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Pilot program on distance training in spirometry testing — the technology feasibility study

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Abstract

Introduction: Office spirometry has been widely used in recent years by general practitioners in primary care setting, thus the need for stricter monitoring of the quality of spirometry has been recognized.

Material and methods: A spirometry counseling network of outpatients clinics was created in Poland using portable spirometer Spirotel. The spirometry data were transferred to counseling centre once a week. The tests sent to the counseling centre were analyzed by doctors experienced in the analysis of spirometric data. In justified cases they sent their remarks concerning performed tests to the centres *via* e-mail.

Results: We received 878 records of spirometry tests in total. Data transmission *via* the telephone was 100% effective. The quality of spirometry tests performed by outpatients clinics was variable.

Conclusions: The use of spirometers with data transfer for training purposes seems to be advisable. There is a need to proper face-to-face training of spirometry operators before an implementation of any telemedicine technology

Key words: telespirometry, spirometry training, COPD

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Introduction

Contemporary medicine, which relies on facts, requires reliable and trustworthy results of diagnostic tests. This is also the case in contemporary pneumonology. Examination and evaluation of pathophysiology of the respiratory system are part of a good medical practice contributing to diagnosis of a disease, determination of its progress and monitoring of treatment results. A typical example of examination that is elementary for proper diagnosis of lung diseases is spirometry.

Office spirometry has been widely used in recent years by general practitioners in primary care setting, thus the need for stricter monitoring of the quality of spirometry has been recognised. Both international [1] and national [2] recommendations treat spirometry as the elementary additional examination in contemporary pneumonology.

Easy access to relatively inexpensive spirometers has allowed to perform spirometry in the offices of general practitioners [3, 4] but the quality of spirometry tests is very often questioned. Observations made by Enright et al. [5] showed that the most important goal when performing and interpreting office spirometry tests is to minimise misinterpretation rates due to bad quality of tests and lack of proper trainings.

Different approaches for the spirometry training of general practitionaires were proposed. One of them was the use of telemetric distance expert counseling. Such centralized expert

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advice may help to minimize false positive and false negative interpretations in specific general practitioner setting. Second approach was to use more traditional face-to-face spirometry trainings for new spirometry centres.

Yet rapid and easy communication between two or more centres in telemetric distance training may be problematic. Traditional way of communication is either too slow (regular post) or inappropriate for transmission of graphic data (telephone). Therefore it is crucial to choose a proper and relatively inexpensive technology that would enable to monitor effectively spirometric tests performed by technicians/doctors in primary care setting, and which simultaneously could serve as a convenient educational tool.

The objective of the present study was to evaluate the usefulness of spirometric data transmission with the help of analogue phone lines for remote monitoring of spirometry quality. This was a pilot technology feasibility study planned as an introduction before the proposed distance spirometric training courses.

Material and methods

The study was performed in 2007–2008 years in Department of Diagnosis and Treatment of Respiratory Failure, Institute of Tuberculosis and Lung Diseases, Warsaw, Poland. After having analysed available equipment in 2007 year, a portable spirometer Spirotel manufactured by MIR (Italy) was chosen. The device has a built-in system allowing to transfer the spirometric data via an analogue modem. It is done by bringing closer the device to a telephone receiver, to which, after getting a connection, sounds produced by a spirometer are coming. The whole procedure is relatively simple and lasts usually few minutes. Unfortunately, at first, a Spirotel was designed for monitoring the respiratory system functions by the patient at home. It was to serve as a tool for measurements performed by the patient (similarly to a traditional peak flow meter), and data transmission was to help in monitoring the patients with asthma and COPD. However, such a sophisticated construction of the device turned out to be too difficult to be used by many patients. It was related to incompatibility of software with database of the device. Luckily, the MIR company agreed to adjust the software that operated the device for the needs of the present study. It resulted in a new version of the device, a Spirotel plus.

After the device for performing spirometry was chosen, a small network of quality control of spirometric tests was created. The centre of the network was located at the Department of Diagnosis and Treatment of Respiratory Failure in Warsaw. There was a central computer with a modem receiving spirometric data.

Ten devices of the Spirotel were distributed to ten outpatient clinics located in a different, remote regions of Poland. The study included centres having some experience in performing spirometry (3 centres) and those, such as general medicine outpatient clinics, where spirometry was never performed (7 centres). Such design was proposed to evaluate possible technical and interpretation problems in centres with different degree of spirometry experience. The staff performing spirometry was asked to send spirometric data once a week. The tests sent to the Department were analysed by doctors experienced in the analysis of spirometric data. In justified cases they sent their remarks concerning performed tests to the centres *via* e-mail.

Results

We received 878 records of spirometry tests in total, 552 of them concerned males and 326 females. A mean age of the person examined was 40.7 ± 20.5 years, a mean age of men was 38.0 ± 21.1 and a mean age of women was 45.5 ± 18.6. Data transmission *via* the telephone was 100% effective, but in 20% of cases, it was necessary to transmit data repeatedly. One transmission lasted 2 minutes on average. The longest one lasted approximately 10 minutes. We evaluated basic parameters of quality of spirometric tests performed at the centres participating in the project.

It turned out that merely a small part of the tests met elementary quality criteria, especially an appropriate number of spirometry maneuvers. The average number of repetitions of forced expiration was only 2.2 (minimum = 1, maximum = 6 repetitions; Fig. 1).

Another parameter that could have been assessed by the examined telespirometric system was forced expiratory time (FET). The best FET of all repetitions of forced expiration made during spirometry was assessed. A mean FET (the best of all repetitions) lasted 6.69 seconds (standard deviation 1.8; minimal FET = 1 sec., maximal = 11 sec.). 27.9% of all tests had FET below 6 sec. and 72.1% had FET above 6 sec. Detailed results of the tests are presented in Figure 2.

The telespirometric system evaluated in the present study also allows to assess graphic parameters of spirometric tests (Fig. 3). The curves of flow-volume and of volume-time were evaluated on a computer. The results of graphic data analysis are presented in Figure 4.

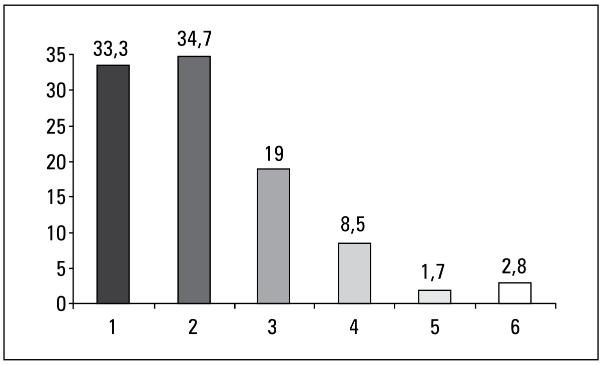

Figure 1. Number of forced expiratory maneuver repetitions in the study group

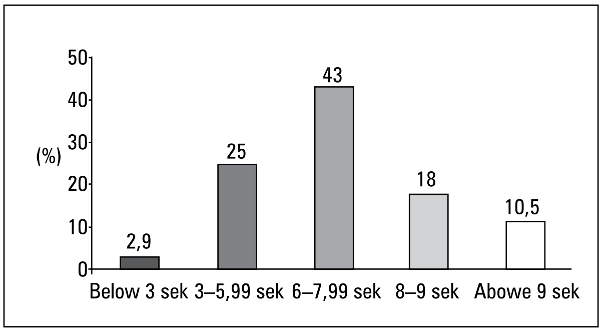

Figure 2. Distribution of forced expiratory time (FET) in the study group

The spirometry system used in the study at the time of assessment did not support in full American Thoracic Society (ATS) quality criteria and did not provide instant messages about test session quality.

Discussion

Recent development in medical diagnostics has allowed doctors to perform an office laboratory testing and a bedsite testing. Point-of-care (POC) diagnostics or near patient testing are not something of a novelty. It is rather a return to the source, for history of medicine provides many examples of diagnostic tests performed by a doctor at bedsite of the patient, e.g. organoleptic test of the urine in diabetic patients. However, POC diagnostics may currently use complicated diagnostic equipment, previously used in hospital laboratories. Among devices used at present in POC diagnostics are office spirometers. Unfortunately, POC diagnostics, and particularly spirometry performed in general medical practice may be associated with some limitations. One of them is the fact that a spirometric test depends on the patient's cooperation and operator's experience. The next crucial element of a spirometric test is the use of proper technique. And the last but not least is appropriate interpretation of spirometric data [5]. Most of the modern spirometers possess built-in software that supports correct spirometry

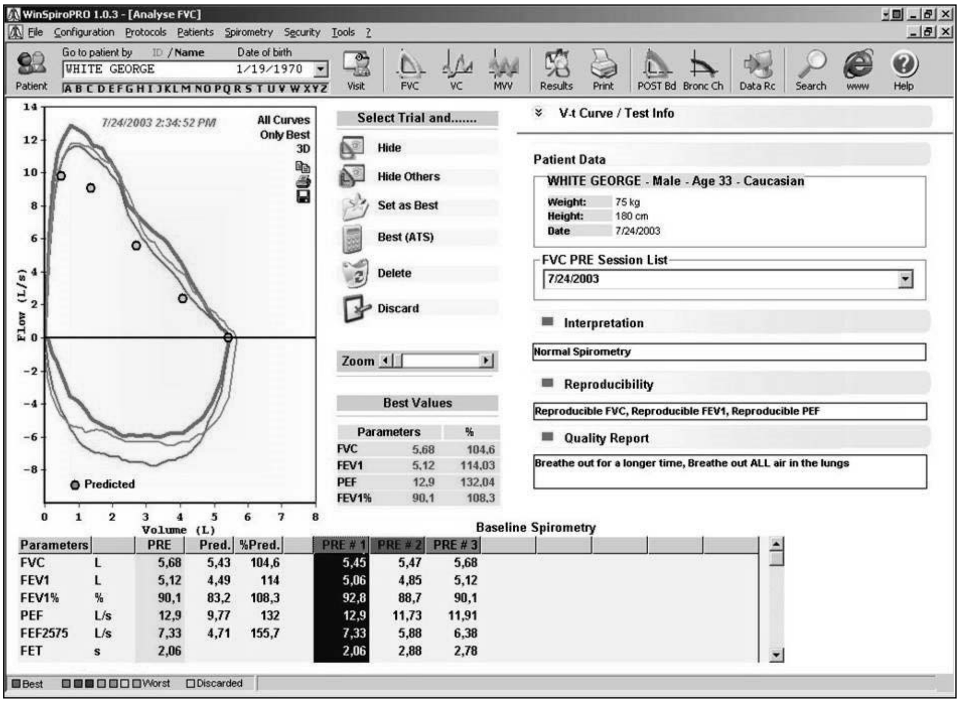

Figure 3. Screenshot of the MIR monitoring telespirometric system

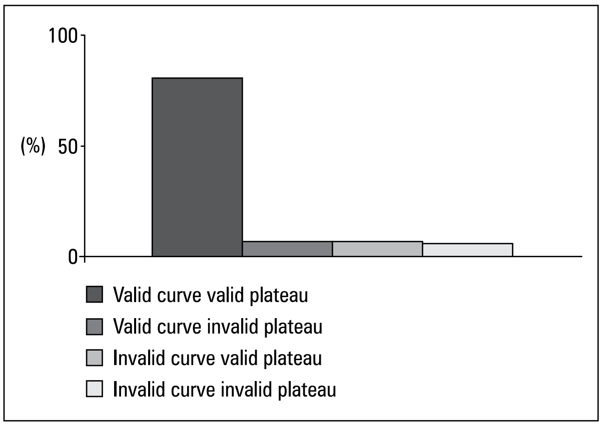

Figure 4. Graphic parameters of a spirometry tests in the study group

[6], however, it cannot replace adequate training or experience of the person performing the test.

The quality of spirometric tests performed in general practitioner's offices investigated by Schermer et al. [6] was satisfactory, comparable with the tests performed in hospital laboratories. Furthermore, the necessity for appropriate training in the performance and interpretation of spirometric tests was emphasised. In the study by Zieliński et al. [7], doctors participating in the project of early detection of COPD in high risk groups also took part in a two-day training. According to authors, apart from intramural training, supervision of a reference spirometric laboratory for a few months would be necessary. However, sending printouts of spirometric tests may pose difficulties due to logistical reasons. The solution seems to be telemedicine. The system examined in our study is one of many possible technologies. Its advantage lied in easy implementation. The possibility of viewing spirometric data in the database on a computer is very convenient and time-saving. This form of "teleeducation" is supported by the fact that it does not require installation of software on the user's spirometer. Obviously, similar results may be obtained using the internet. However, it requires a computer and access to the internet on the user's side, which in Poland still does not belong to the standard in general medical practice.

The objective of this study was not to precisely assess the quality of performance of spirometric tests, but to evaluate the possibilities of using telemedicine technology. However, numerous mistakes were found. One of the most important was insufficient number of repeated maneuvers of forced expiration. 33% of tests had only one repetition. Near 30% of spirometric tests showed maneuvers with too short expiration time and/or inproper graphic shape of the flow-volume loop.

In our pilot study, direct users of telespirometers — in mosts cases nurses — were not trained at the centre in Warsaw. The unsatisfactory result of the quality of the pilot telespirometry study performed in 2007–2008 year prompted researchers to suspend the pilot telespirometry program and focus rather on spirometry courses based on classical stationary trainings.

Now, looking at our 2007–2008 year pilot program from contemporary 2015 year perspective, authors can assume that equipment used in 2007–2008 years wasn't technically matured. Now, when the data transmission is much easier and the use of the internet is obvious the remote teaching and trainings can be probably more successful. Since 2007 year other centres tested various technologies for distance spirometry trainings [8, 9] with various results, so we can conclude that telespirometry still is not mature. On the other hand, majority contemporary pharmaceutical interventional clinical studies in respiratory medicine use central spirometry quality control with good results. Further studies are needed to evaluate what telemetric technology can help to improve Point-of-Care spirometry quality.

So in conclusion, the use of spirometers with data transfer for training purposes seems to be advisable, and the technology of transmission of data *via* the telephone may be easily implemented. There are also other technologies of transmission of spirometric data that can be used effectively in training centres. However, in the authors opinion, it is vital that still is a need to proper face-to-face training of spirometry operators before an implementation of any telemedicine technology.

Conclusions

The use of analog telephone line with Spirotel plus as a tool for centralized quality counseling was possible but the practical usefulness of this technique was far from perfect. The overall quality of spirometry tests send by participating centres was variable, some very poor.

The proper in-house training for general practitioners who decided to perform spirometry testing is required obligatory.

Conflict of interest

The authors declare no conflict of interest.

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