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Are Training Programs Efficient Enough to Improve Spirometry Quality in Primary Care?

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Abstract

Objective: To analyse the spirometry situation in primary care (PC), in terms of its use as well as its quality, one decade after our first analysis and to evaluate the effectiveness of the plans instituted since then.

Methodology: In the first phase, a survey of all health centres (centros de salud, CSs, in Spanish), similar to the one used in 2005, was conducted in which information was requested regarding spirometric equipment, frequency of use, calibration, and personnel training. Subsequently, 96 patients were referred from PC after having a baseline spirometry conducted at a CS. The spirometry was repeated the same morning with a similar spirometer in the pneumology laboratory. Two expert pneumologists in functionalism analysed the quality of the tests according to the ATS/ERS and SEPAR regulations and compared the results with these obtained in 2005.

Results: A spirometer is available in 100% of the CSs (90.9% in 2005). Spirometries are performed in 91.8%, and in 80.3%, daily calibration is performed (4% in 2005). However, the number of spirometries remains similar to that found in our previous study and lower than desired. With respect to their quality, only 40.5% of the 96 tests analysed had sufficient quality (A, B or C in a scale from A to F). The spirometric diagnosis was wrong in 43.7% of the cases (39.7% in 2005), corresponding to an absence of agreement in 29.1% and a discrepancy in the severity in 13.5%.

Conclusions: Spirometry in PC continues to be an unresolved problem in our area, and we have ascertained that exclusively training and non-continuing programmes yield insufficient results. Given the magnitude of the problem and knowledge of the existence of projects that have demonstrated their effectiveness, we believe there should be no further delay in implementing any of these strategies adapted to each area.

Keywords: Spirometry; Primary care; Quality; Training; Telespirometry; Education

Introduction

Among the respiratory diseases are some of the most prevalent chronic conditions, such as asthma or COPD [1,2], with spirometry being the essential tool for their diagnosis and monitoring. This exploration is also essential in other circumstances, such as the evaluation of incapacity for work or interstitial pathology. The COPD Strategy of the National Health System in Spain states that it "is essential to diagnose the disease and to assess its severity and that, in addition, to establish its prognosis, to guide the treatment, to facilitate the control of the therapeutic response and the progression of the disease"[3]. The European Respiratory Society (ERS) is committed to improving the use and quality of spirometry and currently, among other actions, is developing the European Spirometry Training Programme to help health professionals achieve quality spirometry and obtain the accreditation certificate. On the other hand the General Practice Airways Group (GPIAG) in association with the Association for Respiratory Technology and Physiology (ARTP) and Education for Health several years before had already published their Proposed Standards for general practice compliant with American Thoracic Society and European Respiratory Society [4].

The under diagnosis and incorrect diagnosis of respiratory diseases are established facts [5-7]. Regarding the former, in COPD, some studies place under diagnosis at more than 70% [5,8]. Moreover, a study conducted in Australia found that 31% of the patients diagnosed with COPD had not undergone spirometry [9].

Our group analysed the spirometry situation in primary care (PC) in Navarre (Spain) in 2005, ascertaining that, at that time, the majority of the health centres (centros de salud, CSs, in Spanish) provided spirometers and in turn observing a marked underutilization of the devices, poor monitoring of the recommendations for implementing PC spirometry, and inadequate quality of the spirometry performed in that care setting [10]. In recent years, several studies have examined the spirometry situation [11-14], having evaluated and implemented initiatives of various types [15-20]. During this period in our community, measures aimed at training PC health personnel and improving CS equipment was adopted. Therefore, we were interested in re-evaluating the situation, both in terms of utilization as well as in quality, 10 years after our first analysis.

Methodology

In essence, the systematic methodology used was similar to that employed in our 2005 study and was conducted in two phases. The first phase was learning about the current spirometry situation in PC in our community in terms of knowledge, resources, and use. As in our previous work, a simultaneous survey of all CSs (an assisted population of 640,000 inhabitants) was performed. In the second phase, prospectively, the quality of spirometries performed at that level of care was analysed.

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Development of the study and selection criteria of the sample

The survey was distributed to all CSs under the direction of PC, and the data were recorded through a questionnaire that included virtually the same variables as in the previous study (Figure 1).

Once the results thereof were known and analysed, the CSs that performed spirometries were again divided into two groups, depending on the number of tests performed per week (group I: five or more spirometries, group II: less than five spirometries). The homogeneity of the population cared for and the proximity to the pulmonary function laboratory of specialized care (SC) were considered in the implementation of the second phase of the study. Finally, 10 CSs (four in group I and six in group II), attending to a population of 144,985 inhabitants (22.6% of the total) were selected.

Between February and June 2015, the PC teams of the assigned CSs were instructed to systematically refer patients according to the inclusion criteria explained in Figure 2. As an improvement over the previous methodology, patients underwent spirometry the same morning at the two levels of care, and the spirometer used in both events was a Datospir 120 (Sibelmed, Barcelona-Spain). The nurses of the pulmonology laboratory completed a second questionnaire with the patient, in which it was ensured that the patient met the inclusion criteria, anthropometric data were obtained, and the educational level, smoking status, and reason for seeking care were collected. The nurses then proceeded to perform the test, strictly following the quality criteria of the ATS/ERS [21] and SEPAR regulations [22]. The patient brought in a sealed envelope, containing the spirometry performed in the CS with all attempts printed so that the SC nurse was unaware of the quality/result of the PC test. Subsequently, all spirometries performed in PC and SC was anonymized for further analysis by two pulmonologists of the functional exploration laboratory. In addition to the acceptability of the spirometries analysed in 2005, on this occasion, the analysis was completed with the study and validation of repeatability, finally classifying the quality into levels A-F, as stated in the regulations [22], taking levels A, B, and C as reasonably acceptable.

1.- Way of spirometry performance:
- Centralized (always the same nurse/nurse team)
- Non centralized (nonspecific nurse to do it)
- No spirometries performance in that centre
- Others:
- Responsible nurse: yes/no
- Alternate nurse: yes/no

2.- Spirometer model:
- Datospir 100
- Datospir 120
- Datospir 120 c
- Others:

3.- Do you know the reference values used by your spirometer?
- Yes/No

4.- Number of spirometries performed per week:
- None
- <5
- 5-10
- 10-20
- >20

5.- Thermometer and barometer available?
- Yes/No

6.- Calibration syringe available?
- Yes/No

7.-Do you calibrate following recommendations?
- Yes/No

8.-Do you calibrate every spirometry session?
- Yes/No

9.- Do you register your calibrations?
- Yes/No

10.-Do you give your patients systematic instructions before the test?
- Yes/No

11.- Have you received supervised training in spirometry?
- Yes/No

12.-Last training course received:
- <3 months
- 3-6 months
- 6 months-1 year
- >1 year

Figure 1: Survey on spirometry conducted in 2015 with all PC teams of Navarre.

Statistical analysis

Sample size calculation: Assuming an expected proportion of PC spirometries of acceptable quality (A, B, or C) of 40%, the sample size necessary to achieve an estimation accuracy ± 10% was at least 91 individuals. This sample size guaranteed a statistical power of 80% for detecting significant differences in the proportion of acceptable qualities between PC and SC of at least 22%, with a confidence level of 95% (calculations were performed using the epiR and clinfun libraries of the R statistical package).

The degree of adjustment to the normality of the sample was ascertained by means of the Kolmogorov-Smirnov test. For the descriptive study, the quantitative data are expressed as means ± SD, the qualitative data as percentages, and their differences through the Wilcoxon test and Student's t-test for related samples. A nonparametric analysis of variance was performed using the Kruskal-Wallis contrast test to verify the equality between distributions; the morphologies of the curves were studied using a contrast of two proportions. The χ^2 test was used for the comparative analysis of the total quality. A p-value of 0.05 was considered to be the limit of significance in all analyses.

Results

All of the CSs (61) completed the survey sent, and the results obtained are shown, compared with those of 2005, in Table 1. Currently, all PC teams provide a spirometer, a slight improvement compared with the previously evaluated situation, and the models used have been updated and homogenized. We also found a significant improvement in terms of the provision of necessary equipment, knowledge of the reference values, and daily calibration and record keeping. A significant improvement in the number of CSs that perform spirometries was also observed, although no changes were seen in the number of spirometries performed per week in the different CSs, which continues to be less than desired. Likewise, there have been no changes during these 10 years in the degree of training of the personnel performing the tests.

In the second phase of the study, with the objective of analysing the quality of the spirometries, 110 patients underwent spirometry in PC and SC, excluding 14 (12.7%) who did not meet the inclusion criteria, with the final sample being 96 patients. Table 2 reflects the characteristics of the study population, highlighting, as a difference with respect to our previous study, a higher level of studies and similarity in weight and size between the two levels of care (average weight: PC 73 and SC 72.9; average size: PC 164 and SC 163.2).

In relation to the determination of FVC and FEV_1, the correlation between PC and SC remains high (r=0.93 and r=0.95, respectively). Table 3 shows the results of the acceptability of the curves and their comparison with those of 2005, demonstrating the absence of improvement in PC during this time. Analysing the overall acceptability (start, slope, and end) of 2015 between PC and SC, a significant difference (p<0.001)

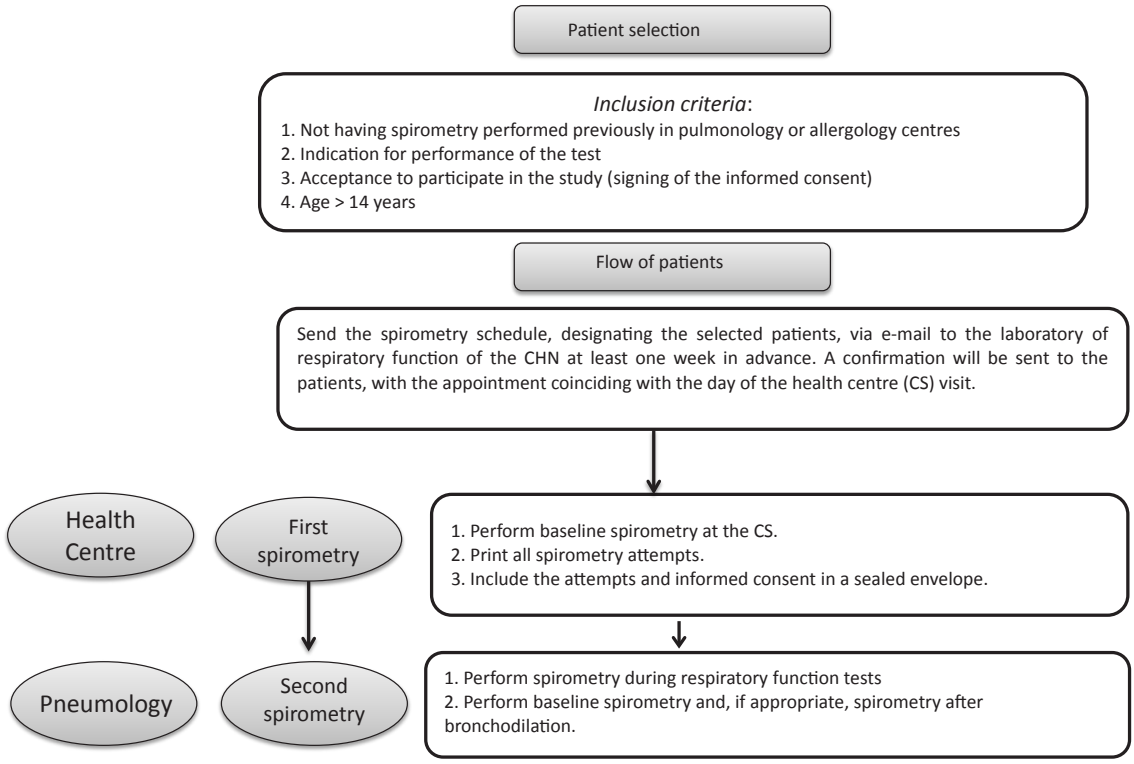

Figure 2: Inclusion criteria and patient referral flow.

Variables	2005	2015	p
	N° (%)	N° (%)	
Number of centres	55	61	
Spirometry availability	50 (90.9)	61 (100)	NS
Model of spirometer (n 2005=50; n 2015=61)			
Datospir 100	36 (72)	15 (24.5)	
Datospir 120	4 (8)	46 (75.4)	
Others	10 (20	0	
Thermometer/barometer (n 2005=50; n 2015=61)	4 (8)	54 (88.5)	<0.0001
Syringe availability (n 2005=50; n 2015=61)	7 (14)	49 (80.3)	<0.0001
Daily calibration (n 2005=50; n 2015=61)	2 (4)	49 (80.3)	<0.0001
Calibration register (n 2005=50; n 2015=61)	0	40 (65.5)	<0.0001
Reference values knowledge (n 2005=50; n 2015=61)	2 (4)	40 (65.5)	<0.001
Spirometry performance (number of centres and %)	34 (61.8)	56 (91.8)	<0.001
Number of spirometries/week (n 2005=50; n 2015=61)			NS
0	11 (22)	5 (8,1)	
0-5	31 (62)	43 (70.4)	
06-10	6 (12)	12 (19.6)	
11-20	2 (4)	1 (1.6)	
>20	0	0	
Previous training course on spirometry	25 (64)*	41 (59.4)*	NS

*number of nurses interviewed (39 in 2005 y 69 in 2015)

Table 1: Results obtained in the 2005 and 2015 surveys.

was evident in favour of the latter (Table 4). The percentages of quality obtained in PC were 21.8% of the tests having a quality of A or B and 18.7% a quality of C (acceptable quality 40.5%) and in SC 72.9% and 11.4%, respectively (acceptable quality 92.7%), p<0.0001. Table 5 shows the acceptability and the quality of the spirometries analysed in relation to the number of tests conducted in the CSs, classified into two groups (more or less than five spirometries/week), with significant differences existing in both. Table 6 shows the correlation of the functional diagnosis between PC and the pulmonology laboratory in the two studies. The percentage of diagnostic errors is now slightly higher than that found previously (43.7% *vs.* 39.7% in 2005). Currently 13.5% of the diagnostic errors correspond to a misclassification of the severity and 29.1% to an absence of diagnostic agreement (diagnostic differences PC–SC/2015: p=0.0001).

Variables	2005	2015	p
Number of patients (%)	171 (100)	96 (100)	
Mean age ± SD	51.75 ± 16.8	58.1 ± 15	NS
Gender (%)			NS
Males	50.8	42.7	
Females	49.1	57.3	
Level of studies (%)	163 (100)	96 (100)	<0.01
Uneducated	7.9	3.1	
Primary studies	55.2	39.5	
Secondary studies	23.9	35.4	
Graduate	12.8	21.8	
Smoking status (%)	166 (100)	96 (100)	NS
Never smoker	30.7	26	
Smoker >40 accumulated packages-year	24	30.2	
Smoker <40 accumulated packages-year	15.6	19.7	
Ex-smoker >6 months >40 accumulated packages-year	14.4	13.5	
Ex-smoker >6 months <40 accumulated packages-year	15	10.4	
Reason for submission (%)	168 (100)	96 (100)	0.05
COPD suspicion	7.7	8.3	
Asthma suspicion	7.7	1	
Dyspnoea	25	18.7	
Others	59.5	71.8	

SD: Standard Deviation; COPD: Chronic Obstructive Pulmonary Disease; NS: No Significative

Table 2: Characteristics of the populations studied in 2005 and 2015.

Discussion

Although for several years, the correct use of spirometry in PC has been considered a priority objective in many health plans, it continues to be an unresolved problem. In Navarre, in 2005, we detected a marked underutilization and improvable quality of the tests, yet there were an adequate number of spirometers in the CSs. The current situation reflects an increase in the CSs that perform spirometries, as well as an improvement in their supply, calibration, records of particular variables, and knowledge of reference values. These data are similar in some respects to those detected in a recent national study [14]. However, we found no significant changes from our previous analysis of the number of explorations per week, which remains low and coincident with that referenced in the 3E study [13].

Of special interest is the analysis of the quality of the curves, and their evolution during this time can be deduced from our findings. Following the methodology employed in our first study, in which only the acceptability was taken into account, it has been noted that no significant changes have been produced in spirometries performed in PC in terms of their start, slope, and end. At present, the number of curves satisfactorily complying with the three criteria is similar to that shown by the control group in the study of Burgos et al. [16] and less than that found in our SC laboratory and that recommended by other authors [23] but slightly improved in those CSs in which a greater number of spirometries is performed, although this number continues to be insufficient. Applying the classification of quality recommended by the consensus of both the ERS/ATS and SEPAR [21,22], only 40.5% attain sufficient quality in PC. Again, in this section, the result improves depending on the number of spirometries performed. The difference observed between the percentages of acceptability and of sufficient quality (A, B, C) could be explained by the fact that, of the 33 cases that were classified as level E, 19 (57.5%) had only one curve for evaluation. The impact derived from these results in terms of diagnostic errors has not improved, although the trend of the false classification of non-obstructive patterns has diminished in favour of other errors or the intensity of the severity.

Variables	Primary Care		P	Pneumology Service		P
	2005	2015		2005	2015	
Acceptability						
Good start	76.6	83.3	NS	91.2	98.9	<0.05
Good slope	77.8	77	NS	88.3	93.7	NS
Good end	84.8	84.3	NS	95.9	95.8	NS

Table 3: Results for the acceptability of the curves in 2005 and 2015.

Acceptability n°curves (%)	Primary Care	Pneumology Service	p
Good start	80 (83.3)	95 (98.9)	<0.001
Good slope	74 (77)	90 (93.7)	<0.001
Good end	81 (84.3)	92 (95.8)	<0.001
Good curve (start+slope+end)	61 (63.5)	85 (88.5)	<0.001

Table 4: Acceptability of the PC and Pneumology Service curves in 2015.

	Group 1* (n=58)	Group 2** (n=38)	p
A, B o C (%) quality	28	11	0.05
Acceptability	43	18	0.007

*Frequency >5 spirometries/week; ** ≤ 5 spirometries/week; ERS 2005/SEPAR 2013 criteria

Table 5: Comparison of the PC spirometry quality according to the number of tests conducted in the CSs (2015).

During these years, the actions taken under the direction of PC planners have focused on improving the supply of CSs, which, as noted, have served their purpose, and the theoretical and practical training of health personnel. During the years 2005-2008, workshops were conducted for the responsible and alternate physicians and nurses in all CSs. In 2009, the management itself evaluated certain aspects consequential to the improvement programme. Using a survey, they ascertained that 65% of the responsible nurses and 45% of the alternates had received the training programme. The management considered the centralization of the test in a responsible nurse or his/her alternate, daily calibration, and recording keeping as the main criteria of quality. The results obtained showed the existence of lines of improvement (PC internal document, unpublished data). The quality of the tests was not evaluated. Undoubtedly, all efforts to improve the training of the staff involved are laudable, but in our area, it does not seem to have yielded a final improvement of the level of training, as the percentage of people trained continued to be stable. An explanation of this fact, as we noted in our first study, may be related to the system of recruitment and the possibility of mobility in the workplace of the nursing personnel, making it difficult to get properly trained technicians who have continuity in the workplace [10]. As early as 1999, Eaton et al. [24] ascertained that a timely intervention with a spirometry-training workshop did not guarantee the quality of the procedure. Recently, several authors have evaluated the effectiveness, in the short and long term, of tutored spirometry training for PC professionals, ascertaining the need for periodic training and a smooth coordination between PC and SC to maintain an adequate level of education [17,19,23].

Moreover, various task forces have been implementing, through the development of new technologies, telemonitoring systems that have been shown to improve the quality of spirometry and the appropriateness of its use in PC. Some of them are noted for facilitating, in addition to training, continuous feedback between professionals, which favours the maintenance of the quality achieved [15,16,18,25-27].

Pneumology Service diagnosis	Total		Primary Care Diagnosis																											
	2005	2015	N		MiO		MO		MSO		SO		MiNO		MNO		MSNO		SNO		M		MIM		MM		MSM		SM	
N (Normal)	69	42	54	34	5	5							10	1			1						1							
MiO (Mild obstruction)	71	24	20	8	26	13	6	3			1		16								2									
MO (Moderate obstruction)	17	7		1	2	1	11	1		1	1		2	1							1		1		1					
MSO (Moderately severe obstruction)		1														1														
SO (Severe obstruction)	2	4					1			1	1	2																1		
MiNO (Mild non obstructive pattern)	12	6	1										11	2		1		1		1								1		
MNO (Moderate non obstructive pattern)		1														1														
MSNO (Moderately severe non obstructive pattern)		1														1														
SNO (Severe non obstructive pattern)																														
M (Mixed pattern)																														
MiM (Mild mixed pattern)		3		1		1											1													
MM (Moderate mixed pattern)																														
MSM (Moderately Severe mixed pattern)		4						1								1							1				1			
SM (Severe mixed pattern)		3								1		1															1			
TOTAL	171	96	75	44	33	20	18	5	0	3	3	3	39	4	0	5	0	3	0	1	3	0	0	3	0	1	0	4	0	0

Table 6: Agreement between PC and Pneumology Service with respect to spirometric functional diagnosis (2005 vs. 2015).

The lack of quality of the spirometries and the presence of inadequate classification lead to an erroneous clinical diagnosis of the patients with respiratory pathology and thus affects their health and healthcare spending [6,28,29]. Undoubtedly, telemedicine programmes have associated investments in health resources that, although in the short term possibly incur increased costs, have proven to be cost-effective in view of the results obtained [30].

Our study has limitations, such as the fact that all the selected CSs are urban, and it is reasonable to think that this bias would lead, in any case, to obtaining a better level of quality than that observed in the overall population. As a consideration, the added advantage of being able to perform both tests the same morning was achieved, which minimizes the expected variability between them. The observers were two expert pulmonologists; however, the analyses were not conducted independently, which could pose another constraint.

Recently, in our country, the Ministry of Health, within the framework of the strategy for COPD, has awarded the recognition of good clinical practice to three projects focusing on the improvement and dissemination of spirometry in PC. One of them, the Galician Health Service, promotes short and long-term tutored training of the professionals involved; the other two, the Vasco and La Rioja Health Services, use telemedicine tools for this purpose [31].

Conclusions

Spirometry in PC continues to be an unresolved problem in our area; furthermore, as we have observed, exclusively training and non-continuing programmes offer insufficient results. Given the magnitude of the problem and knowledge of the existence of projects that have demonstrated their effectiveness, we believe there should be no further delay in implementing any of these strategies adapted to each area. This same consideration can be extended to other communities with a similar situation.

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Specific Contribution of Each of the Authors

Dr. Pilar Cebollero and Javier Hueto participated in the study design, supervision of data collection, analysis of results, and drafting of the manuscript; Dr. María Carmen Bermejo, Jorge Zagaceta, Francisco Campano, and Izaskun Jiménez participated in the data collection and revision of the manuscript; Dr. José Antonio Cascante participated in the analysis of results and drafting of the manuscript.

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