

# THE CORRELATION OF SPIROMETRY AND CHEST X-RAY WITH RESPIRATORY SYMPTOMS

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## ABSTRACT

### *Background*

Concerning relationship between respiratory symptoms, spirometry and chest X-ray, the relationship has been both underestimating and overestimating in the diagnosis and treatment.

### *Objectives*

To show the correlation between symptoms and the findings on different parameters of chest X-ray, spirometry, weight, gender, and age.

### *Methods*

A case-control study has been done in Sulaimani city. The cases have visited the Respiratory Center at SHAR-teaching Hospital in Sulaimania- Iraq from June 1<sup>st</sup>, 2017 to December 1<sup>st</sup>, 2017. 146 cases with respiratory symptoms and 72 asymptomatic subjects served as a control group. A simple respiratory questionnaire has been used, Body Mass Index, Spirometry (Spirometry from both CareFusion and Mir air) and chest X-ray at the Radiological Department at SHAR-teaching Hospital. Age was between 12 and 70 years, undiagnosed respiratory diseases previously, mentally clear: understand how he/she can perform spirometry.

### *Results*

A total of (218) subjects, (146) cases and (72) controls were enrolled. Mean age of (39.7) years for cases and (49.23) years for control group. Gender distribution, both cases and control groups are relatively well matched with (68%) males Vs (32%) females in cases and (72%) males Vs (28%) females among the control group. Smoking habit (30.8%) cases Vs (40.2%) control. SPO<sub>2</sub>% was same in both groups. Chest X Ray findings: Cases (96%) had unremarkable CXR, (1.37%) hyper inflated pattern, (1.37%) Bilateral Hilar Enlargement (BHE), and a single (0.68%) cardiomegaly. Control group (93%) had unremarkable CXR, (1.38%) hyper inflated pattern and (5.55%) cardiomegaly. Spirometry findings cases (88.35%) normal and (11.65%) obstructive pattern. While control groups (97.22%) normal and (2.78%) restrictive pattern. Dyspnea (87%), cough (68%), sputum (36%), wheeze (17%) most common symptoms.

### *Conclusion*

The respiratory symptoms and CXR findings had a strong relation to both age and smoking. Spirometry is more symptomatic dependent than CXR. BMI and gender showed no significant differences between the two groups.

**Keywords:** *Spirometry, Chest X-Ray, Dyspnea, Wheeze, Cough.*

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## INTRODUCTION

Respiratory symptoms include both upper and lower respiratory tract symptoms and the most common symptoms include cough, shortness of breath, sputum, wheeze, chest pain, runny nose, and sneezing. Relationship between respiratory symptoms, spirometry and chest X-ray findings became the subject of our study and hereby we will start with the well-known sentence, "Not all wheezing is asthma and not all asthmatics wheeze" <sup>(1)</sup>, which is the term has been used in the evaluation of both underestimating, and overestimating the upper respiratory symptom concerning asthma diagnosis, for this pulmonary function test is necessary and assessment of pulmonary function testing plays a central role in the everyday practice of the pulmonary physician <sup>(2)</sup>.

There are many other causes of wheezing like vocal cord dysfunction (VCD) which are sometimes confused with asthma because some of the symptoms are similar <sup>(1, 3)</sup>, acute bronchitis, chronic obstructive pulmonary diseases (COPD)<sup>(4)</sup> and bronchiectasis <sup>(5, 6, 7)</sup>. Both spirometry and chest X-ray has been the standard tools in the primo evaluations of the respiratory symptoms, they are cheap, noninvasive and liable. Only spirometry has been shown to detect COPD in its early stages <sup>(8)</sup>, at the same time clinicians should be encouraged to routinely use pulmonary function testing for the diagnosis of asthma to facilitate more accurate diagnosis and improve management <sup>(9)</sup>. There are several reasons why patients might not receive pulmonary function testing to diagnose their asthma. Patient factors such as lack of time, lack of education, disinterest in finding out a diagnosis, or inability to perform the tests may play a role <sup>(1, 9)</sup>. Chest X-ray evaluation is highly appreciated in the lung diseases and acute heart failure, to date, CXR represents the first line imaging exam in patients presenting to the emergency department complaining of acute dyspnea and it is highly useful to diagnose alternative diagnoses when they are, together with decompensated heart failure in the differential <sup>(10)</sup>.

Chest X-ray provides general orientation as an initial diagnostic study and is especially useful in the diagnosis of pneumonia, cancer, and chronic COPD <sup>(11)</sup>. A study of chest X-ray and pulmonary function tests with the subjects who visited respiratory center outpatient with the symptoms from the respiratory system had been connected and the relationship to the symptoms has been highlighted.

## PATIENTS AND METHODS

This is a case-control study done in Sulaimania city. The cases visited the Respiratory Center at SHAR-Teaching Hospital in Sulaimania - Iraq from June 1<sup>st</sup>, 2017 to December 1<sup>st</sup>, 2017. 146 cases with respiratory symptoms and 72 cases without any symptoms, they had referred directly to the lung clinic by themselves and some of them had refereeing letter for the general checkup or smoking-related uncomfortable feeling, they were served as a control group, who agreed to participate in this study. They have been selected randomly to do pulmonary function (Spirometry from both CareFusion and Mir air) and chest X-ray at Radiological Department SHAR –teaching Hospital.

Inclusion criteria were age between 12 and 70 years, undiagnosed respiratory diseases previously, new cases, patients with respiratory symptoms (a cough, sputum, hemoptysis, chest pain, wheezing, seasonal allergy, allergic rhinitis and shortness of breath), mentally clear: understand how he/she can perform spirometry.

Exclusion criteria were age below 12 and above 70 years (spirometry compliance), well-known cases of chronic lung disease, patients with terminal diseases, mentally unclear and bad compliance, patients whose unstable socially and geographically, difficult to follow up inpatient cases.

Statistical analysis was performed using SPSS-22, descriptive analysis was presented as mean  $\pm$  SD for continuous variables and absolute values (percentages) for categorical measures.

## RESULTS

The total number of cases were (146) patients with the mean age of 39.7 years  $\pm$  11.93 SD, while the mean age of apparently normal asymptomatic control was 49.23 years  $\pm$ 10.50 SD with an approximately 10 years age difference between the two studied groups as shown in Table 1.

Regarding gender distribution, both cases and control groups are relatively well matched with (99 (68%) males vs. 47 (32%) females) within cases, and (52 (72%) males vs. 20 (28%) females) within control groups, shown in Figure 1.

The mean BMI of the cases is 27.81 kg /m<sup>2</sup>  $\pm$ 7.31 SD and that of the control group is 30.25 kg/m<sup>2</sup> $\pm$  5.44 SD

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and the P-value for this difference is 0.536. as shown in table 2. The rate of current smoking among cases was 30.8%, and among controls was 40.2% as shown in table 3.

The mean SpO<sub>2</sub> among symptomatic patients was 95.04 % ± SD 2.01, and among controls was 95.58% ± 1.88 SD, with a P-value of as shown in table 4.

Table 5 and figure 2 show the most common presenting respiratory symptoms; dyspnea was present in 127 cases (87%), followed by a cough in 99 cases (68%), sputum in 53 cases (36%) and wheeze in 25 cases (17%), and there were many patients with more than one presenting symptom. No cases were registered with hemoptysis. The correlation of Symptoms with PFTs and CXR findings are shown also.

Regarding CXR Findings, (96%)(N=140) of patients had unremarkable CXR, With only 1.37% (N=2) cases had a hyperinflated pattern, 1.37%(N=2) cases had Bilateral Hilar Enlargement (BHE), and a single

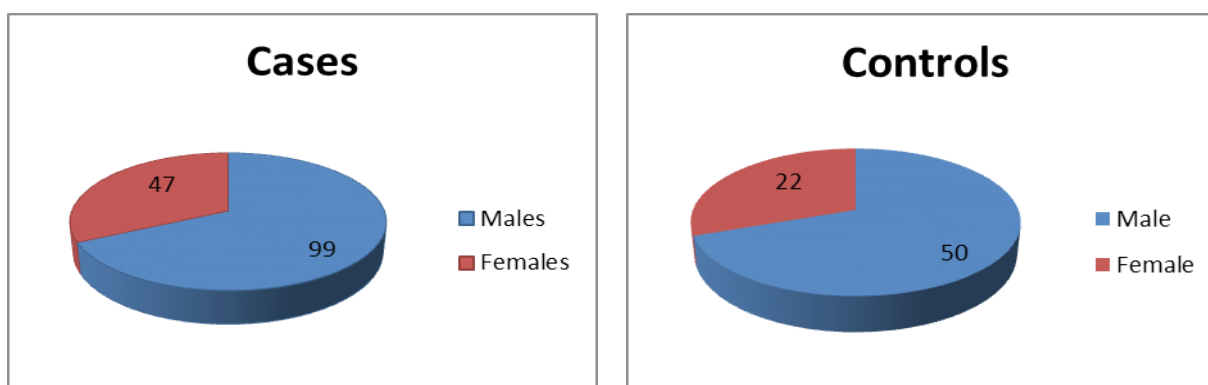
(0.68%) case of cardiomegaly. While among the control group, (93%)(N=67) of patients had unremarkable CXR, with only 1.38% (N=1) cases had a hyperinflated pattern and (5.55%) (N=4) cases of cardiomegaly. Using contingency table analysis, the P-value is 0.511 which is statistically not significant. These values are shown in Figure 3.

Regarding Pulmonary Function Test (PFT) findings, (88.35%) (n=129) of cases had normal PFTs with (11.65%) (n=17) had Obstructive Pattern. While (97.22%) (n=70) of control groups had normal PFTs and (2.78%) (n=2) individuals had Restrictive pattern Figure 4.

Regarding patient characteristics and risk appreciation of patients with Obstructive PFT pattern, their mean age is 42.58 years ± 14.19; their mean BMI was 27.07 kg/m<sup>2</sup> ± 3.72, mean Spo<sub>2</sub> 94%± 2.79 and rate of smoking were 53%(n=9), which are compared to their peers in control groups as shown in table 6.

**Table 1. Mean ages of cases and the control group.**

Age	N	Minimum	Maximum	Mean	Std. Deviation	P-Value
<b>Cases</b>	146	14	70	39.70	11.93	0.0001
<b>Control</b>	72	27	80	49.23	10.50	



**Figure 1. Gender distribution of cases and control groups.**

Table 2. Mean BMI of both studied groups.

BMI	N	Mean	Std. Deviation	P-Value
Cases	146	27.81	7.31	0.012
Control	72	30.25	5.44	

Table 3. The rate of smoking among cases and asymptomatic controls.

Smoking Habit	Total	Non-Smoker	Smoker	Ex-Smoker	Nargile	P-Value
Cases	146	85 (58.2%)	45 (30.8%)	11 (7.5%)	5 (3.4%)	Chi-Square Test 0.385
Control	72	37 (51.5%)	29 (40.2%)	6 (8.3%)	0	

Table 4. Mean SpO2 for both cases and controls.

SpO2	Mean	Std. Deviation	P-Value
Cases	95.04 %	2.01	0.058
Control	95.58%	1.88	

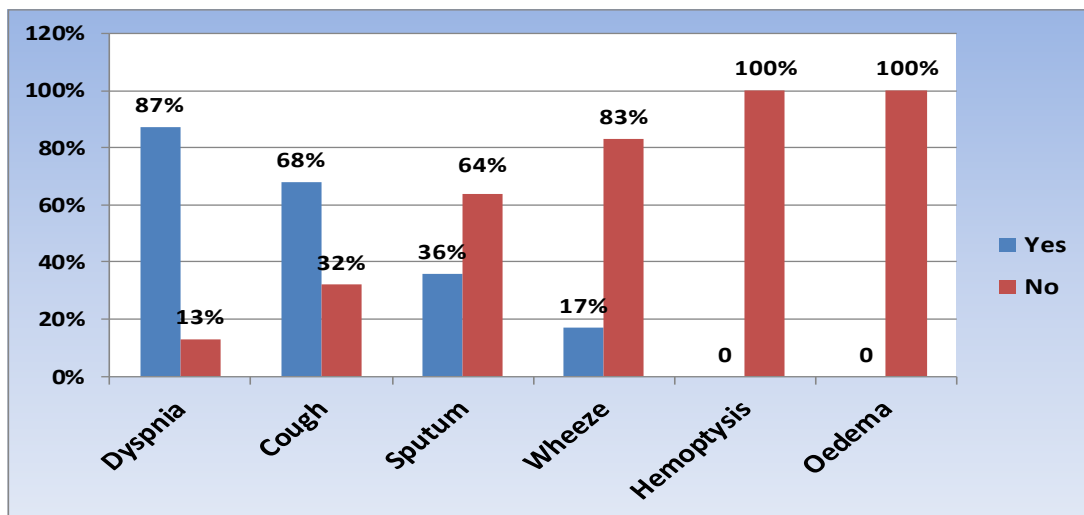
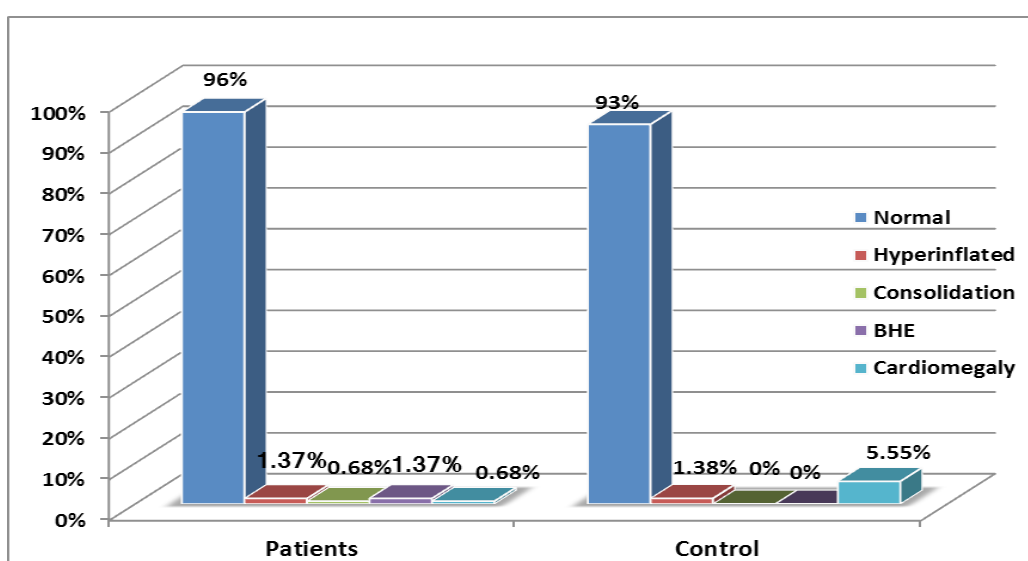


Figure 2. Rates of different presenting symptoms among cases.

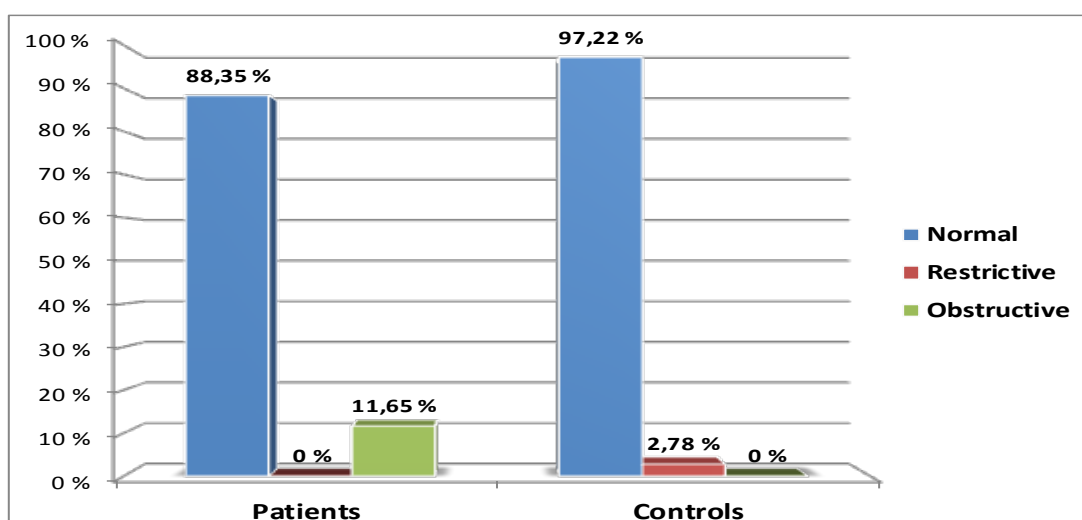
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**Table 5. Rates of different presenting symptoms among cases, with their chest X rays and PFT finding.**

Symptoms	N(%)	PFT pattern			CXR Findings			p-Value
		Normal	Obstructive	Restrictive	Normal	Hyperinflated	Cardiomegaly	
Dyspnea	127(87%)	110	17	0	124	2	1	
Cough	99(68%)	85	14	0	97	2	0	
Sputum	53(36%)	43	10	0	51	2	0	<0.001
Wheeze	25(17%)	16	9	0	24	1	0	
Hemoptysis	0	0	0	0	0	0	0	



**Figure 3. Distribution of CXR findings among both groups.**



**Figure 4. PFT findings among patients and asymptomatic controls.**

**Table 6. Comparing age, BMI, SpO2 and smoking rate between patients with Obstructive PFT and normal controls.**

	<b>N</b>	<b>Mean Age</b>	<b>Mean BMI</b>	<b>Mean Spo2</b>	<b>Smoking rate</b>
<b>Obstructive PFT</b>	17	42.58 ± 14.19	27.07 ± 3.72	94% ± 2.79	53% (n=9)
<b>Controls</b>	72	49.23 ±10.50	30.25 ±5.44	95.58% ±1.88	40.2% (n=29)
<b>P-Value</b>		0.013	0.024	0.0059	0.417

## DISCUSSION

A total of 218 subjects, 146 cases, and 72 control subjects, were enrolled in the study. In this study, we are going to discuss our findings and briefly mention some points concerning age differences, smoking habit, and gender distribution.

Concerning our Chest X-ray findings, we revealed that 96% and 93% in both groups were unremarkable and there was a non-significant difference between the two groups. Normal CXR cannot exclude some diseases, a report of 63,648 subjects from Pakistani candidates<sup>(12)</sup>, who took chest X-rays during medical screening for employment abroad and they concluded that a normal CXR by itself neither categorically rules out problems in the chest nor does any finding in it confirms some diseases. On the other hand, negative or misleading chest X-rays in lung cancer are quite common in primary care. In those who had an X-ray taken, the report was not suggestive of cancer in almost a quarter<sup>(13)</sup>.

Although Chest X-Ray is the first diagnostic step in patients with pneumonia, cancer, and chronic obstructive pulmonary disease (COPD), but the findings depend on other factors especially clinical findings, the positive predictive value (PPV) for diagnosing community-acquired pneumonia by CXR is 27% in comparison with CT as the gold standard<sup>(14)</sup>. In spite of the negative predictive value of CXR but clinical guidelines, recommend a CXR in all patients with respiratory symptoms<sup>(15)</sup>. In the similar study of adult patients with asthma admitted to hospital for acute asthma attack radiological abnormalities were detected in 50%<sup>(16)</sup>, but in most patients with uncomplicated asthma, radiographic findings are normal. The results of the present study are similar to a study done in Iran<sup>(17)</sup> which was emphasized that vital signs and physical

examinations are reliable parameters for predicting chest radiograph findings in the outpatient setting CXR would be unnecessary in patients with acute respiratory symptoms. In the survey of screening collecting data of 9,420 x-rays films, thirteen abnormal CXR were found, the prevalence of abnormal CXR is 0.25%<sup>(18)</sup>. In our study, most of the cases had one or more symptoms, table 5 above explained our findings with CXR and spirometry.

Parallel to the CXR, spirometry, FEV1, FVC, FEV1/FVC %, FEF parameters have been used in the analysis<sup>(1, 4)</sup> for the evaluation of abnormality detection. The spirometry was normal in approximately (88%) of cases, and with Obstructive Pattern in (12%) of cases, while about (97%) of control subjects were normal spirometry with about 3 % showed a restrictive pattern. After a clinical evaluation of the subjects, we have found that they could not perform the test correctly, not enough exhalation to have enough volume for FVC, and it has been documented in other studies. In a Swedish study, about 70% of patients with the diagnosis of COPD lacked spirometry results confirming the diagnosis. This shows that the high availability of spirometry equipment is not enough; it must be used with good quality and according to the guidelines<sup>(19)</sup>. These results suggest that spirometry is most likely to supplement the physician's history and physical examination in the management of outpatients with pulmonary disease<sup>(20)</sup> and a study of 386 asymptomatic smokers without a history of lung diseases<sup>(21)</sup> spirometry screening detected only 2.3 % of evidence of airway obstruction. Concerning spirometry and the diagnosis, it can be normal and at the same time underdiagnoses chronic lung diseases. The study of Amany & co mentioned that the prevalence of mild COPD among smokers is high, yet under-diagnosis remains a major problem and further tests beyond spirometry are useful<sup>(22)</sup>, it

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means that spirometry alone could not confirm the early stages of lung diseases. In contrary to this Over-diagnosis is a frequent phenomenon in patients with a clinical diagnosis of COPD managed in Primary Care Medicine.

There are different features between patients with a correct and incorrect diagnosis. Spirometry is an essential tool to reduce COPD over-diagnosis<sup>(23)</sup>. Our study has found 12 % prevalence of airway obstruction pattern similar to San Ngu & co-study, they showed airway obstruction prevalence of 14.6%<sup>(24)</sup>. We have documented symptoms accordingly, notice the table 5 above, dyspnea 87 % which was related to the most CXR and PFT abnormalities, subjects with shortness of breath had more findings than subjects with a cough 68%, sputum 64 %, wheeze 17%.

There are many studies and overall evidence base medicine inside respiratory medicine (EBM)<sup>(25, 26)</sup> showed that the most common causes of acute and subacute cough are upper and lower respiratory tract infections. At the same time asthma among the most common causes of a chronic cough (24%-29%) in adult nonsmokers<sup>(27)</sup>. Another survey (16,692 subjects) found that 36% of obese adults experienced dyspnea when walking up a hill<sup>(28)</sup>. Ten years age differences between the two groups shown in Table 1, mean age about 40 years for cases and for the control group of about 50 years. The case-control study which is matching on factors such as age and gender are commonly used in these studies<sup>(29, 30)</sup> and gender distribution was relatively well matched and the selected control group was relatively at higher risk of developing the lung diseases, but it is not significant in some diseases like lung cancer and COPD.

American College of Chest Physician, ACCP, Guideline on Screening for Lung recommendation is: "For smokers and former smokers who are age 55 to 74 and who have smoked 30 pack-years or more and either continue to smoke or have quit within the past 15 years, we suggest that annual screening with LDCT [Low-Dose Computed Tomography] should be offered<sup>(31)</sup>. In the same direction, Canadian guideline confirmed what ACCP recommended that there is no clear benefit of low-dose CT screening for lung cancer in adults younger than 55 years and older than 74 years or in those at a lower risk based on smoking history and they emphasised that CXR has no benefit for lung cancer screening<sup>(32)</sup>. In our study population, both groups showed mild overweight, and the breathing

disorder has been studied and showed a negative physiological effect on lung function (33,34,35), but we did not observe significant differences in our subjects. Smoking habit was about 31 % among cases and about 40% in control. Oxygen saturation in the peripheral circulation, SpO<sub>2</sub>%, was the same, 95 % on room air. After discussion, the study will be finished with limitations, conclusions, and recommendations.

This study was done in a very difficult situation in Kurdistan-Iraq both socially and economically which made an obstacle to perform good and solid study. The community health education is really at a low level which sometimes gives a small chance for follow up and performing a good spirometry test. This shows that the high availability of spirometry equipment is not enough; it must be used with good quality and according to the guidelines.

In conclusion, , we have found that chest X-ray findings and spirometry abnormalities related to the age and smoking habit. In the current study, the spirometry results were more symptomatic dependent than chest X-ray findings which were related to the clinical status of the airway affection. The most common documented symptoms among cases were dyspnea, cough, sputum, and wheeze. BMI in our study had not shown significant effects on the results of spirometry and chest X-ray. CXR and spirometry are the most two important, cheap and available investigations inside respiratory medicine, we recommend spirometry performance for all cases who visit lung and medical clinics with respiratory symptoms and history of allergy. We do not recommend regular and routine chest X-ray for young non-smokers with upper airway symptoms. We recommend the presence of spirometry machine at the clinics of internal medicine, allergy, asthma, and lung clinics. Still smoking is the most dangerous risk factor for lung diseases. Thus, we recommend that all private and public lung clinics and medical departments should have a skillful nurse inside the methodology of smoking cessation.

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### **Competing Interests**

The authors confirm that there are no competing

interests in relation to this work and this research received no specific grant from any funding agency in the public, commercial or non-profit sectors.

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