

# Nurses Lack of Knowledge On Inhaler Devices In China: A Cross-Sectional Study

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## Research Article

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# Abstract

**Background:** To know the knowledge on inhaler devices in medical staff, this study surveyed knowledge of inhaled therapy and the use of inhaler devices in nurses in China.

**Methods:** 1831 nurses were selected to survey on a new self-designed questionnaire online. The questionnaire has 11 questions, including the storage location of the inhaler devices, steps of using the inhaler device, and the common errors when using various devices, etc.

**Results:** Among the 1831 participants, 816(44.57%), 122(6.66%) and 893(48.77%) nurses worked in community hospital, secondary hospital and tertiary hospital respectively. Adequate knowledge of inhaler devices was demonstrated by nurses working in community hospital(20.10%) Secondary hospital(8.2%) and Tertiary hospital(13.1%). 27.70% nurses in community hospital knew operational key points in using inhaler compared to in secondary hospital (15.57%) and tertiary hospital (23.18%)  $P < 0.01$ . Only 9.5%-26.00% of participants chosen correct answers about the ten questions about the use of inhaler. Question six (Which of the following is the wrong option when using Ellipta?) was the one with the highest percentage of correct answers (26.00%). The question with lowest rate of correct answers (9.50%) was question 3 (What are the main points that need to be followed when using DPI?). The most people of correct answers number is Ellipta(26.00%) and the least is Respimat(10.32%).

**Conclusion:** The focus on community hospitals has some results in China. However, knowledge on inhaler devices should be continued to strengthen among nurses in hospital. It is necessary to create training opportunities for nurses to increase their awareness and knowledge of chronic respiratory diseases management.

## Background

Non-communicable diseases (NCDs) are the leading cause of death globally. Chronic respiratory diseases are among the leading causes of morbidity and mortality, and the prevalence of these diseases is expected to increase in the coming years [1–2]. World Health Organization (WHO) mentioned that hundreds of millions of people currently suffer from these conditions worldwide[2]. A national cross-sectional study showed that the overall prevalence of asthma in China was 4.2%, representing 45.7 million Chinese adults [3]. The overall prevalence of spirometry-defined Chronic Obstructive Pulmonary Disease (COPD) was 8.6%, accounting for 99.9 million people with COPD in China [4]. Prevalence was higher (13.7%) in people aged 40 years or older than the Chinese national survey in 2007(8.2%) [5].

Although these diseases have become a major public-health problem, chronic respiratory diseases are frequently not adequately treated. The asthma control level improved from 28.7% in 2007–2008 to 39.2% in 2015–2016( $P < 0.01$ ), while the rate of peak flow meter (PFM) usage showed no significant improvement [6]. A national survey across seven provinces found that the regular medical treatment rate

of COPD patients was only 7.9% [7]. It is crucial to increase the diseases' awareness and self-management of patients to reduce the disease burden.

Efficient delivery of inhaled medication is essential for the success of chronic respiratory disease therapy. Thus, correct inhaler technique is crucial as it can impact efficient delivery of inhaled medication. Poor inhaler technique has been the cause of uncontrolled chronic respiratory disease as the failure to deliver the medication effectively to the lungs compromised its clinical efficacy [8]. Numerous patients with chronic airway disease do not use inhaler devices properly, which can contribute to poor disease control [9].

It is essential to ensure that the patient grasp the correct inhaler technique to increase its clinical efficacy. Studies have shown that patients are often confused about various attributes of different inhalers, and poor technique is common regardless of the device used [10–11]. Therefore, medical staff play a critical role in educating patients on appropriate inhaler use and in ensuring medication adherence. Especially in China, nurses are more responsible for educating patients to use inhaler devices.

To address the relevant knowledge in medical staff, our study surveyed knowledge of inhaled therapy and the use of inhaler devices in nurses in China. The results of this study provide basic data for recommendations on physician education in this arena.

## **Methods**

### **Selection of participants**

Nurses were selected in the study. The total number of nurses working in community hospital, secondary hospital and tertiary hospital was 1,831.

### **Questionnaire**

A new self-designed questionnaire was created in accordance with knowledge about the inhaler devices. It was designed in two parts. The first part contained the age, gender, the academic degree, education and contact information of the participants. The second part consisted of a total of 11 questions, with all kinds of inhaler device technique. The first question is about the main route of administration for asthma and COPD. The second question is about the storage location of the inhaler devices. The third question is to list the steps of using inhaled drugs. The fourth and fifth questions are about the main points in using meter dose inhaler (MDI) and dry powder inhaler (DPI) respectively. Questions 6 to 8 are respectively which one is the wrong option when using Turbuhaler, Accuhaler and Ellipta. Questions 9 to 11 are respectively which one is the wrong option when using Turbuhaler, Accuhaler and Ellipta.

### **Statistical Analysis**

Statistical analyses were performed using SPSS21.0 statistical software. Socio demographic characteristics and other categorical variables were presented in frequency and percent. The chi-square

test was used to test the differences. The significance level was set to  $P < 0.05$ .

## Results

### Baseline characteristics

Table 1 shows the sociodemographic characteristics of participants. The 751 (41.02%) nurses were in the age from 20 to 30. Most was female (98.69%) and they mainly came from province-level municipality (87.38%). The number of nurses working in community hospital, secondary hospital and tertiary hospital respectively were 816 (44.57%), 122 (6.66%) and 893 (48.77%). There were more nurses with junior titles (49.65%) and intermediate titles (32.22%). Their education was mainly undergraduate (54.18%) and junior college (41.23%). Most of them (74.71%) never worked in Respiratory medicine.

Table 1 Sociodemographic characteristics of participants

<b>Nurses Characteristics (n=1831)</b>	<b>Frequency</b>	<b>Percent (%)</b>
Recoded age in years		
<20 years	20	1.09
20≤age<30	751	41.02
30≤age<40	627	34.24
age≥40	433	23.65
Sex		
Male	24	1.31
Female	1807	98.69
Religion		
Province-level Municipality	1600	87.38
Provincial Capital	46	2.51
Prefecture-level city	46	2.51
County-level city or below	139	7.59
Hospital level		
Tertiary hospital	893	48.77
Secondary hospital	122	6.66
Community hospital	816	44.57
Professional title		
Titles below junior title	318	17.37
Junior title	909	49.65
Intermediate title	590	32.22
Senior title	14	0.76
Education		
Senior school or below	78	4.26
Junior college	755	41.23
Undergraduate	992	54.18
Postgraduate	6	0.33
Working years		

≤5 years	445	24.30
5≤years<10	451	24.63
10≤years<20	526	28.73
≥20 years	409	22.34
Major in Respiratory medicine		
Never	1368	74.71
Once	346	18.9
At present	117	6.39

### Storage place of inhaler devices

As shown in figure 1, Storage place of inhaler devices being used after opening should be in living room cabinet or in bedroom. The nurses choosing two options respectively were 82.8% and 78.59%. 50.52% nurses chose both of options. 49.48% of nurses chose an unsuitable storage place (such as the bathroom, balcony, kitchen or refrigerator) for inhaler devices.

### Adequate knowledge of inhaler devices

Figure 2 shows that 1576 (86.07%) nurses thought that the main route of administration for asthma and COPD was inhalation. 13.93% of nurses thought that the main route of administration was oral administration, intravenous administration, et al.

Supplemental table 1 shows the sociodemographic characteristics and adequate knowledge of inhaler devices. Adequate knowledge of inhaler device was demonstrated by nurses working in community hospital (20.10%) Secondary hospital (8.2%) and Tertiary hospital (13.1%). Only 54 of 117 nurses working in respiratory medicine at present have adequate knowledge on inhalers. There was statistically significant between working in respiratory medicine and never in respiratory medicine (P<001).

### Technique of inhaler use

As shown in supplemental table 2, a slightly higher proportion (27.70%) of nurses in community hospital knew operational key points in using inhaler (MDI and DPI) compared to in secondary hospital (23.18%) and tertiary hospital (15.57%). This difference was statistically significant. The nurses of senior title (28.57%) and intermediate title (26.44%) knowing operational key points in using inhaler had higher proportion than junior title (23.32%) and below junior title (25.16%).

The main points of MDI including Inhalation and pressing being synchronized, slow and deep inhalation, the ratio of choosing two points is 21.41%. The DPI including no need for hand-mouth synchronization during inhalation, force and deep inhalation during inhalation, the ratio is 9.50%. There are 114 nurses (6.23%) who answered both questions correctly.

## Use knowledge of inhaler devices

As shown in table 2, there are nine questions about use knowledge of inhaler. The first question is to list the steps of using inhaled drugs. Only 25.34% of nurses got it right. The second and thirist questions are about the main points in using MDI and DPI respectively. Questions 4 to 6 are respectively which one is the wrong option when using Turbuhaler, Accuhaler and Ellpta. Questions 7 to 9 are respectively which one is the wrong option when using Turbuhaler, Accuhaler and Ellpta. Question six (Which of the following is the wrong option when using Ellpta?) was the one with the highest percentage of correct answers (26.00%). The question with lowest rate of correct answers (9.50%) was question 3 (What are the main points that need to be followed when using DPI?). Regarding the use of different inhaler devices in this survey, the most people of correct answers number is Ellpta (26.00%) and the least is Respimat (10.32%).

Table 2 Overview of the questions about use knowledge of inhaler

Items in the questionnaire	Correct answers number (%)	Number (%) of wrong answers and unknown answers
Q1: Please list the steps of using inhaled drugs (Fill in the blank)	464(25.34%)	1367(74.66%)
Q2: What are the main points that need to be followed when using MDI? (Multiple choice)	392(21.41%)	1439(78.59%)
Q3: What are the main points that need to be followed when using DPI? (Multiple choice)	174(9.50%)	1657(90.50%)
Q4: Which of the following is the wrong option when using Turbuhaler? (Single choice)	302(16.49%)	1529(83.51%)
Q5: Which of the following is the wrong option when using Accuhaler? (Single choice)	424(23.16%)	1407(76.84%)
Q6: Which of the following is the wrong option when using Ellpta? (Single choice)	476(26.00%)	1355(74.00%)
Q7: Which of the following is the correct option when using Handihaler? (Single choice)	434(23.70%)	1397(76.30%)
Q8: Which of the following is the correct option when using Respimat? (Single choice)	189(10.32%)	1642(89.68%)
Q9: Which of the following is the correct option when using Easyhaler? (Single choice)	455(24.85%)	1376(75.15%)

## Discussion

This survey showed the knowledge of inhaler devices in nurses in China. We found that a very high proportion of nurses who work in the hospital lacked adequate knowledge concerning inhaled therapy

and related educational aspects in China.

Several studies have consistently shown that many patients with chronic airway disease achieved incomplete benefit from their treatment, due to poor disease control and adherence [12–14]. There are several reasons for poor disease control and adherence, such as the type of medication, dosing frequency, patient's awareness of control, and a variety of patient beliefs and sociocultural and psychological variables [15]. Adherence is a big problem for all chronic diseases, but in asthma and COPD patients there are some additional difficulties because of inappropriate use of inhalers. Many patients do not receive appropriate inhaler training or have not had their inhaler technique checked. The main reason for this current situation is that physicians and nurses who prescribe or supervise these inhalers have poor knowledge and skills regarding their use [16–17].

Hospitals in China are divided into three levels by National Health Commission of China, which are community hospital, secondary hospital and tertiary hospital. The national roadmap, the Healthy China 2030 plan [18], highlighted the important role of primary health care to be substantially strengthened Chronic disease management [19]. In China, nurses, especially in community hospital, usually give information to patients about inhaler devices. Our study identified that 44.57% of participants work in community hospital. And they have more adequate knowledge of inhaler device than in secondary hospital and tertiary hospital. The number of nurses knowing at least 2 essential steps in using inhaler was more in community hospital than in secondary hospital and tertiary hospital. The result is consistent with Chinese national conditions. The reason may be that the division of labor in secondary and tertiary hospitals in China is relatively fine, which leads to the lack of knowledge of non-respiratory nurses.

Our questionnaire is different from other questionnaires in that it focuses on the errors that patients tend to make when using various inhalation devices. The composite variable, general inhaled therapy knowledge, which pooled the answers of overview of the questions about the use of inhaler devices, identified only 9.5%-31.45% of participants having correct answers about the ten questions in our study. Our result indicates that the knowledge of nurses about inhalers is not sufficient to communicate effectively to the patients. It is similar to the results of other studies. Abdullah Alismail et al. evaluated the ability of these health care professionals to retain knowledge about the different techniques required to properly use different inhalers. They found that the mean score of respiratory therapists was significantly higher than those of registered nurses and physicians [20]. Another study showed that the general level of knowledge regarding the use of inhalation devices is low among nurses working in this field in Spain [21]. This is an important consideration because Al Jahdali et al. demonstrated that improper inhaler technique is associated with poor asthma control and frequent emergency department visits [22]. Thus, teaching patients the correct use of inhaler devices by educated health care workers is of vital importance.

In this study, we found some problems, such as lack of knowledge about inhaler devices in nurses. Based on the current situation, it is necessary to create training opportunities for nurses to increase their knowledge of inhaler devices. In addition, We should put together a team of professionals to measure the

nurses' knowledge of inhaler devices regularly. Finally, related institution improvement is also very important.

The survey is the first domestic exploration on the problem of medication errors in inhalation preparation. Meanwhile it is a comprehensive survey of nurses in community hospital, secondary hospital and tertiary hospital. However, there are some shortcomings in the self-designed questionnaire, such as all participants being nurses. In addition, there is no screening of nurses, and nurses who are not in the respiratory department or who have not been exposed to inhaler devices may not have enough knowledge in this aspect. The questionnaire was only done once, without repeated verification. It may be necessary to expand the types of participants including physicians and pharmacists in the future, which the relevant data obtained is more accurate in this way.

## **Conclusion**

In this study, we have found nurses are lack knowledge of inhaler devices. Therefore, sufficient and professional training focus on inhaler devices is urgent and necessary. Based on current situations in China, we also put forward some specific measures to solve the problem. Although the findings of our studies are preliminary, they may provide a possible explanation for the current issues with inhalant use.

## **Abbreviations**

NCDs: Non-communicable diseases

WHO: World Health Organization

COPD: Chronic Obstructive Pulmonary Disease

PFM: peak flow meter

MDI: meter dose inhaler

DPI: dry powder inhaler

## **Declarations**

### **Ethics approval and consent to participate**

The study was approved by research ethics committee of Zhongshan Hospital Fudan University with No.B2017-022R.

### **Consent for publication**

Not applicable.

## Availability of data and materials

The data and materials used for analysis and make conclusion are available from the corresponding author on reasonable request.

## Competing interests

The authors declare that they have no competing interests.

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## Authors' contributions

NX and ZZ have drafted the work or substantively revised it; QY charged the acquisition of data; ML were the main responsible for analysis and interpretation in the study; XY designed of the work, and was a major contributor in writing the manuscript; XY, NX, ZZ and QY participated in the design, planning and development of the study and the questionnaire. All authors read and reviewed the final manuscript. All authors read and approved the final manuscript.

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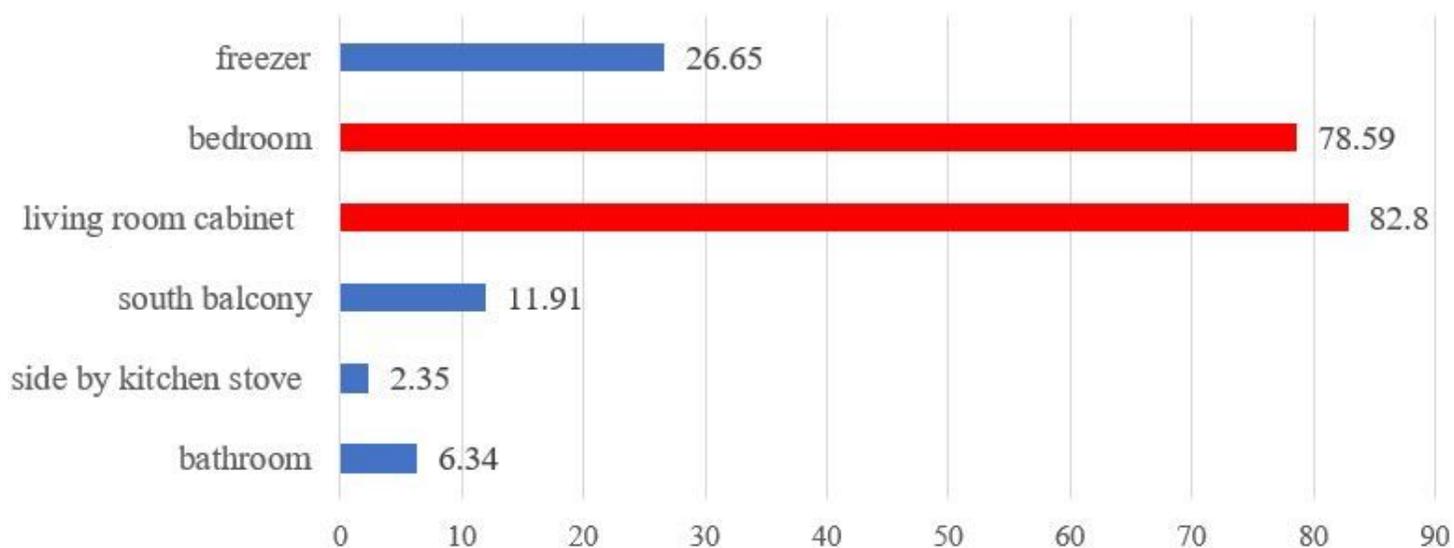
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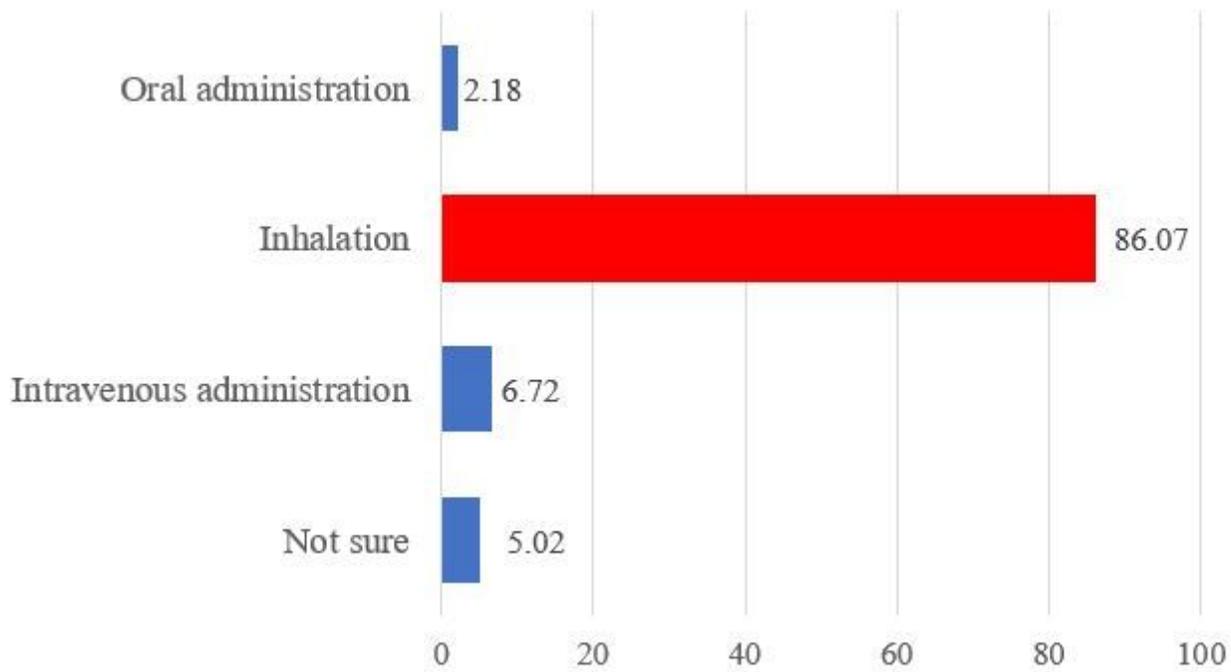
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## Figures



**Figure 1**

Storage place of inhaler devices being used after opening Percent (%)



**Figure 2**

The main route of administration for asthma and COPD

## Supplementary Files

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