



Impact of a supervised training course on spirometry competency for primary care pediatricians

Giuliana Ferrante, Amelia Licari, Giovanna Cilluffo, Enrico Lombardi, Attilio Turchetta, Massimo Pifferi, Giancarlo Tancredi & Stefania La Grutta on behalf of the Italian Pediatric Respiratory Society (IPRS)

To cite this article: Giuliana Ferrante, Amelia Licari, Giovanna Cilluffo, Enrico Lombardi, Attilio Turchetta, Massimo Pifferi, Giancarlo Tancredi & Stefania La Grutta on behalf of the Italian Pediatric Respiratory Society (IPRS) (2021) Impact of a supervised training course on spirometry competency for primary care pediatricians, Journal of Asthma, 58:10, 1292-1297, DOI: [10.1080/02770903.2020.1781888](https://doi.org/10.1080/02770903.2020.1781888)

To link to this article: <https://doi.org/10.1080/02770903.2020.1781888>



Published online: 26 Jun 2020.



Submit your article to this journal [↗](#)



Article views: 54



View related articles [↗](#)



View Crossmark data [↗](#)

DIAGNOSIS



Impact of a supervised training course on spirometry competency for primary care pediatricians

Giuliana Ferrante, PhD^{a*} , Amelia Licari, MD^{b*} , Giovanna Cilluffo, PhD^c , Enrico Lombardi, MD^d ,
Attilio Turchetta, MD^e , Massimo Pifferi, MD, PhD^f , Giancarlo Tancredi, MD^{g†} , and
Stefania La Grutta, MD, PhD^{c†} ; on behalf of the Italian Pediatric Respiratory Society (IPRS)

^aDepartment of Health Promotion, Mother and Child Care, Internal Medicine and Medical Specialties, University of Palermo, Palermo, Italy; ^bDepartment of Pediatrics, Foundation IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; ^cInstitute for Biomedical Research and Innovation (IRIB), National Research Council of Italy, Palermo, Italy; ^dPediatric Pulmonary Unit, “Anna Meyer” Pediatric University-Hospital, Florence, Italy; ^eSport Medicine Unit, Bambino Gesù Children’s Hospital, Rome, Italy; ^fSection of Pneumology and Allergology, Unit of Pediatrics, Pisa University Hospital, Pisa, Italy; ^gDepartment of Pediatrics, Sapienza University, Rome, Italy

ABSTRACT

Objective: Spirometry is the most commonly performed lung function test, and performance, adherence to acceptability and repeatability criteria, and accurate interpretation of results help optimize the test’s usefulness. This study aimed to measure the effects of spirometry training courses supported by the Italian Pediatric Respiratory Society (IPRS) on primary care pediatricians’ (PCP) knowledge of spirometry test quality, ability to interpret results, and overall degree of satisfaction with the course.

Methods: Of the six face-to-face courses, four lasted two days and two lasted one day: mean duration of theoretical lessons was five and four hours respectively; and practical sessions lasted eight and six hours, respectively. At the end of each course, participants took a learning test consisting of evaluating six flow-volume curves. Degree of satisfaction was assessed by asking participants to rank the relevance, quality, and usefulness of the course.

Results: 261 PCPs were involved, with most (67.43%) taking two-day courses. Nearly all participants correctly identified normal and restrictive patterns. Intrathoracic large-airway obstruction was the pattern most difficult to identify correctly (70.5% overall), whereas > 80% of the participants correctly classified artifacts, obstructive-restrictive, and obstructive patterns. Participants in longer courses reported significantly higher values on the learning score. The overall degree of satisfaction average ranged between “good” and “excellent”.

Conclusions: This pilot study showed the greater impact of two-day courses than one-day courses for training PCPs to properly interpret spirometry, confirming that a practical module lasting at least six hours is sufficient to deliver adequate training on spirometry for healthcare professionals.

ARTICLE HISTORY

Received 3 January 2020
Revised 20 May 2020
Accepted 8 June 2020

KEYWORDS

Spirometry; spirometry training; disease management; primary care; pediatricians; children; knowledge; practice

Introduction

Spirometry is the most commonly performed lung function test and is widely recognized as a valuable tool for diagnosing and monitoring a variety of pediatric respiratory diseases (1). Spirometry is often regarded as simple and noninvasive, but to optimize results, careful attention to test performance, adherence to standards and repeatability criteria, and accurate, well-informed interpretation of the results are needed. To address this need, quality standards for spirometry, published by the American Thoracic

Society/European Respiratory Society (ATS/ERS) (2,3), are accepted internationally and have been recently updated (4). Knowledge of these standards and the competency of healthcare professionals performing the test, plus their ability to interpret the results are essential skills for obtaining useful clinical information from spirometry (4). If performed or interpreted incorrectly, the test can lead to misdiagnosis, delay in treatment, and/or unnecessary treatment being administered (5).

Healthcare professionals should be adequately trained to perform and interpret spirometry according

CONTACT Giovanna Cilluffo  giovanna.cilluffo@irib.cnr.it  Institute for Biomedical Research and Innovation (IRIB), National Research Council (CNR), Via Ugo La Malfa, 153, Palermo 90146, Italy.

*Equally contributing co-first authors.

†Equally supervising this work.

© 2020 Taylor & Francis Group, LLC

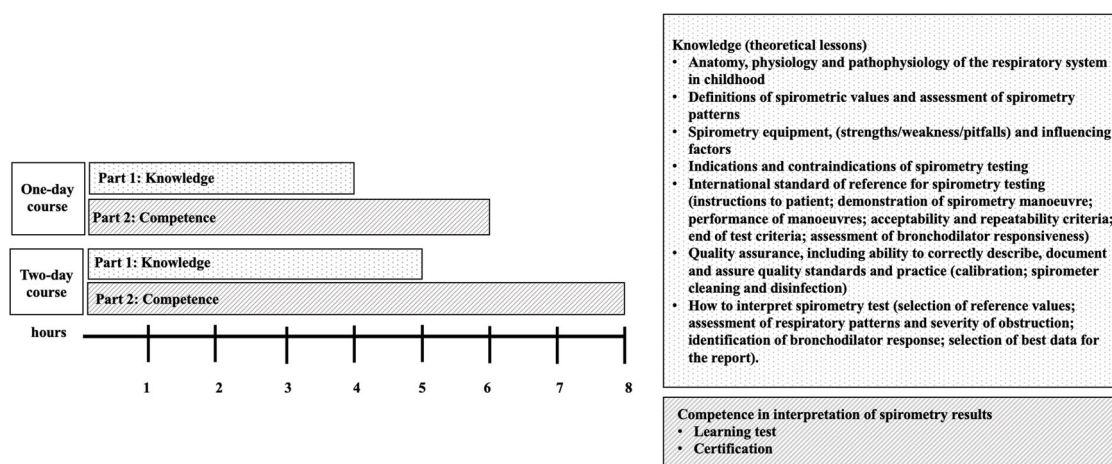


Figure 1. Program for spirometry training courses.

to international best practice. Effective spirometry training courses must follow the latest international ATS/ERS standards for spirometry testing and interpretation (2–4), and should include minimum core components (purpose of spirometry, test performance requirements, reference values, interpretation, quality control) (6). Training courses for conducting quality spirometry testing are available in many countries, but training methods may vary, and the quality of training may be not easily determined (7). Furthermore, it should be emphasized that spirometry certification is not mandatory for healthcare professionals who manage pediatric respiratory diseases in Italy.

Recently, the Italian Pediatric Respiratory Society (IPRS) has been promoting and supporting spirometry training courses dedicated to primary care pediatricians (PCPs), only 30–50% of whom use spirometry measurements for the diagnosis and treatment of asthma (8). These courses were designed to certify the competency to perform and interpret this test in preschoolers (3–5 years of age) and school-age children (age ≥ 6 years), and ultimately, to raise the quality of care provided to pediatric patients with respiratory diseases. The aim of this pilot study was to measure the effects of these training courses on PCPs by evaluating their knowledge of spirometry test quality, their ability to interpret the results, and the overall degree of satisfaction with the courses.

Materials and methods

Case study

Six face-to-face spirometry training courses across Italy were aimed at PCPs to provide a comprehensive understanding of respiratory pathophysiology and the basic skills to interpret spirometry results in pediatric

clinical practice. The courses were coordinated by a team of qualified physicians (tutors) with at least 10 years of experience in the theoretical and practical aspects of spirometry measurement and interpretation in children. Of the six courses, four lasted two days (mean duration of theoretical lessons: 5 h; mean duration of practical sessions: 8 h), and two lasted one day (mean duration of theoretical lessons: 4 h; mean duration of practical sessions: 6 h) (Figure 1). During the practical sessions, participants were placed in small groups coordinated by tutors (ratio of participants to tutor 5:1) with practical demonstrations and discussion of clinical cases.

At the end of each course, participants underwent a learning test consisting of evaluating six flow-volume curves illustrating different respiratory patterns (normal, obstructive, restrictive, intrathoracic large-airway obstruction, obstructive-restrictive, artifact). The learning score ranged from 0 (all answers wrong) to 6 (all answers right). In addition, the degree of satisfaction was assessed by asking participants to rank the relevance, quality, and usefulness of the training course, using a scale from 1 (insufficient) to 5 (excellent).

Statistical analysis

Data were presented as n (%) or as mean $\pm$ SD. Differences of categorical variables were analyzed using the Chi-squared test. To avoid distributional assumptions, when comparing quantitative variables, a nonparametric Wilcoxon test (also called Mann-Whitney test) was applied to investigate whether two independent samples were selected from populations having the same distribution. The total number of correct answers was tallied to yield a spirometry test learning score, as previously detailed.

Table 1. Demographics and number of right answers to the learning test.

	ALL <i>n</i> = 261	One-day courses <i>n</i> = 85	Two-day courses <i>n</i> = 176	<i>p</i> -value
Gender: Male, <i>n</i> (%)	56 (21.71)	16 (19.28)	40 (22.86)	0.624
Age, years, mean $\pm$ SD	41.47 $\pm$ 10.69	42.68 $\pm$ 10.59	40.87 $\pm$ 10.72	0.213
Normal pattern, <i>n</i> (%)	260 (99.62)	85 (100.00)	175 (99.43)	1.000
Obstructive pattern, <i>n</i> (%)	249 (95.40)	78 (91.76)	171 (97.16)	0.102
Restrictive pattern, <i>n</i> (%)	260 (99.62)	85 (100.00)	175 (99.43)	1.000
Intrathoracic obstruction pattern, <i>n</i> (%)	184 (70.50)	63 (74.12)	121 (68.75)	0.456
Obstructive-Restrictive pattern, <i>n</i> (%)	222 (85.06)	70 (82.35)	152 (86.36)	0.505
Artifacts, <i>n</i> (%)	212 (81.23)	48 (56.47)	164 (93.18)	<0.001

Data are presented as *n* (%) or as mean $\pm$ SD. *p* values come from Chi-squared test or Wilcoxon-test.

Analyses were performed using R 3.5.2 software. A *p* values <0.05 was considered statistically significant.

Results

Two hundred sixty-one PCPs participated in the six spirometry training courses. This group consisted of 56 males (21.56%); mean age $\pm$ SD was 41.47 $\pm$ 10.69 years. Most participants (*n* = 176, 67.43%) took part in two-day courses.

Learning test

Table 1 shows the percentage of right answers in the learning test, depending on the length of the course. Nearly all participants correctly identified the normal and restrictive spirometry patterns (99.62% for each). Intrathoracic large-airway obstruction was the pattern most difficult to identify correctly (70.50% overall), whereas more than 80% of the participants correctly classified artifacts, obstructive-restrictive, and obstructive patterns. Artifacts were correctly identified significantly more frequently by participants in two-day training courses versus those who took part in one-day training courses (*p* < 0.001).

Overall, participants in longer training courses reported significantly higher values on the learning score than participants in one-day courses (two-day courses: 5.44 $\pm$ 0.78 vs. one-day courses 5.05 $\pm$ 0.72, *p* < 0.001). In one-day training courses, however, younger participants ($\leq$ 41 years) reported higher learning scores than older participants (>41 years), showing a borderline significance level (*p* = 0.052). No age differences were found in two-day training courses (Figure 2). Also, in one-day courses, the Spearman correlation between learning score and age of participants was negative and statistically significant (ρ = -0.31, *p* = 0.004), whereas no correlation was found in the two-day training courses (data not shown).

Degree of satisfaction

All participants were highly satisfied with the relevance, quality, and usefulness of the training courses. The evaluation average ranged from 4.63 to 4.69 (between good and excellent), and there were no differences between participants in one-day and two-day training courses (Table 2).

Discussion

This pilot study evaluated the effectiveness of spirometry training courses dedicated to helping PCPs in Italy improve their ability to interpret spirometry tests in a clinical setting. The current study describes the evaluation of an interactive approach with face-to-face courses, including theoretical lessons and practical sessions, which have been similarly implemented for clinical staff working in primary care (9,10). The most common training method in this field consists of theoretical-practical courses, however, published data on the impact of these training programs on knowledge and satisfaction of PCPs are lacking.

Regarding the ability to interpret spirometry results, most of the participants correctly identified the normal and restrictive spirometry patterns. Intrathoracic obstruction was the pattern most difficult to identify correctly, whereas obstructive and obstructive-restrictive patterns were correctly classified by more than 80% of the participants. Artifacts were much more frequently identified by participants in the two-day training courses than by those who took part in one-day courses.

The right interpretation of spirometry results requires high competency in order to identify patterns of normality and abnormality. Previous studies reported limited confidence of general practitioners in interpreting spirometry results (11–13). Similarly, PCPs generally report that they are not comfortable making these interpretations. Indeed, lack of training is one of the most frequently cited concerns for limiting implementation of this diagnostic test in primary care (14). Consequently, we believe that training

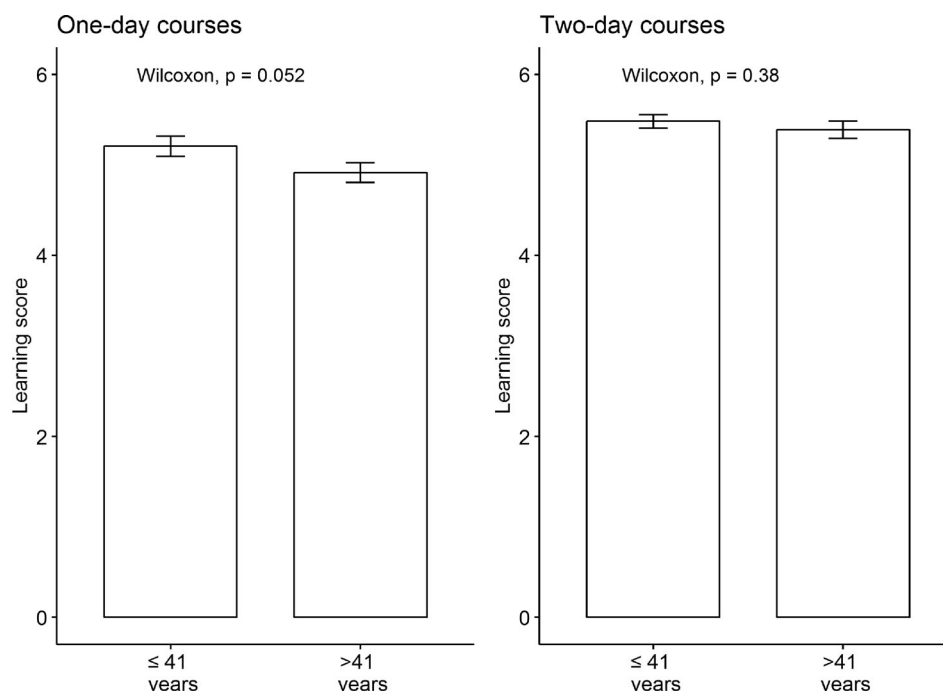


Figure 2. Error chart of learning score given age class in One-day and in Two-day courses.

Table 2. Degree of satisfaction of the participants given the length of spirometry training courses.

	ALL n = 249	One-day courses n = 81	Two-day courses n = 168	p-value
Relevance	4.69 ± 0.50	4.65 ± 0.57	4.71 ± 0.47	0.430
Quality	4.63 ± 0.54	4.57 ± 0.59	4.66 ± 0.51	0.204
Usefulness	4.68 ± 0.53	4.64 ± 0.60	4.70 ± 0.50	0.451

Data are presented as mean ± SD. *p* values come from Chi-squared test or Wilcoxon-test.

opportunities may need promotion, especially among PCPs, to encourage more widespread use of spirometry and subsequent proper interpretation of results. This training would enhance the quality of the diagnosis of obstructive diseases, such as asthma in children, which would reduce the number of inappropriate referrals to specialized care (10). This is especially relevant in Italy, where the National Health Service is planning to provide a pediatrician for every 800 children, meaning that pediatricians who followed IPRS courses would take care of almost 200 000 patients overall.

Participants in longer courses reported a significantly higher value of the learning score than those who participated in one-day courses, suggesting that longer training might prompt better results in spirometry knowledge and interpretation. This finding correlates somewhat with previous studies with family physicians (15,16), nurses and physiotherapists (7), PCPs and pediatric pulmonologists (17), in which heterogeneous results were reported based on length of

different training programs. Some studies showed the length of training as possibly contributing to achieving valid spirometry performance and interpretation in clinical settings, but other results were less clear.

According to international standards, spirometry training courses should be designed as a fully attended course lasting a minimum of 10 h with at least six hours of practical training (6). In our study, the longer duration of the practical session in two-day training courses, namely eight hours, may have enabled PCPs to acquire higher competency and confidence in interpreting flow-volume curves and results. As for age, participants of one-day training courses > age 41 reported lower learning scores than those of the younger participants, which approached borderline significance level, whereas the learning score of participants of two-day training courses did not differ by age.

We reported a completion rate in all courses of 100%, indicating a satisfactory reliability and validity in delivering these trainings. A positive satisfaction score was reported at the end of the courses and there were no recommendations for changes to the training program of IPRS courses. However, an additional evaluation of faculty satisfaction should be included in the next training courses to identify further learning needs and put into practice the valuable feedback obtained after training completion.

Spirometry training programs should do more than enable technically well-performed procedures. It

should also support participants in making clinical decisions in real practice (10). It is worth noting that learning skills of participants in an educational training program are influenced by an individual's pre-training knowledge and competency, which were not assessed in the current study. Healthcare professionals who are tasked with performing spirometry in their clinical practice may have general knowledge about spirometry, even if they have not been trained on test performance. As a result, we cannot exclude the possibility that previous training and experience influenced the results of the current study. Additionally, the frequency of spirometry testing in routine clinical practice of every participant in the training courses may have affected our findings. Another limitation of the current study is the lack of a long-term assessment in the months following completion of the training courses, which might have provided insight into the ongoing proficiency of some learning tasks. These might include calibration of the spirometer, test performance, use of reference values, and interpretation of spirometry results. Quality of spirometry knowledge has been shown to decline with time after completion of the training program (10), and as studies on this subject are scant, a refresher course 12 months after the initial training course, and every three years thereafter, is suggested to maintain the acquired skills (6). As such, continuous assessment of skills after adequate training is essential, given the evidence that the quality of spirometry improves when monitoring sessions and individual feedback continue over time (18).

The implementation of spirometry training courses for PCPs has been promoted by IPRS to harmonize the standard of education and training, while also guaranteeing a high quality of care in line with the international standards. This training could enable PCPs to empower their knowledge on spirometry, while also taking part in multidisciplinary working teams, acting as a link between primary care and specialized pulmonology centers of care. The European programs for education and training of pediatric respiratory medicine require extensive knowledge and skills in conducting respiratory function testing in children (19). For this reason, we believe that receiving such education programs could provide PCPs with an excellent opportunity to improve their knowledge and practice of spirometry in clinical settings. It is noteworthy that following successful completion of each course, all participants acquired the official spirometry executor certification, which currently is not mandatory in Italy, unlike other European countries.

Conclusion

This pilot study showed the greater relevance of two-day training courses as compared to one-day courses for training primary care pediatricians to properly interpret spirometry tests, confirming that a practical module lasting at least six hours may be sufficient to deliver adequate training for healthcare professionals. Our findings highlight the need for this type of structured spirometry training and widespread delivery of effective spirometry training courses based on the current international standards for pediatric primary care professionals.

Declaration of interest

The authors declare that they have not conflict of interest.

ORCID

Giuliana Ferrante  <http://orcid.org/0000-0001-9917-2387>
 Amelia Licari  <http://orcid.org/0000-0002-1773-6482>
 Giovanna Cilluffo  <http://orcid.org/0000-0003-4305-3981>
 Enrico Lombardi  <http://orcid.org/0000-0003-4749-9091>
 Attilio Turchetta  <http://orcid.org/0000-0001-6105-1950>
 Massimo Pifferi  <http://orcid.org/0000-0002-8266-1923>
 Giancarlo Tancredi  <http://orcid.org/0000-0002-7603-5408>
 Stefania La Grutta  <http://orcid.org/0000-0001-8026-0715>

References

1. Fasola S, La Grutta S, Cibella F, Cilluffo G, Viegi G. Global Lung Function Initiative 2012 reference values for spirometry in South Italian children. *Respir Med* 2017; 131:11–7. doi:10.1016/j.rmed.2017.07.061.
2. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, Crapo R, Enright P, Van Der Grinten C, Gustafsson P, ATS/ERS Task Force, et al. Standardisation of spirometry. *Eur Respir J* 2005; 26(2):319–38. doi:10.1183/09031936.05.00034805.
3. Beydon N, Davis SD, Lombardi E, Allen JL, Arets HG, Aurora P, Bisgaard H, Davis GM, Ducharme FM, Eigen H, American Thoracic Society/European Respiratory Society Working Group on Infant and Young Children Pulmonary Function Testing, et al. An official American Thoracic Society/European Respiratory Society statement: pulmonary function testing in preschool children. *Am J Respir Crit Care Med* 2007;175(12):1304–45. doi:10.1164/rccm.200605-642ST.
4. Graham BL, Steenbruggen I, Miller MR, Barjaktarevic IZ, Cooper BG, Hall GL, Hallstrand TS, Kaminsky DA, McCarthy K, McCormack MC, et al. Standardization of spirometry 2019 update. An official American Thoracic Society and European Respiratory Society technical statement. *Am J Respir Crit Care*

- Med 2019;200(8):e70–e88. doi:[10.1164/rccm.201908-1590ST](https://doi.org/10.1164/rccm.201908-1590ST).
5. Nair SJ, Daigle KL, DeCuir P, Lapin CD, Schramm CM. The influence of pulmonary function testing on the management of asthma in children. *J Pediatr* 2005;147(6):797–801. doi:[10.1016/j.jpeds.2005.07.023](https://doi.org/10.1016/j.jpeds.2005.07.023).
 6. Swanney MP, O'Dea CA, Ingram ER, Rodwell LT, Borg BM, ANZSRS Spirometry Training Course Working Group. Spirometry training courses: Content, delivery and assessment - a position statement from the Australian and New Zealand Society of Respiratory Science. *Respirology* 2017;22(7):1430–5. doi:[10.1111/resp.13133](https://doi.org/10.1111/resp.13133).
 7. Borg BM, Hartley MF, Fisher MT, Thompson BR. Spirometry training does not guarantee valid results. *Respiratory Care* 2010; 55:689–94.
 8. García-Marcos L, Castro-Rodríguez JA, Montaner AE, Garde JG, Bernabé JJM, Belinchón JP, Group S, Spanish Pediatric Asthma Study Group. The use of spirometers and peak flow meters in the diagnosis and management of asthma among Spanish pediatricians. Results from the TRAP study. *Pediatr Allergy Immunol* 2004;15(4):365–71. doi:[10.1111/j.1399-3038.2004.00154.x](https://doi.org/10.1111/j.1399-3038.2004.00154.x).
 9. Parsons R, Schembri D, Hancock K, Lonergan A, Barton C, Schermer T, Crockett A, Frith P, Effing T. Effects of the spirometry learning module on the knowledge, confidence, and experience of spirometry operators. *Npj Prim Care Respir Med* 2019; 29(1):8. doi:[10.1038/s41533-019-0143-9](https://doi.org/10.1038/s41533-019-0143-9).
 10. Represas-Represas C, Botana-Rial M, Leiro-Fernández V, González-Silva AI, García-Martínez A, Fernández-Villar A. Short-and long-term effectiveness of a supervised training program in spirometry use for primary care professionals. *Archivos de Bronconeumología (English Edition)* 2013;49(9):378–82. doi:[10.1016/j.arbr.2013.07.005](https://doi.org/10.1016/j.arbr.2013.07.005).
 11. Kaminsky DA, Marcy TW, Bachand M, Irvin CG. Knowledge and use of office spirometry for the detection of chronic obstructive pulmonary disease by primary care physicians. *Respir Care* 2005;50(12):1639–48.
 12. Bolton C, Ionescu A, Edwards P, Faulkner T, Edwards S, Shale D. Attaining a correct diagnosis of COPD in general practice. *Respir Med* 2005;99(4):493–500. doi:[10.1016/j.rmed.2004.09.015](https://doi.org/10.1016/j.rmed.2004.09.015).
 13. Poels PJP, Schermer TRJ, Thoonen BPA, Jacobs JE, Akkermans RP, de Vries Robbé PF, Quanjer PH, Bottema BJAM, van Weel C. Spirometry expert support in family practice: a cluster-randomised trial. *Prim Care Respir J* 2009;18(3):189–97. doi:[10.4104/pcrj.2009.00047](https://doi.org/10.4104/pcrj.2009.00047).
 14. Dombkowski KJ, Hassan F, Wasilevich EA, Clark SJ. Spirometry use among pediatric primary care physicians. *Pediatrics* 2010;126(4):682–7. doi:[10.1542/peds.2010-0362](https://doi.org/10.1542/peds.2010-0362).
 15. Eaton T, Withy S, Garrett JE, Whitlock RM, Rea HH, Mercer J. Spirometry in primary care practice: the importance of quality assurance and the impact of spirometry workshops. *Chest* 1999;116(2):416–23. doi:[10.1378/chest.116.2.416](https://doi.org/10.1378/chest.116.2.416).
 16. Yawn BP, Enright PL, Lemanske RF, Jr Israel E, Pace W, Wollan P, Boushey H. Spirometry can be done in family physicians' offices and alters clinical decisions in management of asthma and COPD. *Chest* 2007; 132(4):1162–8. doi:[10.1378/chest.06-2722](https://doi.org/10.1378/chest.06-2722).
 17. Zanconato S, Meneghelli G, Braga R, Zacchello F, Baraldi E, others. Office spirometry in primary care pediatrics: a pilot study. *Pediatrics* 2005;116(6):e792–e797. doi:[10.1542/peds.2005-0487](https://doi.org/10.1542/peds.2005-0487).
 18. Enright PL, Connett JE, Kanner RE, Johnson LR, Lee WW. Spirometry in the Lung Health Study: II. Determinants of short-term intraindividual variability. *Am J Respir Crit Care Med* 1995;151(2):406–11. doi:[10.1164/ajrccm.151.2.7842199](https://doi.org/10.1164/ajrccm.151.2.7842199).
 19. Gappa M, Paton J, Baraldi E, Bush A, Carlsen K-H, de Jongste JC, Eber E, Fauroux B, McKenzie S, Noël J-L, et al. Paediatric HERMES: update of the European Training Syllabus for Paediatric Respiratory Medicine. *Eur Respir J* 2009;33(3):464–5. doi:[10.1183/09031936.00001209](https://doi.org/10.1183/09031936.00001209).