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Home spirometry: Assessment of patient compliance and satisfaction and its impact on early diagnosis of pulmonary symptoms in post-lung transplantation patients

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Abstract

Telemedicine is useful in monitoring patients, and in particular those, such as lung transplant recipients, suffering from chronic illnesses. This prospective cohort study was conducted on 15 lung transplant recipients. The patients provided physicians with data from spirometry as well as their clinical respiratory symptoms via SMS messages. In cases where spirometry results or clinical symptoms required follow-up, the monitoring physician contacted the patient according to guidelines and gave appropriate instructions. Qualitative assessment of satisfaction showed that the sense of increased support from medical staff was rated highest (92.9%). Telespirometry is an efficient method of monitoring lung transplant recipients which leads to patient satisfaction, compliance, adherence to study and sense of security. Nevertheless, for optimal implementation of this method, thorough training of both medical staff and patients is required.

Keywords

Telemedicine, lung transplantation, home spirometry, telespirometry, patient adherence

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Introduction

Monitoring patients, in particular those with chronic illnesses and life-threatening diseases, is of great importance. Review studies show that remote monitoring of patients with chronic obstructive pulmonary disease has reduced rehospitalization and visits to the emergency clinic.[1] Lung transplant recipients are another high-risk group that can benefit from telemedicine. These patients have the shortest life expectancy in comparison with other transplant recipients.[2,3] Thus early detection of diseases and following up these patients are of particular importance.[4–6]

Distance from specialized medical centres, economic and social problems as well as immune deficiency make these patients susceptible to infection while travelling to medical centres, all of which can be impediments to timely post-transplant follow-ups.

Remote spirometry is an approach that contributes to timely monitoring of patients, because it is an efficient tool for assessment of lung function and prognosis of transplantation. The measured respiratory volumes together with clinical symptoms can effectively contribute to timely diagnosis of infection or transplant rejection.[7–9]

Patients' compliance is a key factor in successful monitoring by home spirometry, and can positively affect survival of the lung transplantation patients.[6,10] Considering this, the present study aimed to assess patient adherence and associated factors. Moreover, due to the importance of spirometry findings and clinical symptoms in the early diagnosis of complications such as respiratory infections, the relationship between them was studied.

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Method

The present study is a prospective cohort study conducted on lung transplant recipients. Patients who were willing to participate in the study and had undergone transplant six months earlier were recruited. Some participants were excluded due to factors such as illiteracy, physical disability, inability to send SMS messages, depression and family problems. The device used in the study was an RC-test spirometer manufactured in Ireland, which was calibrated at the hospital's respiratory laboratory.

Each of the participants was asked to send the results of home spirometry as well as their clinical symptoms via SMS messages. For this purpose, they were given special forms to record variables such as forced expiratory volume (FEV1), volume and colour of sputum, cough, wheezes and dyspnoea at rest. The patients were provided with a chart, designed by Finkelstein et al.,[11] to rate each symptom and to determine the threshold of those that required follow-up. Relevant protocols were used to rate the respiratory symptoms. An SMS format containing the same variables as the daily charts was designed for each patient. Training sessions on how to operate the home spirometer and how to rate each symptom were held for all patients, and each participant was asked to test his/her respiration in order to ensure effective training.

The following steps were taken to increase the patients' adherence:

1. Free supply of spirometer.
2. Assistance provided by and access to the medical staff throughout the course of study.
3. Constant follow-up by the physician in cases where problems occurred regarding symptoms and/or FEV1.
4. Training sessions for spirometer operation and participation procedure.
5. Convincing the patients of their potential to enhance their own health through participation in the study.
6. Free counselling in cases needing psychological support.
7. Decreasing the frequency of sending SMS messages from a daily to a weekly basis.

For the first three months, participants were asked to send SMS messages on a daily basis. The information was examined by the investigating physician and recorded on the relevant form allocated to each patient. If a patient failed to send an SMS, he/she was called by phone and encouraged to cooperate with the study. In cases where any of the symptoms required follow-up, the patient was contacted and recommended to report the symptoms to his/her attending physician and to receive the appropriate recommendations on the same day.

After three months, all the participants were contacted by phone and asked to send the results of their respiratory tests on a weekly basis thereafter. They were also asked to perform additional tests whenever symptoms occurred during the week. During this phase, the health conditions of the patients were followed up by the physician on a weekly basis. Each patient continued to send SMS messages for a total period of six months.

The suggestions and critical remarks received from the patients in the course of the study were recorded, and in due course special forms were completed to indicate the patients' level of satisfaction. These forms included parameters such as sense of increased support from the medical staff, increased access to the medical staff, duration of time spent for participation in the study, satisfaction with using mobile phone, satisfaction with the spirometer device and the role of this study in alleviating the patient's stress (Table 1).

Finally, patient compliance, adherence, satisfaction and feasibility of the study were investigated by analysing the above-mentioned parameters. Statistical analysis of the data was performed using Repeated Measure and Wilcoxon statistical tests, by SPSS16 ver.16 software.

Results

Initially, 23 lung transplant recipients were enrolled in the study, but eight patients were excluded considering the exclusion criteria; therefore the study was conducted with 15 participants. The socio-demographic characteristics of the patients are shown in Table 2.

As shown in Figure 1, average compliance of the patients during the study was rated as 78% (baseline compliance = 80%, compliance at the end of the study- = 27%). The level of compliance significantly declined over time (p-value = 0.001), but an increase was noticed in the middle of the study which coincides with the stage at which patients began to send SMS messages on a

Table 1. Results of patient satisfaction according to satisfaction assessment questions.

Patient satisfaction	Feeling of increased support by treatment group	The increased access to treatment groups	Time to participate in the study	Satisfaction of working with mobile phone	Satisfaction of Spirometery device	Reducing stress in patients
Dissatisfaction	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (7.1%)	2 (14.3%)
Low satisfaction	0 (0%)	3 (21.4%)	2 (14.3%)	0 (0%)	2 (14.3%)	2 (14.3%)
Average satisfaction	1 (7.1%)	3 (21.4%)	3 (21.4%)	2 (14.3%)	6 (42.9%)	4 (28.6%)
Completely satisfied	13 (92.9%)	8 (57.1%)	9 (64.3%)	12 (85.7%)	5 (35.7%)	6 (42.9%)

weekly basis. Certain factors decreased patient adherence, including:

1. Not taking the spirometer along on a trip.
2. Forgetting to perform spirometry or to send the result via SMS.
3. Failure to conduct spirometry at times of illness due to anxiousness of outcome.

Qualitative assessment of satisfaction parameters was conducted to determine the patients' level of satisfaction during the course of the study. A sense of increased support from the medical staff was rated highest (92.9%), while satisfaction with the spirometer was rated the lowest (35.7%). Table 1 shows the results of patient satisfaction assessment in detail. One of the patients died during the study due to visceral TB and did not complete the satisfaction form.

Changes in FEV1 over time were examined to assess the patients' respiratory function during the study. There was no statistically significant difference between values of initial FEV1 (mean baseline FEV1 $= 2.26 \pm 0.92152$) and values of FEV1 recorded during the study (mean FEV1 during the study $= 2.39 \pm 1.07$, p-value $= 0.835$), which means that this variable had remained stable over the course of the study (Figure 2).

The agreement between FEV1 and the clinical symptoms reported by the patients was calculated using Cohen's Kappa coefficient; weak agreements between dyspnoea at rest and wheezing with FEV1 were found (dyspnoea at rest and FEV1: Kappa $= 0.17$ and p-value $= 0$; wheezing and FEV1: Kappa $= 0.179$ and p-value $= 0$).

Three patients were hospitalized due to non-respiratory causes such as visceral TB and gastro-intestinal infection. None of the patients was hospitalized due to respiratory causes during the study.

Table 2. Socio-demographic charcteristics of Patients.

Socio-demographic characteristics		frequency
Gender	Male	12
	Female	3
Age	Mean	39.4667 ± 12.49495
Dwelling	Capital	7
	Far district	4
	Capital suburban	4
Level of education	Illiterate	4
	Elementary or high school education	8
	University education	3

Discussion

The clinical respiratory symptoms of 15 lung transplant recipients were monitored over a period of six months, in order to assess the patients' adherence and satisfaction with telespirometry. The results showed a relatively good adherence and satisfaction, but the correlation between clinical symptoms and FEV1 results was not significant.

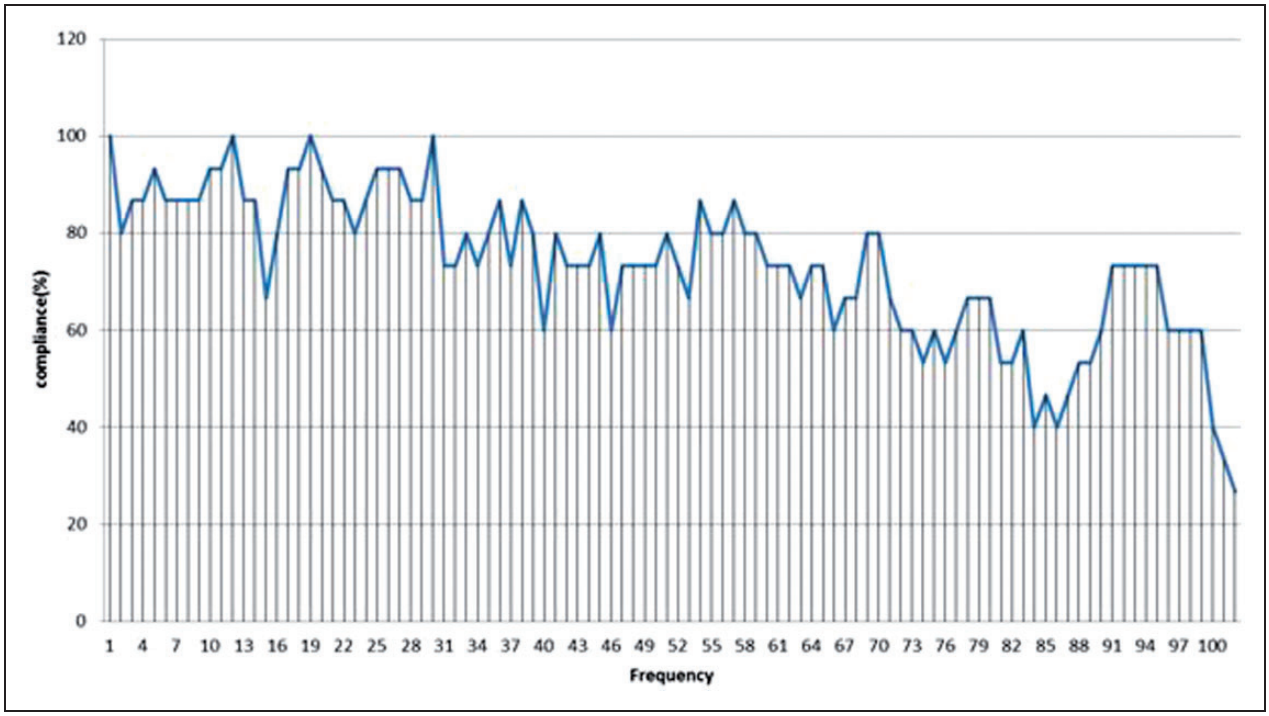

Figure 1. Patient adherence to performing home spirometry testing.

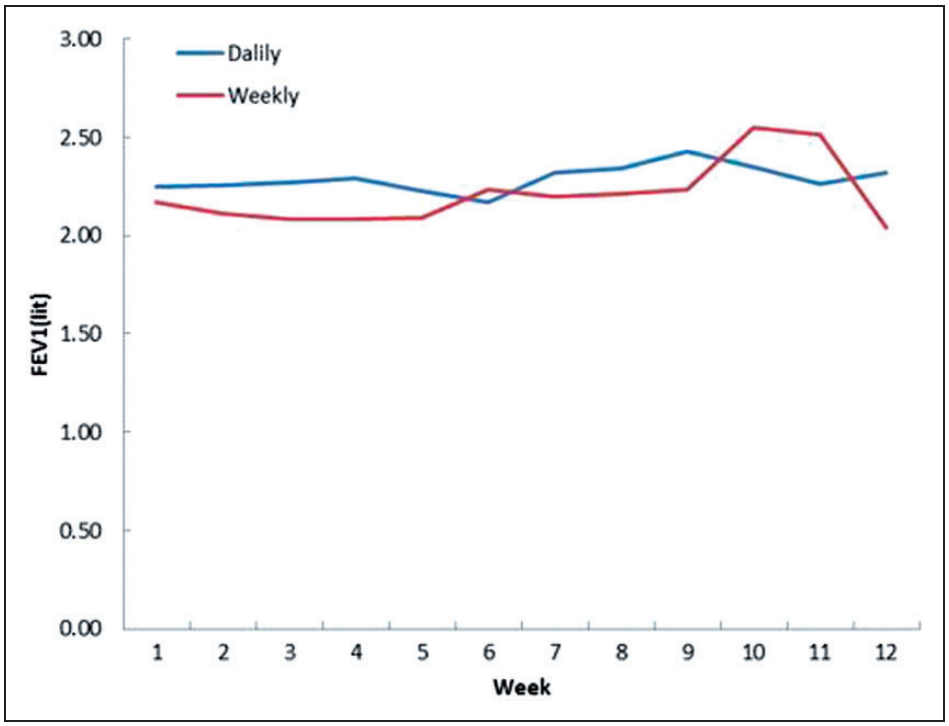

Figure 2. Changes in FEV1.

Patient adherence is an important point in telespirometry. In a study by Dew et al., lung transplant recipients demonstrated poor adherence to home monitoring, namely telespirometry. Increased support of healthcare providers and financial support can eliminate this problem to a great extent.[12] According to our results, patient adherence was rated at 78%, and changing reporting intervals from daily to weekly basis increased the patients' adherence considerably. However, during both stages of the study, the level of adherence declined over time. It is possible that these problems could be overcome by organizing more training sessions about the objectives and advantages of home spirometry.

Patient satisfaction is another key factor that affects compliance. In a similar study by Finkelstein et al. on lung transplant recipients, 90% of participants expressed satisfaction with home spirometry.[13] In our study, participants expressed their highest satisfaction with support provided by the medical staff (92.9% expressed full satisfaction). This suggests that constant contact and follow-up by physicians can encourage and assure the patient of the support provided by the medical team, and therefore increase patient satisfaction. The patients were least satisfied with using the spirometer device (35.7% expressed full satisfaction), and the causes of such low level of satisfaction were:

1. Inability to sterilize the device.
2. Concerns about device errors.
3. Concerns about incorrect use of the device.

Using the mobile phone was another factor with which the patients expressed a relatively high sense of satisfaction (85.7% expressed full satisfaction). Given the fact that using the internet for transferring the results of spirometry in a similar study had decreased patient compliance, it seems that a mobile phone is a suitable tool for monitoring patients.[4]

A sense of cooperation on the part of the attending physicians, patient compliance, accessibility of the device, and means of transferring data are factors that affect the feasibility of a telemedicine study. The factors of most importance for feasibility of this study may be that the attending physicians were fully cooperative and that mobile network was accessible throughout the country. In a similar study by Goin et al., patient compliance in sending spirometry results three times per week was rated 70%, and therefore telespirometry was considered feasible.[14] Based on the results of our study – which shows high patient compliance in sending test results on a daily basis – we consider that performing this mode of patient monitoring is feasible in the specific setting of our country.

Assessment of the clinical symptoms and FEV1 showed that there are weak agreements between clinical symptoms and FEV1 results in our study. This could have been caused by incorrect use of the spirometer by the patient, leading to false-positive FEV1 results that were not related to any of the reportable symptoms. Some studies have suggested that although spirometry is an effective tool in the early diagnosis of respiratory diseases, poor-quality spirometry in primary healthcare services can adversely

affect the reliability of the results. Further training in the correct performance of spirometry has been suggested in order to overcome this problem.[15–17]

Of the 15 subjects in this study, three were hospitalized for non-respiratory causes. Therefore, inclusion of symptoms related to the involvement of other organs such as fever, abdominal pain, diarrhoea and headache in monitoring the patients is recommended to be considered in future studies.

One major limitation of this study was lack of a control group for comparison, which was due to the small number of patients; therefore, performing this study in a larger group is recommended.

Conclusion

The main purpose of telemedicine is to avoid unnecessary commuting for patients between home and hospital, as well as unnecessary hospitalization. Performing home spirometry is a useful method for monitoring chronic and rare cases, such as lung transplant recipients, which not only leads to patient satisfaction and a sense of security, but also avoids unnecessary patient referrals to hospital. Nevertheless, an optimal implementation of this method for best results requires thorough training of both medical staff and patients.

Declaration of Conflicting Interests

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