains in economic strength and financial revenue, the state funding for public health has increased steadily. However, the gap between the health services provided and public demand is still substantial, and the problem of “high costs to receive treatment” is still grim. It is unclear what the CCE of respiratory diseases are and the major

influencing factors of CEE according to beneficiary characteristics. These questions can be answered by analyzing data from the System of Health Accounts 2011 (SHA 2011) framework.

SHA2011 is one of the most advanced international health account accounting methods, which allows cross-balancing accounting and analysis of any two dimensions and reflect the flow process of health funds more comprehensively. It has been adopted by all member countries of the European Union and nearly all member countries of the Organization of Economic Cooperation and Development [10]. Under SHA 2011 framework, “current expenditure on health care” and “gross capital formation in health care” have been separated. The SHA 2011 framework abandoned the expression of total health expenditure and recommended the usage of current health expenditure, which refers to the final consumption of health care goods and services by the government, nonprofit institutions, and households, excluding the expenditure of fixed assets [11]. Using the current health expenditure, we can track medical expenditures more accurately.

Respiratory diseases cause both health consequences and high medical expenses to patients.[7][8] Many of these patients and their families already suffered from poverty. Previous studies have focused on the pathogenesis or medical costs of specific respiratory diseases[9] and the relationship between air quality and the respiratory diseases [10] -

seldom have previous studies discussed the CCE while considering the dimensions of institutional flow, the distribution of different respiratory diseases, and service function. This study was based on the SHA 2011, and aimed to analyze the population distribution, institutional flow, financing distribution and influencing factors of the costs of respiratory diseases[11]. Currently, China is reforming its national health strategy and health care system to implement policies and interventions for a more equitable health system [17]. Assessment and describing the components of the cost of treatment in China is a necessary first step in achieving these goals. Therefore, analyzing the influencing factors of the current curative expenditure (CCE) in patients with respiratory diseases is essential. The data calculated based on the SHA 2011 framework may help clarify the decisions linked to the allocation of resources, estimate the monetary flows related to curative care expenditure, analyze the factors that likely influence the CCE, aid in protecting the rights of patients by revealing inequity, and help achieve the universal health coverage strategy proposed by the WHO.

## **Material and methods**

### **1. Data sources**

The basic data used in this study were obtained from the current Health Expenditure Research Project in Hunan Province. Data were divided into two categories. First, the official statistical data of the Health

Commission of Hunan Province, such as the Health Statistics Yearbook, Health Financial Yearbook, Government Input Monitoring Data of Hunan Province in 2017. Second, we procured patients information in 2017 from sample institutions.

## **2. Study samples**

Multistage stratified cluster random sampling was used in this study. Lottery-style drawings (prefecture-level cities), and programmatic selection (streets, communities, and towns) were used to select samples for each stage. In the first stage, according to the different levels of economic development, geographical locations, and modernization of 14 cities in Hunan province, Changsha, Zhuzhou, Yueyang, Hengyang and Yongzhou were selected as sample cities. In the second stage, four districts or counties in each city were selected as sample districts or counties for a total of 20 counties or districts. In the third stage, five towns or communities were randomly selected from each county or district, with 100 towns or communities selected in total. After the towns and communities were selection, sampling was conducted according to the levels and classifications of the local medical and health institutions. These included general hospitals, traditional Chinese medicine hospitals, maternal and child health care institutions, disease control institutions, and specialized hospitals. The final sample comprised a total of 1,072 medical institutions with 71 hospitals, 27 public health institutions, 131

community health service centers or township hospitals, 678 village clinics, and 165 clinics. Basic information was obtained from the information systems of the sample institutions, including outpatient and inpatient data on gender, age, disease, cost, hospital level, admission time, duration of hospitalization, and insurance type. The data collected were classified and coded according to the 10th Revision of the International Classification of Diseases (ICD-10). After removing incomplete and invalid data, 160,370 inpatients and 987,899 outpatients with respiratory diseases were included to establish a standardized basic database.

### **3.Statistical method**

Referring to the theoretical framework, accounting system, and methods of SHA 2011, multiple linear regression analysis was used to analyze the expenditures of patients with respiratory diseases.

A total of 160,370 observations of inpatient visits due to respiratory diseases were extracted. Because the inpatient expenditures do not follow the normal distribution, the data were log transformed, after which the data were distributed normally. Stepwise regression was used to select the influencing factors for the final model. The candidate independent variables included age, gender, length of stay, hospital level, treatment dosage, and surgery or not. The threshold of being selected was set at 0.05 and the threshold of entry was set as 0.10. All statistical analyses were performed using SPSS 25.0 (Inc., Chicago, IL, USA).

#### **4. Quality control and data management**

Data gathering was classified and coded according to ICD-10. Data extraction, audits, cleaning, and calculation were maintained by implementing the basic accounting guidelines of SHA 2011. Research team member received training from the National Health Commission of China for the data cleaning process. All data were entered electronically into a data terminal which included SPSS 25.0 (Inc., Chicago, IL, USA).

### **Results**

#### **1. Fundamental result of CCE for respiratory diseases**

Based on the SHA 2011 framework, the CCE for respiratory diseases was 215.42 billion CNY (1 USD  $\approx$  6.67 RMB, 2017), which accounted for 15.94% of the total CCE in Hunan Province. Among the treatment expenses, 58.32% were for men and 41.68% were for women.

#### **2. Allocation of CCE in different ages**

The CCE age distribution of respiratory diseases shows that patients aged 0 to 4 had the highest CCE, accounting for 12.6% of all expenditure. 60-69 age group also had high CCE. Before the age of 69, with the increase of age, the CCE keeps increasing. After that, the expenditure of CCE keeps decreasing. The CCE age distribution showed an “N”-shaped curve. (see Figure. 1).

#### **2. Distribution of the CCE in different types of respiratory diseases**

As classified using ICD-10, the top eight respiratory diseases by

CCE for inpatients were pneumonia, COPD, lung infections (excluding pneumonia), respiratory failure, acute tonsillitis, acute suppurative tonsillitis, influenza, and upper respiratory tract infection. The CCE of these eight diseases accounted for 71.57% of the total CCE for respiratory diseases in 2017 (see Figure.2). The highest average inpatient expenditure was 7,745.92 CNY (see Figure.4). Other diseases included more than 40 low cost respiratory diseases other than the eight common diseases mentioned above. The top 8 outpatient respiratory diseases for outpatients were pneumonia, lung infection(excluding pneumonia), bronchitis, acute upper respiratory tract infection , and acute bronchitis (which had the highest total outpatient costs). The highest outpatient cost per item among these was 171 CNY (see Figure.3 and Figure.5).

### **3.Distribution of the CCE for respiratory diseases in different medical institutions**

Most of the CCE for respiratory diseases was in basic-level medical and health institutions and in general hospitals. Likely due to differences in hospital types and medical services, maternal and child health-care hospitals and specialist diseases prevention hospitals accounted for a relatively low proportion of the overall cost of respiratory disease treatments (see Figure.6).

### **4. Financing scheme for respiratory diseases**

According to the financing distribution, public financing accounts for

the largest proportion of the financing schemes for the treatment of respiratory diseases (19.59% for government schemes and 37.41% for social medical insurance). Expenditure for family health in the financing plan was 84.75 billion CNY, accounting for 39.36% of total financing. Although the cost of treatment mainly depends on public financing, the proportion of family health expenditure is nevertheless relatively high, and the burden for individuals is heavy (see Figure.7).

## **5. Influencing factors to inpatient expenditure**

The included independent variables were gender, age, length of stay, institution level, medicine dosage, and insurance type. There was no collinearity detected between independent variables. The linear model can explain the 67.9% change in total hospitalization expenses. The first three factors affecting hospitalization expenses were the length of stay, age, and institution level(see Table.1).

## **Discussion**

In this study, respiratory diseases CCE were calculated using the SHA 2011 framework, which was previously recommended for use to create National Health Accounts for all countries by the WHO to facilitate international comparison. The purpose of this study was to describe the economic burden of respiratory diseases in Hunan, and to analyze the CCE between different types of respiratory diseases, age groups, service functions, institutional flow types, and the influencing

factors of inpatient expenditure.

The results indicated that children and the elderly incur the greatest costs related to respiratory diseases, likely due to physiological differences that leave these age groups at higher risk of respiratory disease[12]. With the "two-child" policy and the ageing of the population, it appears likely that the age distribution of China's population is approaching a "U" shape with large groups of high cost patients at both extremes. In the future, we might strengthen children's health education and enhance their guardians' awareness of health protection. On the other hand, it is advisable to increase the reimbursement rate of basic medical insurance for common diseases and for the frequent diseases of children and the elderly in order to reduce the direct economic burden of medical treatment. Finally, it may be valuable to promote some families to participate in commercial insurance[13] to improve their resilience against risks.

Among outpatient expenses, pneumonia, lung infection (excluding pneumonia), and bronchitis were found to cost the most. Children are at elevated risk of these diseases, which typically increase with common cold incidence brought by weather changes. Children usually go to the hospital for treatment, which drives increased treatment costs[14]. Among hospitalization expenses, pneumonia, COPD, pulmonary infection, and respiratory failure cost the most. Studies have shown that these

respiratory diseases often cause complications, especially in the elderly. At present, the medical security for the elderly is imperfect, especially the precise prevention and control of certain diseases. In the prevention and treatment of respiratory diseases among the elderly, we should treat key diseases of different age groups, implement healthy and effective intervention and treatment plans according to the characteristics of respiratory diseases among the elderly[15], and direct medical funding towards specific diseases such as pneumonia, COPD to more accurately .

In the distribution of the institutions for the treatment of respiratory diseases, general hospitals had the highest proportion of inpatient expenditure, while the proportion of basic-level institutions was relatively low. Only 36.96% of the outpatient treatment costs were in basic-level medical centers and health organizations, indicating the poor capacity for these diseases in basic-level medical centers and health institutions. This results in a failure to attract more patients. One reason for this problem may be a lack of qualified doctors<sup>[16]</sup>. In a competitive environment for medical services, if the government cannot provide guidance or issue relevant policies to support, a hierarchical medical system will be difficult to maintain[17].

The results of multiple regression analysis showed that length of stay, age, and institution level were the main factors affecting CCE. Consistent with previous studies, the longer a patient stays in hospital, the higher

of the hospitalization expenses. The length of stay is not only related to the severity of the disease, but also to the efficiency of the hospital. Age was positively correlated with hospitalization expenses, which may be because most respiratory diseases involve infection. Older patients have reduced immune function, making it more difficult to control infection, often necessitating the use of expensive antibiotics. In the case of severe infection, the patient often needs to be admitted to intensive care units, increasing hospitalization expenses accordingly. Institution level was positively correlated with hospitalization expenses, which was consistent with YangJuan's research[18]. It is also directly related to the national medical price policy that allows higher standard charges for higher-level institutions[19]. Furthermore, hospitalization expenses of males were higher than those of females, which was consistent with the results in Sichuan, Xinjiang and other provinces[20]. This may be related to men's working environment, smoking and other factors, suggesting that more attention should be paid to male patients[21]. Patients with health insurance or with free health care had higher hospitalization expenses than those without health insurance. This finding aligned with previous studies[22]. In a previous observational cohort study[23], medicine dosage and surgery had little influence on the cost of hospitalization expenses, likely because most respiratory diseases did not require surgery and medicine dosage varied little.

Studies have shown that rising hospitalization expenses were associated with excessive medical treatment in China[24]. Some doctors conduct unnecessary tests for patients, as in many hospitals doctors' incomes are largely linked to patients' drug and examination fees - while the value of doctors' services has long been neglected. This perversely incentivizes some doctors, leading to unnecessary medical tests and treatments. In addition, poor supervision of medical insurance funds is another reason for the rapid increase of medical expenses[25]. To stop the unreasonable increase of medical expenses, we must also strengthen the management of prescriptions and further the reform of the medical system.

In recent years, many scholars have focused on the correlation between the incidence of respiratory diseases and air pollution, which is related to the high prevalence of respiratory diseases in Hunan. The causes of air pollution are varied, including climate, geographical locations[26], industry, automobile and exhaustion, and others. Hunan is located in the central part of China. In autumn and winter, the temperature drops, precipitation decreases, and the air flow stabilizes[27], which is not conducive to the dissipation of pollutants. In addition, Hunan is on the east, west and south of a basin land formation. Without strong air lift, pollutants are difficult to diffuse [28].

## **Conclusion**

The CCE for respiratory diseases based on SHA2011 can estimate the overall CCE of respiratory diseases and analyze the financing burden of different groups. We find that the CCE of respiratory diseases is extremely high and that the patient's medical burden is heavy. The first three factors affecting hospitalization expenses were the length of stay, age, and institution level. Governments need to restructure financing, redistribute the costs of respiratory diseases, and establish a hierarchical medical system. Medical institutions should improve their management[29], control medical costs, avoid excessive medical treatments, and reduce the curative expenditure.

### **Abbreviations**

CCE: current curative expenditure; SHA 2011: System of Health Accounts 2011; CNY: Chinese Yuan; ICD-10: International Classification of Disease, the 10th revision;

### **Authors' contributions**

LL designed the study, conducted the statistical analysis, and drafted the manuscript. ZLR conceptualized the study, coordinated the data collections. WX interpreted the results and revised the paper. ZH contributed to planning the analysis and revised the manuscript. All authors have read and approved the final manuscript.

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**Availability of data and materials**

All data sets supporting the conclusions of this article are included within the article.

**Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no conflicts of interest to report.

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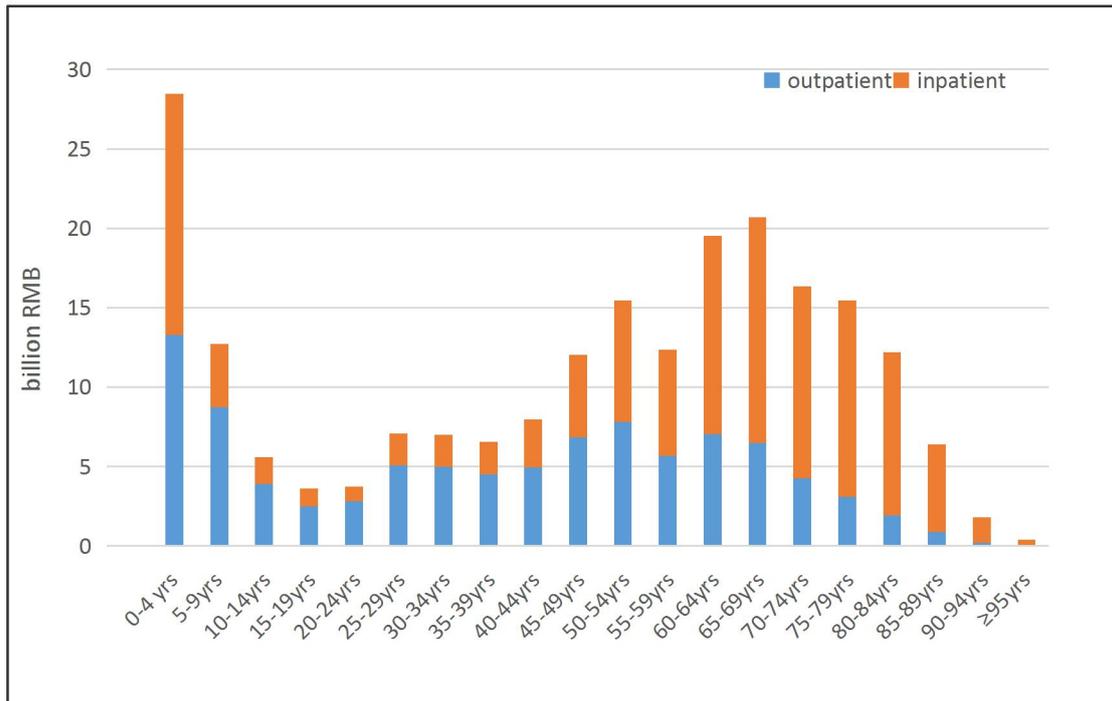


Figure 1. Distribution of the CCE for respiratory diseases in different age groups

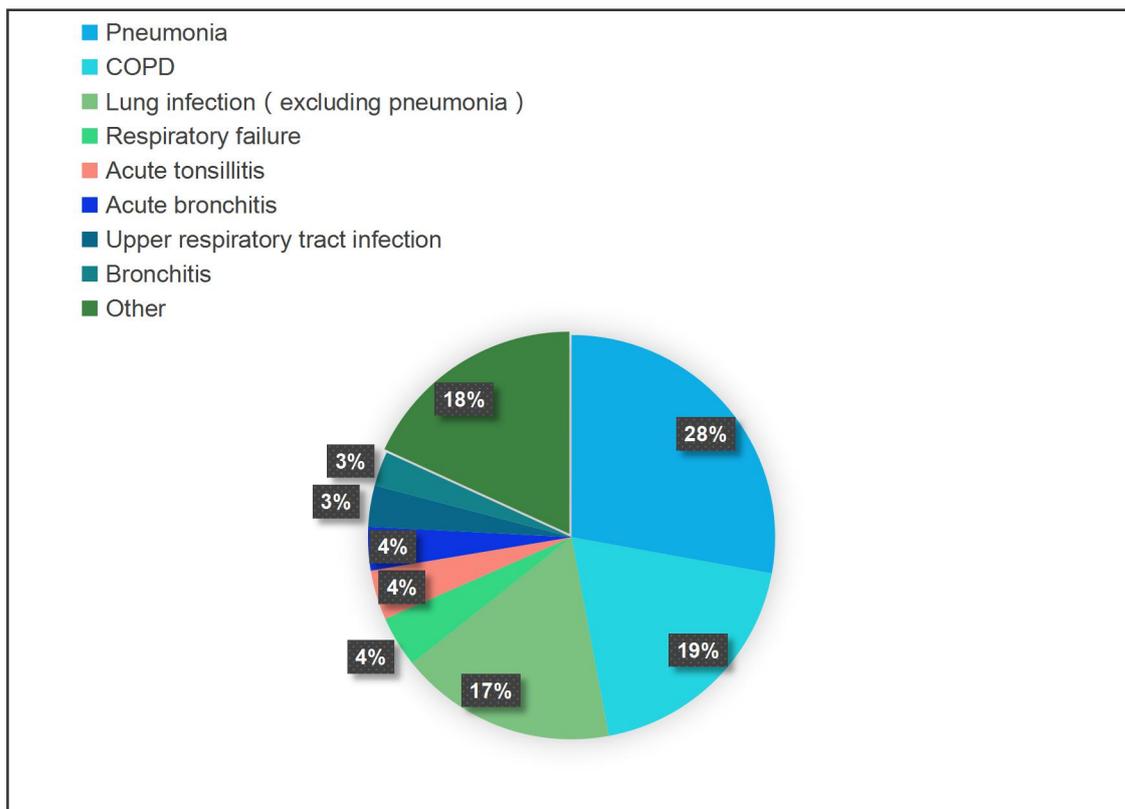


Figure 2. Distribution for inpatient in different types of respiratory diseases

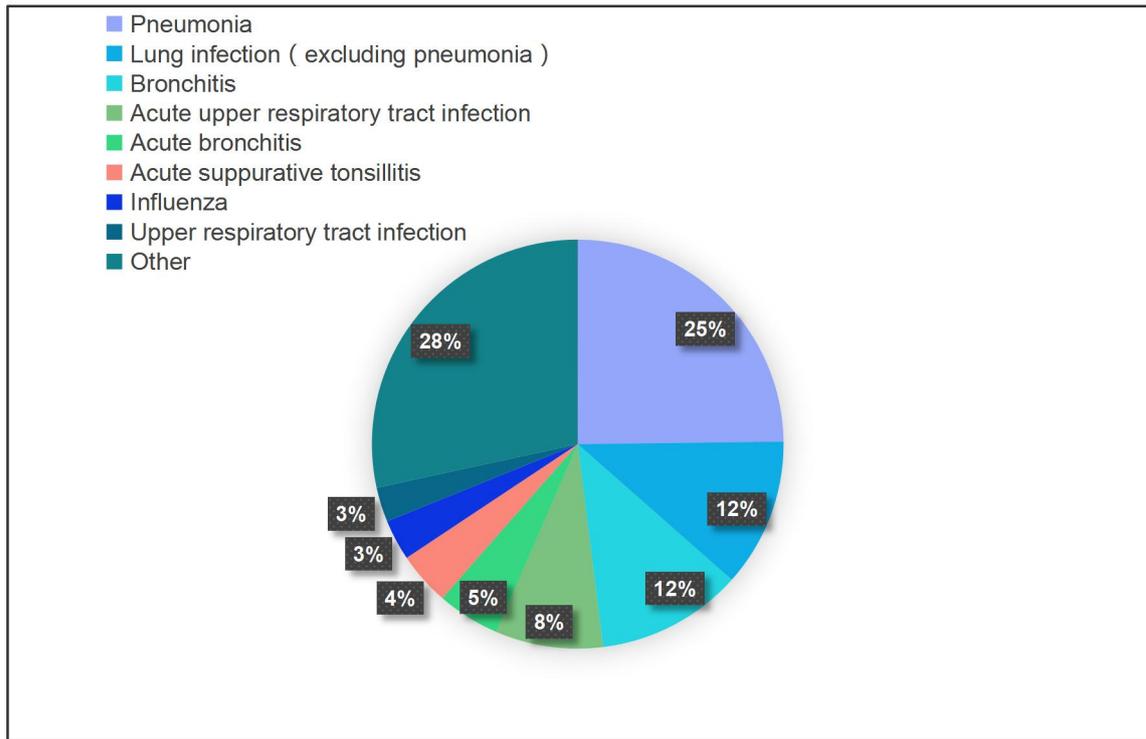


Figure 3. Distribution for outpatient in different types of respiratory diseases

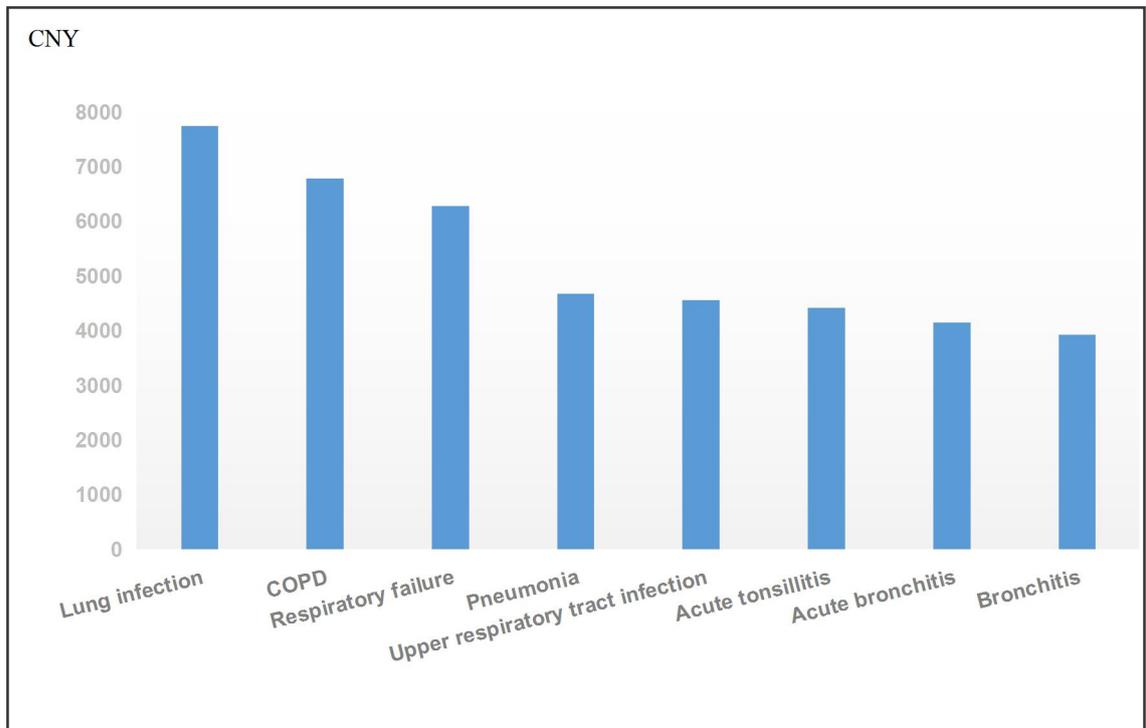


Figure 4. Cost of each hospitalization in different respiratory diseases

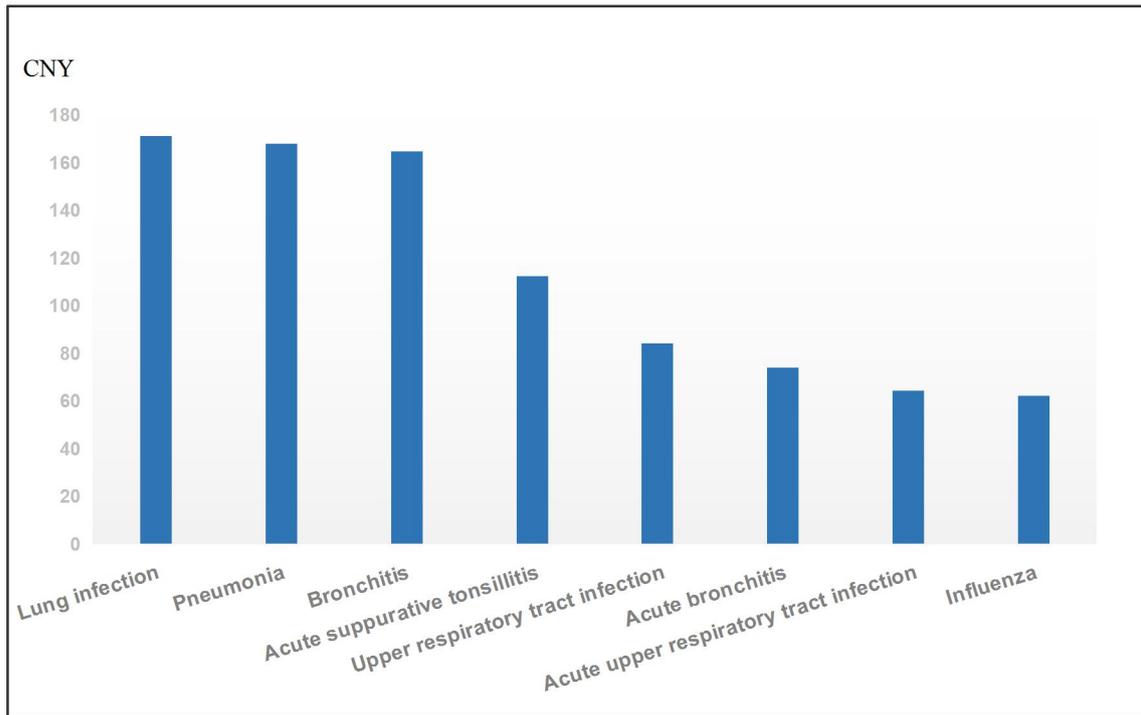


Figure 5. Cost of each outpatient service in different respiratory diseases

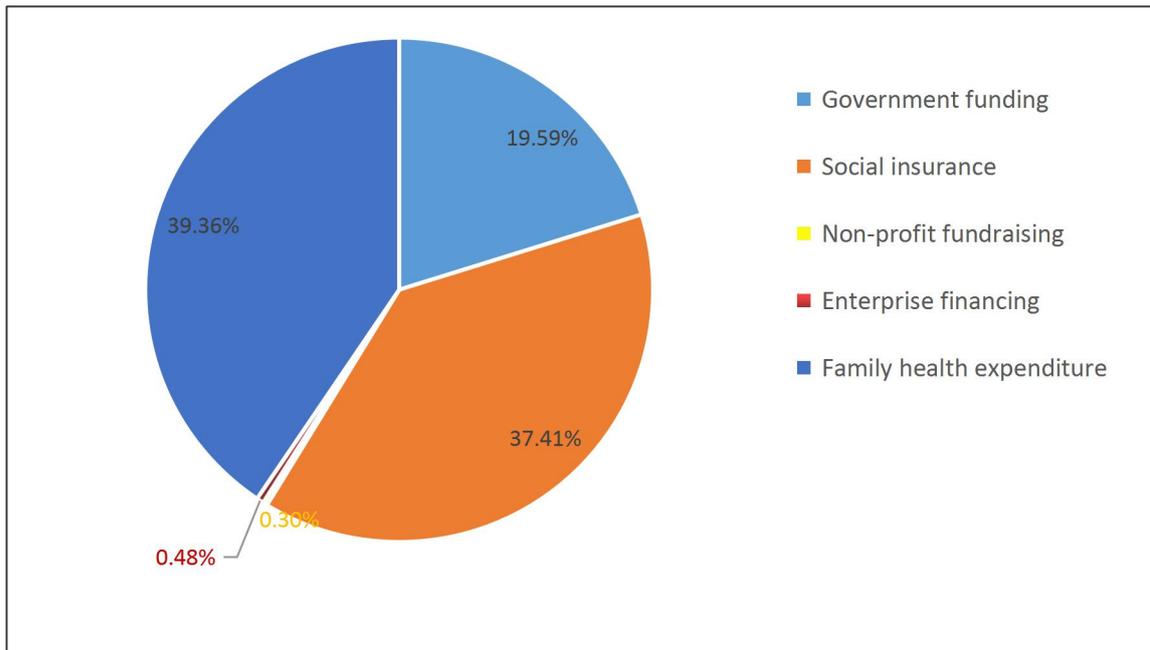


Figure 6. Financing scheme for respiratory diseases

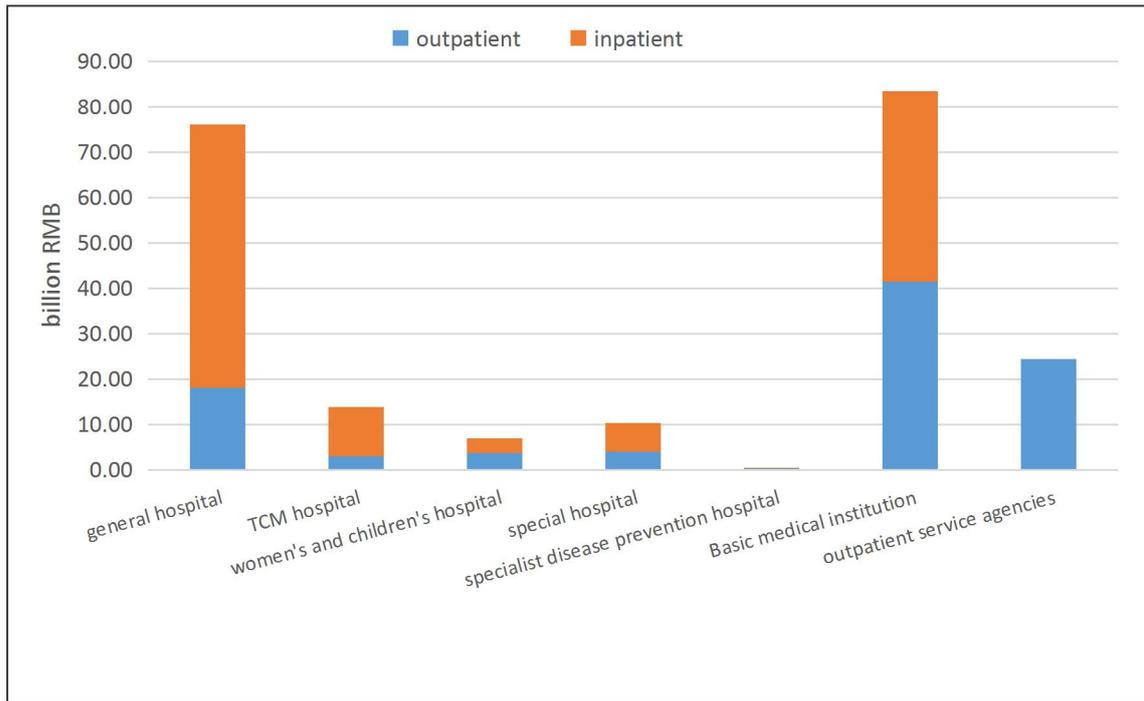


Figure 7. Distribution of medical institution for respiratory diseases

Table.1 Regression analysis of influencing factors of hospitalization expenditure

Model	Unstandardization Coefficient		Standardization Coefficient	t	P
	B	Standard Error	$\beta$		
Constant	3	0.011		275.25	<0.001
Age	0.005	0	0.411	76.621	<0.001
Gender	0.025	0.004	0.029	6.212	<0.001
Length of stay	0.024	0	0.488	99.634	<0.001
Medicine proportion	0.061	0.018	0.017	3.374	0.001
Surgey	6.47E-05	0	0.056	11.889	<0.001
Insurance	-0.053	0.004	-0.06	-12.386	<0.001
Institution level	0.193	0.004	0.258	50.866	<0.001

Model fit:  $F=4466.111$ ,  $p < 0.001$ ;  $R_2=0.680$ ; adjusted  $R_2=0.679$

# Figures

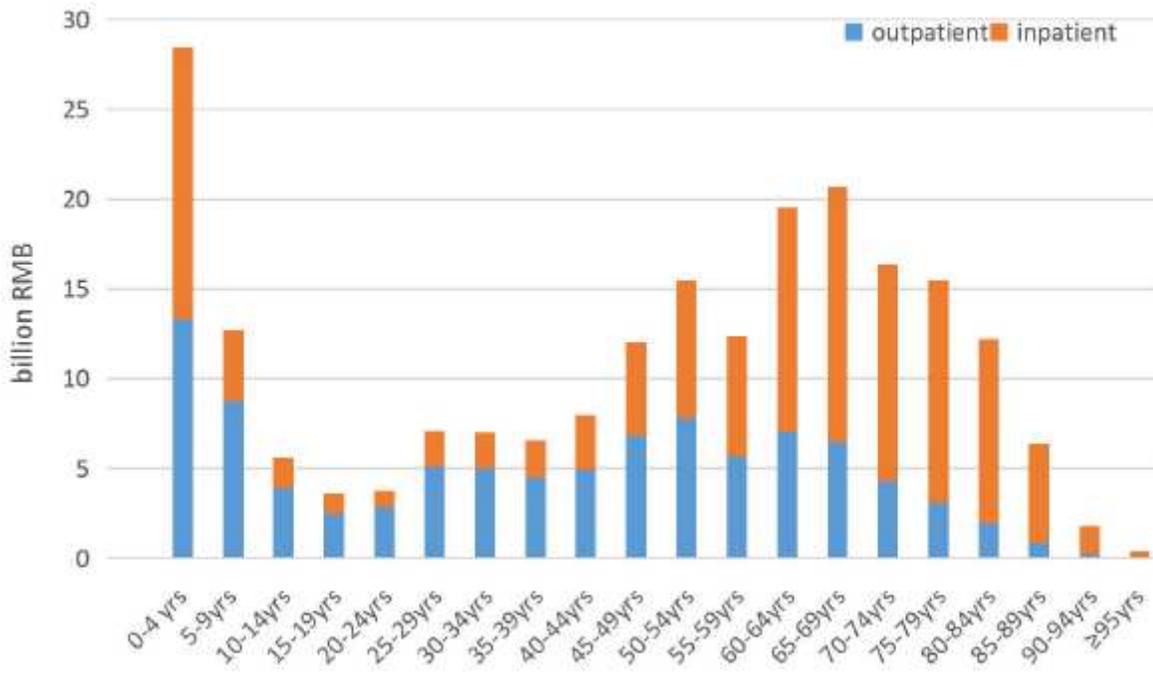


Figure 1

Distribution of the CCE for respiratory diseases in different age groups

- Pneumonia
- COPD
- Lung infection ( excluding pneumonia )
- Respiratory failure
- Acute tonsillitis
- Acute bronchitis
- Upper respiratory tract infection
- Bronchitis
- Other

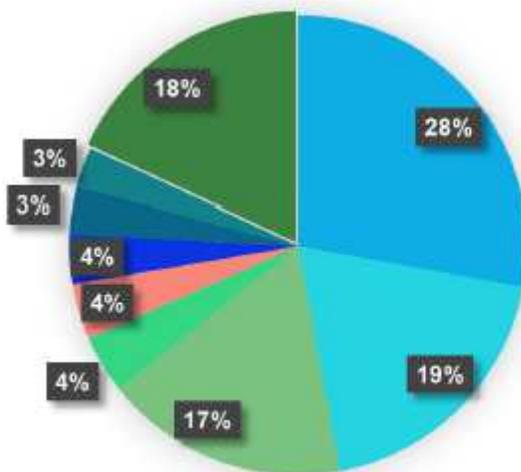


Figure 2

Distribution for inpatient in different types of respiratory diseases

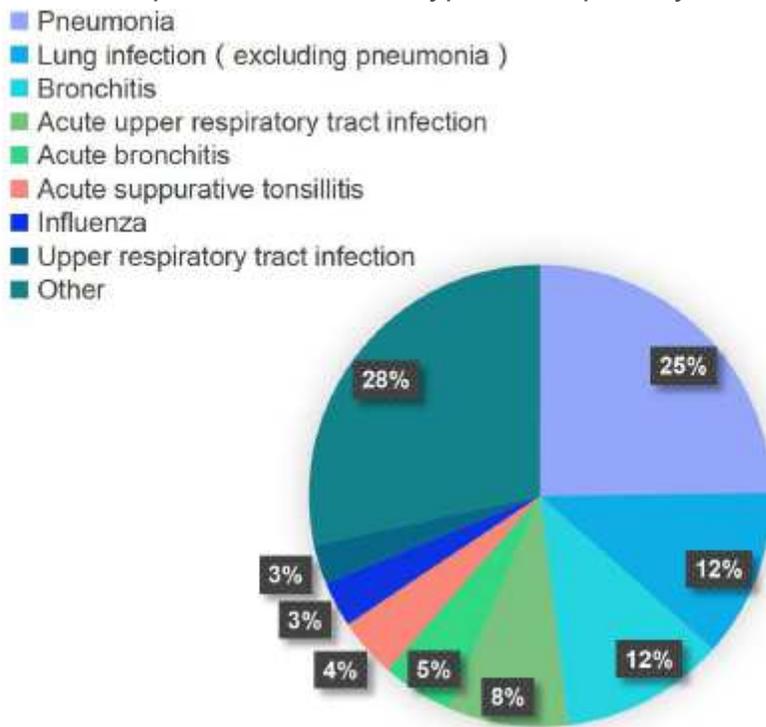


Figure 3

Distribution for outpatient in different types of respiratory diseases

CNY

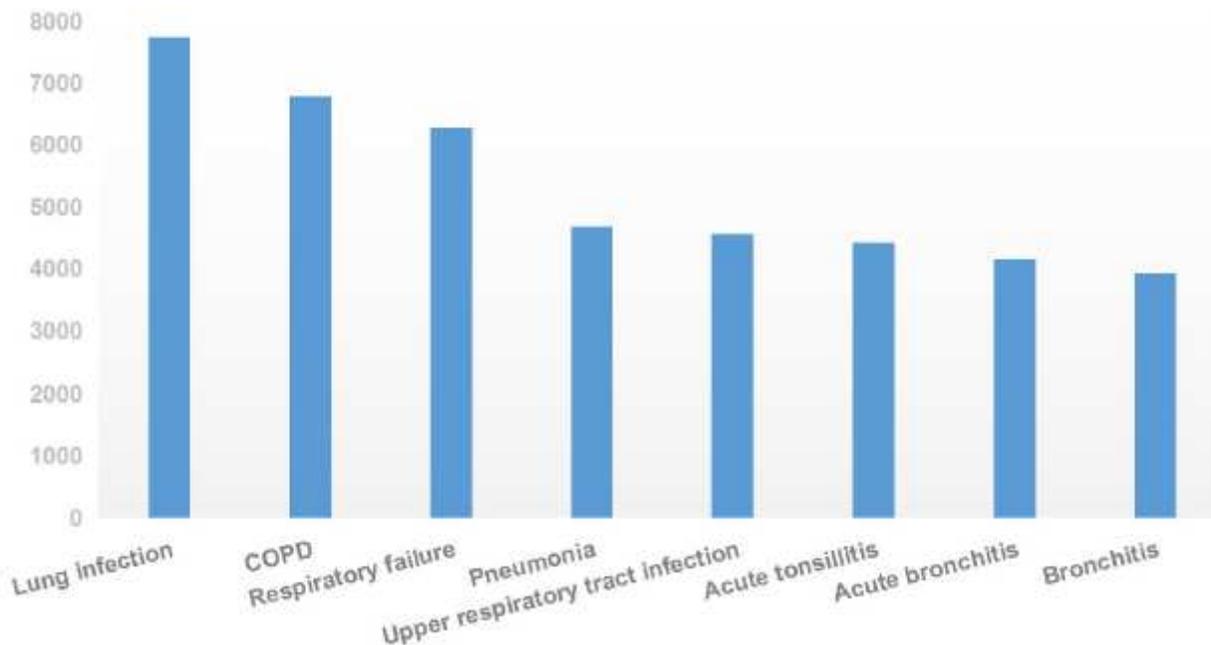


Figure 4

### Cost of each hospitalization in different respiratory diseases

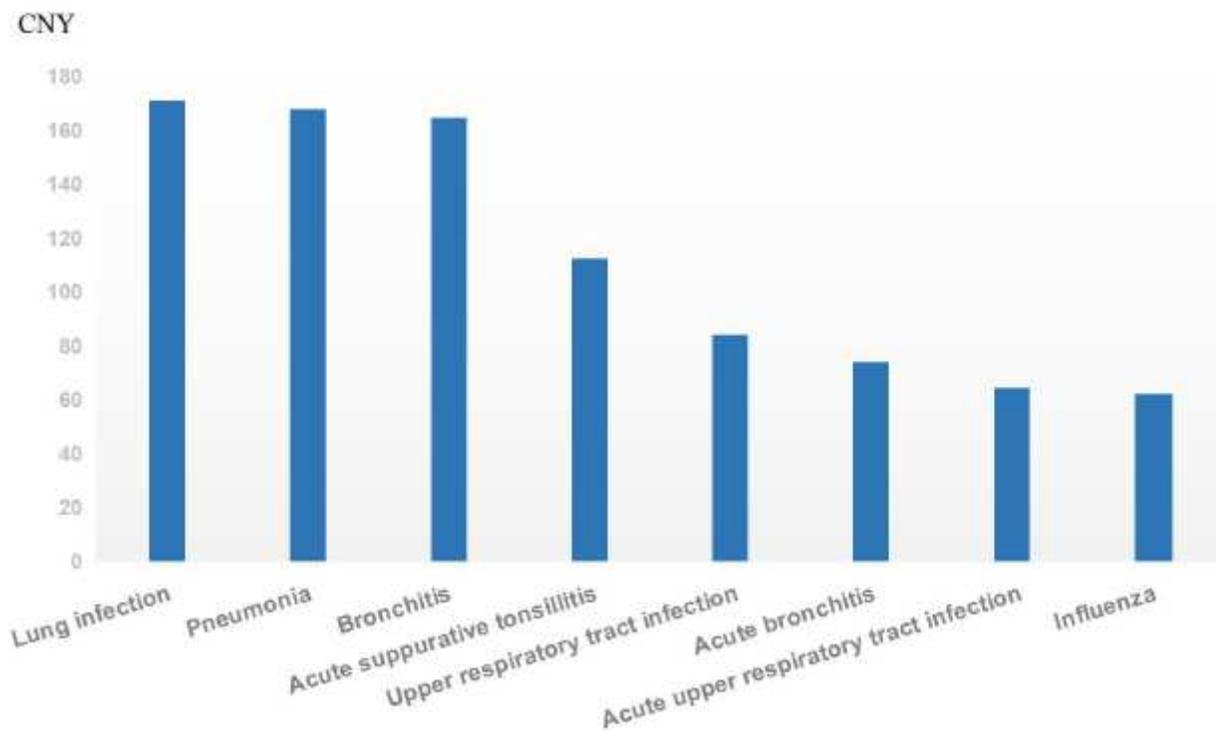


Figure 5

### Cost of each outpatient service in different respiratory diseases

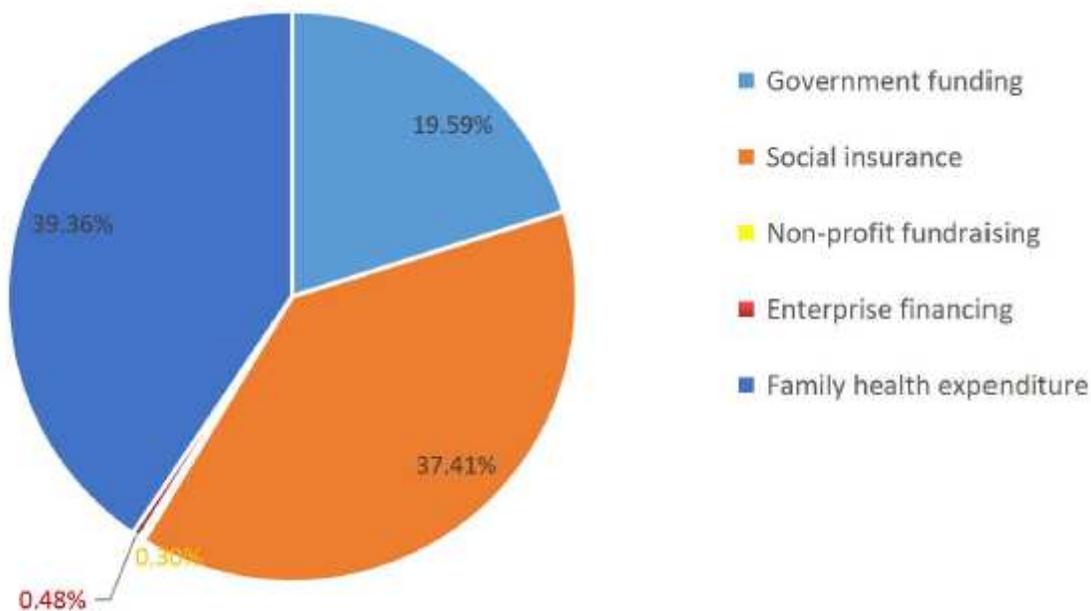
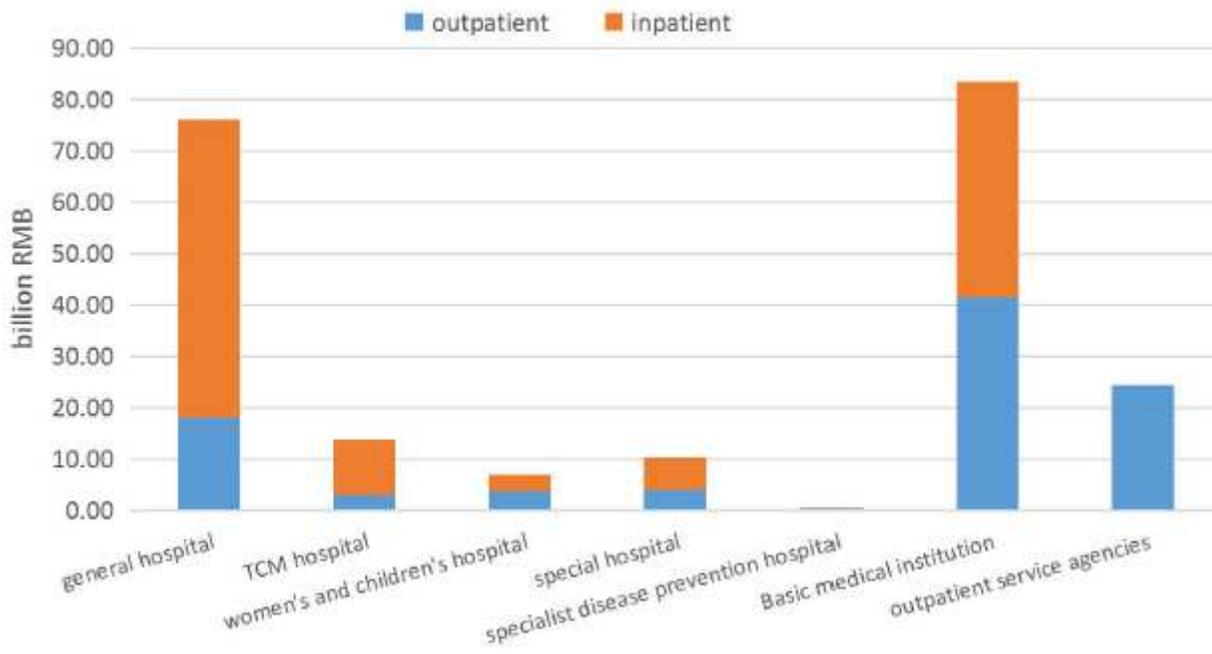


Figure 6

### Financing scheme for respiratory diseases



**Figure 7**

Distribution of medical institution for respiratory diseases