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 those 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; Telepirometry; 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.
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.

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 χ² 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 FEV₁, 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)
Inclusion criteria:
1. Not having spirometry performed previously in pulmonology or allergology centres
2. Indication for performance of the test
3. Acceptance to participate in the study (signing of the informed consent)
4. Age > 14 years

Flow of patients:
Send the spirometry schedule, designating the selected patients, via e-mail to the laboratory of respiratory function of the CHN at least one week in advance. A confirmation will be sent to the patients, with the appointment coinciding with the day of the health centre (CS) visit.

1. Perform baseline spirometry at the CS.
2. Print all spirometry attempts.
3. Include the attempts and informed consent in a sealed envelope.

1. Perform spirometry during respiratory function tests
2. Perform baseline spirometry and, if appropriate, spirometry after bronchodilation.

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).
The impact derived from these results in terms of diagnostic errors observed between the percentages of acceptability and of sufficient attain sufficient quality in PC. Again, in this section, the result improves by the consensus of both the ERS/ATS and SEPAR [21,22], only 40.5% to be insufficient. Applying the classification of quality recommended that shown by the control group in the study of Burgos et al. [16] and of curves satisfactorily complying with the three criteria is similar to in PC in terms of their start, slope, and end. At present, 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.

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

| Pneumology Service diagnosis | Total | 2005 | 2015 | N | M | MiO | MO | MSO | SO | MiNO | MNO | MSNO | SNO | M | MIM | MM | MSM | SM |
|-----------------------------|-------|------|------|---|---|-----|----|-----|----|------|-----|------|----|---|----|----|-----|-----|
| N (Normal)                  | 69    | 24   | 34   | 5 | 5 | 3   | 1  | 1   | 1  | 1    | 1   | 1    |    |    |    |    |     |     |
| MIO (Mild obstruction)      | 71    | 20   | 18   | 8 | 1 | 5   | 1  | 1   | 2  | 1    | 1   | 1    |    |    |    |    |     |     |
| MSO (Moderately severe obstruction) | 17 | 7    | 10   | 2 | 1 | 2   | 1  | 1   | 1  | 1    | 1   | 1    |    |    |    |    |     |     |
| SO (Severe obstruction)     | 2     | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| MNO (Mild non obstructive pattern) | 12 | 6    | 6    | 1 | 1 | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| MNSO (Moderately severe non obstructive pattern) | 1 | 1    | 1    |   |   | 1   |    | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| SNO (Severe non obstructive pattern) | 1 | 1    | 1    |   |   | 1   |    | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| M (Mixed pattern)           | 3     | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| MM (Mild mixed pattern)     | 3     | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| MM (Moderate mixed pattern) | 4     | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| MSM (Moderately severe mixed pattern) | 4 | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| SM (Severe mixed pattern)   | 3     | 1    | 1    |   |   | 1   | 1  | 1   | 1  | 1    |    | 1    |    |    |    |    |     |     |
| TOTAL                       | 171   | 98   | 75   | 44 |33 |20   |18 |5   |5  |3     |3   |39   |4  |0 |5  |0 |3  |0 |


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