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Accuracy of spirometry performed by general practitioners and pneumonologists in the Pomeranian region in the 'COPD Prevention' NHF programme

Abstract

Introduction: Spirometry is the key test in diagnosing and severity assessment of chronic obstructive pulmonary disease (COPD). Despite the simplicity of the test, the discrepancy between results obtained by general practitioners and specialists is noted, what may lead to under- or overestimating of COPD prevalence.

The aim of the study was to evaluate the quality of spirometry testing and interpretation performed by general practitioners and pulmonologists.

Material and methods: Physicians from 56 healthcare units in the region of Pomerania were included. The participants (both GPs and pulmonologists) were trained in methodology and interpretation of spirometry tests. Then they were asked to choose 10 spirograms and send them for evaluation. Presence of patients' personal details and signature of staff member, contents of graphs and tables, accuracy of the test and correctness of interpretation were evaluated. In statistical analysis c-square test was used.

Results: The response from 14 healthcare units was received including 142 spirograms from GPs and 80 from pulmonologists. All spirograms contained personal details, gender, age, body weight and height as well as results of spirometry in form of tables and diagrams with predicted and measured values. Pulmonologists signed the spirograms more often than GPs (91% *v.* 77%, $p < 0.001$) and more often presented results of properly performed tests (75% *v.* 45%, $p < 0.0001$). However, in their group there were more interpretation errors (73% *v.* 91%, $p < 0.05$). Methodological mistakes revealed during the study were usually: too short and not enough dynamic inspiration and expiration. In some cases spirograms with expiration lasting 1.3 sec were considered normal. The most common interpretation mistakes included: diagnosis of mixed-type ventilatory defects, wrong classification of obstruction level and lack of interpretation. In two cases result was found to be normal despite the lack of forced expiratory volume in one second value.

Conclusion: The results indicate the necessity of continuous training in spirometry testing and interpretation by both general practitioners and specialists and nurses.

Key words: spirometry, prevention of COPD, general practitioners, pulmonologists

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Introduction

Chronic obstructive pulmonary disease (COPD) remains a significant socio-economic problem worldwide as in Poland. Together with cardiovascular conditions and malignant neoplasms, COPD is one of the commonest causes of death [1]. In Poland nearly 5% of the population is affected [2]. Pulmonary function tests should be performed in each case of suspected COPD and spirometry

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still remains a 'gold standard' in diagnosing, assessing the severity of, and monitoring COPD [3]. Despite the simplicity of the test, technical errors are frequent, which may result in under- or overestimation of COPD prevalence. In Poland a health-promoting 'COPD Prevention' programme, financed by the National Health Fund (NFZ, *Narodowy Fundusz Zdrowia*) has run since 2004.

Its aims are early diagnosis of the disease and stopping smoking. The programme is targeted at current and ex-smokers 40–65 years of age with a smoking history of at least 10 pack years. It is being conducted by general practitioners in about 600 primary care clinics across the country. It consists of two phases. The first comprises a questionnaire concerning overall health status, spirometry, physical examination and smoking cessation advice. In the second phase, subjects with abnormal results of spirometry are referred to a pneumonologist in order to confirm the diagnosis. Before the programme, training was organized in spirometry performance and interpretation for nurses, general practitioners and pneumonologists.

The aim of the study was to assess correctness of spirometry performance and interpretation by general practitioners and pneumonologists under the National Health Fund programme 'COPD Prevention'.

Material and methods

In the region of Pomerania, general practitioners, pneumonologists and nurses from 56 public or non-public primary care clinics participated in the programme.

Training in spirometry performance and interpretation

Before the programme, a one-day (five-hour) course was organized for study participants, devoted to the fundamentals of spirometry testing and interpretation. The course was divided into two parts: a theoretical one (one hour) and hands-on training for four hours. The latter was conducted in small groups. Each participant could perform a spirometry test several times. During the course particular emphasis was put on meeting reproducibility critieria i.e. the difference between the two highest FVC and FEV_1 values could not exceed 150 ml in consecutive measurements and expiration time had to be at least six seconds. How to interpret results was also widely discussed. One spirometer was used by a group of four trainees (Easy One, ndd Medizintechnik AG, Switzerland). A physician and a nurse were invited from every participating clinic.

Table 1. The most frequent errors in spirometry performance and interpretation

The commonest performance and interpretation mistakes	General practitioners (number of spirograms)	Specialists in pneumonology (number of spirograms)
Total number of spirograms	142	80
Too short and not dynamic expiration	40	15
Expiration lasting < 2 s	6	2
Expiration lasting 3–6 s	29	3
No FEV_1 measurement — spirograms evaluated as normal	2	–
Mistakes in obstruction's grade evaluation	5	10
Mixed-type abnormalities	7	11
No interpretation	33	16
No signature of medical staff (doctor/technician)	32	7

The measurements were performed according to ATS guidelines [4]. Spirometry was considered normal if the FEV_1/FVC ratio was higher than 0.7 and the FVC higher than 80% of predicted value. Obstruction was diagnosed in cases where the FEV_1/FVC was lower than 0.7. Its severity was classified according to the COPD severity scale by GOLD (*Global Initiative for Chronic Obstructive Lung Disease*). Obstruction was described as mild when the FEV_1 > 80% of predicted value, moderate when it was 80–50% of predicted value, severe when 50–30% of predicted value, and very severe when <30% of predicted value. Restriction was suspected in cases where the FEV_1/FVC > 0.7 and FVC < 80% of predicted value [3].

Competence was demonstrated by properly performed spirometry and, additionally for physicians, by correct interpretation of the result. At the end of the course trainees received certificates entitling their clinics to participate unlimitedly in the 'COPD Prevention' programme. Training two spirometry practitioners from each primary care clinic in this way made it possible to conduct thorough screening tests.

Assessment of spirometry performance and interpretation's correctness

Six months after the training, all participants were sent a written request to choose and present ten (potentially the best technically) spirograms. It was specified that printout of test results should contain personal data of a patient, values of variables measured (Tab. 1), flow-volume loop as well as comment and authorisation by a techni-

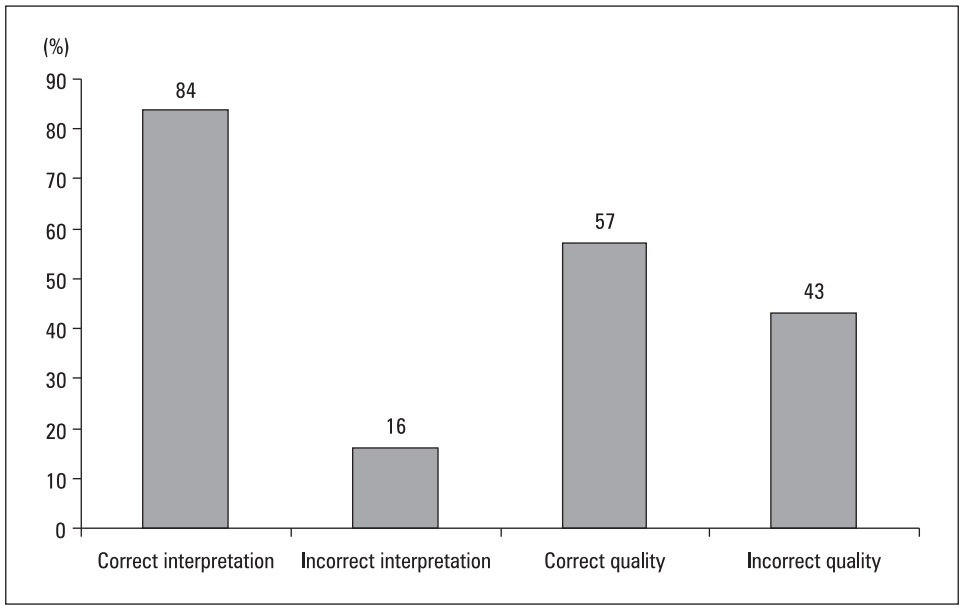

Figure 1. Evaluation of spirometry test quality and interpretation

cian performing the test and the physician interpreting the results. Participants were also asked to specify whether spirometry was performed by a general practitioner or by a specialist in pneumonology.

1. The spirogram was found satisfactory if all the elements listed above were included.
2. Spirometry performance was assessed as correct if all the criteria for spirometry tests set by the Polish Society of Pneumonology were met [5].
3. The result was classified as well-interpreted if obstruction and/or restriction and their severity were described correctly by the trainee (according to ATS/ERS guidelines) [6].

In statistical analysis, random variable distribution chi-square test for independent groups was used.

Results

A response from 14 (25%) clinics was received i.e. 222 spirograms including 142 from general practitioners and 80 from pneumonologists. Ten centres refused to present results for evaluation. No response was received from the remaining 32 healthcare centres. Spirograms sent for evaluation were performed with the five most commonly used spirometers: Pneumo (artMed, Poland), Lungtest 250 (MES, Poland), Lungtest 500 (MES, Poland) Easy One (NDD, Switzerland) and Microlab Spiro V 1.23 (Micro Medical Ltd, Great Britain). All spirograms contained personal data such as age, height, weight and gender as well as spirometry results in the form of charts and tables with predicted and current values. Some of the printouts contained the expiratory part of flow-volume loop only. Graphs presented one flow-volume loop and one set of numbers in the form of a table showing the best of all measures. As a consequence it was impossible to analyze whether all tests were conducted correctly.

The commonest error was expiration that was not full and not dynamic. In some cases measurements were accepted in spite of an expiration lasting only one second. The commonest errors in spirometry interpretation were: misdiagnosis of an obstruction's severity, diagnosis of mixed-type abnormalities and lack of any comment. Two results were found normal despite the lack of any FEV_1 value. Basic data concerning quality and correctness of spirometry is presented in Figure 1. In Table 1 the commonest mistakes made by general practitioners and pneumonologists in spirometry performance and interpretation are listed.

Pneumonologists presented more authorised results compared to general practitioners (91% *v.* 77%, $p < 0.001$) as well as more technically correct tests (75% *v.* 45%, $p < 0.0001$). However, they were poorer at interpreting results (73% *v.* 91%, $p < 0.05$) (Fig. 2).

Discussion

COPD is one of the commonest chronic respiratory conditions. Its prevalence is related to age and amount of cigarettes smoked daily. It is esti-

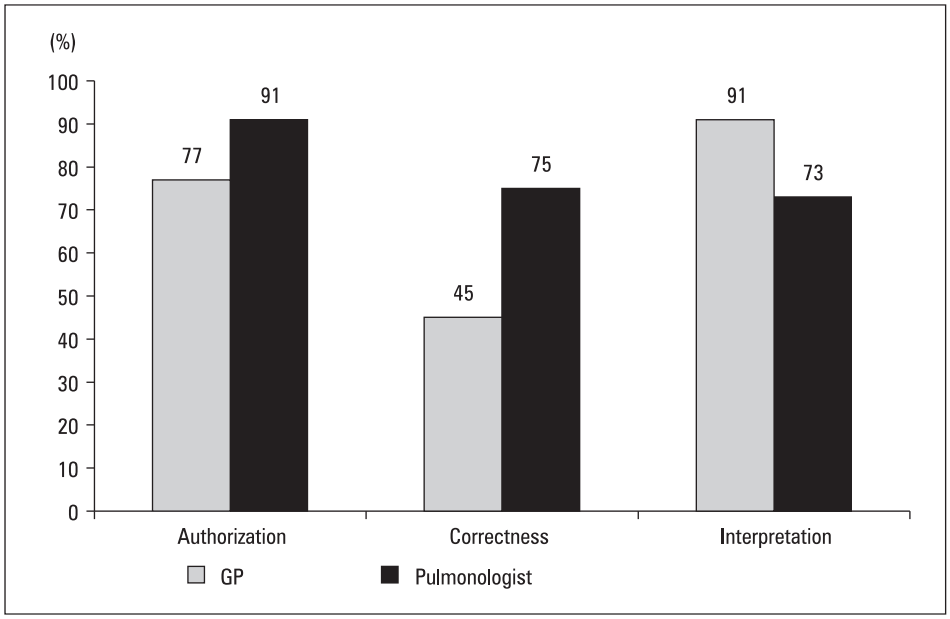

Figure 2. Comparison of the quality of spirometry between GPs and pulmonologists

mated that over 2 million people are affected in Poland and new data gained from the BOLD study (*Burden of Obstructive Lung Disease)* indicates an even higher prevalence of COPD in the Polish population [7, 8]. In men, the frequency of stage I is assessed at 14.1%, stage II at 10.3%, stages III and IV at 3%. In women: stage I is 8.1%, II is 7.8%, III and IV are 0.8%. Overall it is estimated that in Poland 27.7% of men and 16.7% of women are affected (in all stages of the disease) [8]. A recent study by Bednarek et al. showed a significantly higher incidence of advanced forms of COPD as well as a high rate of misdiagnosis by general practitioners [9]. The group at highest risk of developing COPD consists of active smokers aged 40 or above with a smoking history of at least 10 pack years [10]. It seems spirometry in this social group could increase the number of correct diagnoses.

In order to diagnose COPD early, screening tests are used in high-risk groups chosen from the general population [11]. The efficacy of screening spirometry in the early detection of COPD in smokers has been documented by Zieliński et al. [12]. According to updated GOLD guidelines [3], spirometry should be performed in every patient with suspected COPD. It is a valuable supplement to a patient's history that helps towards the final diagnosis. In this study, general practitioners and pneumonologists participated in a nationwide drive towards early detection of COPD. The programme was conducted with the help of NFZ. One of the conditions of its efficiency was correct measurement and interpretation of spirometry which was in many cases the basis of the diagnosis. That is why co-ordinators emphasized particularly training in spirometry performance according to international standards [6]. To get a final credit, participants had to present properly measured spirometry that was correct and reproducible. Particular attention was paid to meeting reproducibility criteria i.e. the two highest values of FVC and FEV_1 could not differ by more than 150 ml in consecutive measurements [6]. Unfortunately, in the present study, this element could not be evaluated due to technical reasons and the fact that presented printouts contained one flow-volume loop and one set of results (the best of all measured).

Training and improving qualifications by general practitioners in the field of spirometry performance and interpretation are currently under the spotlight [13]. In Poland, the gap between everyday practice in the field of diagnosing and treatment of COPD and the Polish guidelines has been described by Zieliński et al. [14]. According to a questionnaire study conducted during the Polish Society of Pneumonology Congress 2004, only 81% of doctors measure spirometry in order to confirm COPD diagnosis. In the group surveyed internal medicine specialists reported worse accessibility to spirometry compared to pneumonologists. The present study shows that several mistakes in measurement and interpretation are still being made. It seems only regularly repeated refresher training may be beneficial in this area

[15]. While measuring spirometry, particular attention should be drawn to three elements of a proper test: maximal deep inspiration, forced expiration and then continuation of expiration for at least six seconds. Three maximal expirations are performed, and two of them should not differ by more than 150 ml. No more than eight measurements of flow-volume loop should be done. The commonest reasons for false results are: inspiration that is not full, submaximal or too short expiration, imprecise or not calibrated spirometer, or wrong anthropometric data (e.g. height, age).

Properly prepared and repeated training with adequate commitment of participants minimises the risk of mistakes in spirometry interpretation, particularly in respect of diagnosing and assessing the severity of COPD and asthma [16]. Having trained general practitioners in proper measurement and interpretation of spirometry, Chavannes et al. asked them to interpret 12 standard clinical cases together with spirograms [17]. The cases had been earlier consulted with and approved by a group of experts in pneumonology. The fewest mistakes were made in assessing normal flow-volume loops and obstruction abnormalities. The highest number of mistakes were made in interpretation of loops with suspicion of restriction or overlapping of obstruction with restriction.

In the present study, mistakes have been made in both performance and interpretation of spirometry. The most frequent mistakes made by general practitioners and pneumonologists were: accepting spirometry despite not full, not intensive and too short expiration. Two results were found normal despite the lack of any FEV_1 value. 42 spirograms with an expiration lasting less than six seconds were revealed. Overall, out of 222 spirograms received in the study (potentially the best) 35 (16%) contained interpretation mistakes.

The most troublesome was interpretation of obturation's severity. Mixed-type abnormalities were also often misdiagnosed. In describing them, a decrease of both FEV_1 and FVC was wrongly taken for coexistence of restriction and obstruction (FEV_1/FVC ratio). However, this term is currently limited to overlapping of obstruction with restriction (FEV_1/VC decreased) confirmed by TLC decrease [18]. Thus this type of abnormality cannot be confirmed by a general practitioner during a screening test and body pletysmography is required to confirm the diagnosis. Only after consultation in a specialist centre could such a diagnosis be made. What is particularly striking and worrying is that specialists were the poorest interpreters of spirometry results.

We need to discuss the insufficient response of study participants to the letter encouraging them to evaluate correctness of spirometry measurement. Only 14 clinics (25%) responded positively. Probably these were the best ones, confident that their results were correct. Spirograms from other clinics may have been much worse. Imperfect co-operation with a regional branch of NFZ may have also discouraged doctors who, as a result, did not want to verify tests' results. In detailed terms of the NFZ 'COPD Prevention' programme, no information has been provided on making tests' results accessible to research centres in order to monitor their quality. As a consequence, only a limited number of spirograms was sent in response to the co-ordinator's letter and could have been evaluated.

Particular attention should be drawn to the quality of the NFZ programme. The main advantage of the 'COPD Prevention' programme was in alerting general practitioners and local communities to the risk of chronic tobacco-dependent diseases such as COPD. If properly carried out, the programme helps early detection and prophylaxis of COPD as well as introduction of adequate medication.

A spirometric result authorized by a physician is a medical document, which is in many cases the basis for COPD diagnosis and is often used as a supplement to certificates confirming health status. This makes proper spirometry measurement particularly important.

Conclusions

Results of the study indicate the necessity of continuous training in perfomance and interpretation of spirometry by both general practitioners and pneumonologists. Planning is needed to monitor the quality of measurement and interpretation of results following the training course. As a consequence, wrong diagnoses of COPD and the subsequent costs of medication could be limited.

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