

# Long-term adherence to CPAP treatment in patients with obstructive sleep apnea: importance of educational program

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**Background:** Lack of adherence with continuous positive airway pressure (CPAP) therapy is the major cause of treatment failure in patients with obstructive sleep apnea syndrome. We evaluated the effectiveness of our intensive educational program on adherence in the short term and the long term.

**Methods:** The educational program consisted of: intensive training, whereby each patient performed individual and collective sessions of three hours receiving information about obstructive sleep apnea syndrome, familiarizing themselves with CPAP tools, on six consecutive days; long-term training; and support meetings, with reassessment at three months and one year.

**Results:** In 202 patients with obstructive sleep apnea syndrome, the mean (standard deviation) apnea/hypopnea index was  $45 \pm 22$ , the Epworth Sleepiness Scale score was  $14 \pm 5$ , and the average titration pressure was  $10 \pm 2$  cm H<sub>2</sub>O. At three months, 166 patients (82%) used CPAP for an average of 7.3 hours per night. At one year, 162 (80%) used CPAP for about seven hours per night. At two years, 92 patients (43%) used CPAP for about five hours per night. The level of satisfaction remained higher in patients in ventilation.

**Conclusion:** Our data show strong adherence to CPAP at three months and one year, with a decrease at two years. The initial educational program seems to play an important role in adherence. This effect is lost in the long term, suggesting that periodic reinforcement of educational support would be helpful.

**Keywords:** adherence, continuous positive airway pressure, obstructive sleep apnea syndrome, educational program

## Introduction

Obstructive sleep apnea syndrome is a disorder characterized by repeated interruption of breathing<sup>1</sup> due to obstruction of the upper airway.<sup>2</sup> The prevalence of obstructive sleep apnea syndrome is 4%–5% in the general population, and is associated with increased cardiovascular risk,<sup>3</sup> increased risk of car accidents,<sup>4</sup> and increased use of health care resources.<sup>5</sup> Continuous positive airway pressure (CPAP) therapy for obstructive sleep apnea syndrome reduces daytime sleepiness,<sup>6</sup> improves cognitive function,<sup>7</sup> and reduces sympathetic neural activation, blood pressure,<sup>8</sup> and mortality.<sup>9</sup> These results are related to proper adherence with treatment.<sup>10</sup> Side effects, such as claustrophobia, difficulty in using the machine, and psychological or psychosocial factors, can affect night-time ventilator use.<sup>11</sup>

Predictors of adherence to night-time CPAP treatment for obstructive sleep apnea are still lacking.<sup>12</sup> Suspension of CPAP use restores symptoms and the risks of obstructive sleep apnea at critical levels.<sup>13</sup> It is estimated that between 29% and 83% of patients

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are not adherent with CPAP ventilation. The most recent definition of CPAP adherence is ventilator use for at least four hours per night on at least 70% of nights, and for at least 30 days in the first three months after prescription.<sup>14</sup> It is stressed that the main problem with treatment of obstructive sleep apnea syndrome is poor adherence to CPAP in the short term, and even more so in the long term.<sup>15</sup>

Various methods have been proposed to increase compliance, such as achieving the proper titration, using the most appropriate ventilator, eg, auto-CPAP, auto-BiPAP (bilevel positive airway pressure), proper humidification of the upper airways, and educational and psychological programs.<sup>11</sup> These interventions are based on theoretical models, and their aim is to remove all barriers that the patient perceives in using CPAP. This suggests the need for an educational program, as recommended in the literature,<sup>16–18</sup> with structured models developed in hospital.

The role of education in improving CPAP use in the long term has only received modest attention until now. Likar and al showed that therapeutic education of two hours every six months increases CPAP use by at least one hour per night in more than 90% of patients.<sup>19</sup> In this study, we assessed the educational effectiveness of an educational protocol for adherence to CPAP at three months and one year after titration, and its effect was still present at two years. Our educational program comprised two stages, ie, initial “intensive” training and a subsequent “periodic” follow-up approach.

## Methods

Two hundred and two patients diagnosed with obstructive sleep apnea were recruited consecutively from the Pulmonary Rehabilitation Unit at Rivolta d'Adda Hospital from January 1, 2004 to May 31, 2008. Inclusion criteria were age 25–85 years, a new polysomnographic diagnosis of obstructive sleep apnea, and not having received previous treatment with noninvasive mechanical ventilation. The severity of obstructive sleep apnea was assessed by the apnea-hypopnea index (AHI, ie, the number of apneas and hypopneas per hour).

Apneas and hypopneas were analyzed according to the guidelines of the American Academy of Sleep Medicine Task Force,<sup>20</sup> with apnea defined as absence of air flow for at least 10 seconds and hypopnea as a reduction in air flow of at least 30% associated with desaturation of 4%. An AHI of at least 15 events per hour was considered the lower limit for enrolment. The anthropometric characteristics and baseline measures of disease severity for the study population are shown in Table 1.

**Table 1** Baseline characteristics and anthropometric measures of disease severity in the study population

Gender, M/F	159/43
Age (years)	57 ± 12
BMI (kg/m <sup>2</sup> )	36 ± 8
AHI (events/hour)	45 ± 22
TSpO <sub>2</sub> < 90%	14 ± 18
ESS	14 ± 5
CPAP average (cm H <sub>2</sub> O)	10 ± 2

**Note:** Values are expressed as the mean ± standard deviation.

**Abbreviations:** AHI, apnea-hypopnea index per hour; CPAP, continuous positive airway pressure; ESS, Epworth Sleepiness Scale; TSpO<sub>2</sub> < 90% percentage of recording time spent with saturation below 90%.

All patients underwent an adaptive training program in two steps, comprising “intensive” adaptive training for three hours on six consecutive days after CPAP titration, using an individually tailored technical and practical approach,<sup>21</sup> followed by periodic follow-up in a group setting to reinforce the concepts and treatment techniques relevant to obstructive sleep apnea.<sup>21</sup> The study protocol was approved by the local ethics committee.

During the six days of intensive training, each patient underwent both individual and group training. The follow-up support program provided for an ambulatory meeting at three months and one year. At three months, one year, and two years, hours of adherence and degree of satisfaction were evaluated on a subjective three-level scale (poor, enough, good) by each patient. Hours of CPAP adherence were assessed by the memory card in the home ventilator. Adherence to CPAP treatment was defined as a minimal acceptable duration of use of at least four hours per night on >70% of nights monitored. Subjects who spontaneously suspended CPAP or were absent from the scheduled control checks, were considered to be nonadherent.

## Statistical analysis

Descriptive statistics were used to describe the study population. Statistical analysis was performed using the Stat View software package (StatView, SAS Institute Inc, Cary, NC). A nonparametric method Mann–Whitney test was performed. A *P* value less than 0.05 was considered to be statistically significant.

## Intensive adaptive training

The following steps were performed strictly according to the order stated and were repeated several times depending on the patient's subjective response (see Figure 1).

	Aims	Interventions
<b>Step 1</b>	To provide basic information on OSAS	Verbal approach supported by leaflets
<b>Step 2</b>	To familiarize patient with CPAP	Practical demonstration on use of CPAP ventilator Simulation of concrete situations with ventilator use
<b>Step 3</b>	To understand different comfort levels and features of different masks	To test different models and different masks
<b>Step 4</b>	To prepare patient for use of night CPAP in long term	To interview patients to provide solutions to any problems with CPAP use

**Figure 1** Intensive training.

**Abbreviations:** CPAP, continuous positive airway pressure; OSAS, obstructive sleep apnea syndrome.

### Step 1

The aim of the first step was to provide basic information on obstructive sleep apnea, focusing on a proper knowledge of the etiology of sleep apnea, how it occurs, what causes it, the health risks involved if it is left untreated, and the treatments available, in order to improve patient awareness for the illness. A verbal approach was taken, based on a brochure (Figure 3) given to patients, in which the use of CPAP use was explained.

### Step 2

The aims of the second step were to enable the patient to become familiar with the equipment used for home CPAP, to improve awareness of the CPAP circuitry and of each accessory (whisper, tubing, filters), and to provide a modality of maintenance and regular cleaning of the machine, with a telephone number to call in the event of machine failure. This was achieved by practical demonstration and simulation of ventilator use, and of the alarm and humidification systems (Figure 4).

### Step 3

The purpose of the third step was to introduce the features and comfort of the different nasal masks and caps, and to

provide solutions to problems with nasal masks, in particular the possible impact of claustrophobia. This step involved performing tests with different models and different masks.

### Step 4

The final step was to prepare the patient for use of CPAP in the long term and to provide solutions to problems with the home ventilator (Figure 5). This step comprised a question and answer session, directed to build trust and collaboration in the patient/caregiver relationship.

## Long-term support program

The long-term support program (Figures 2 and 6) was based on educational criteria, and had the following components:

- Coordination of training groups according to homogeneity of patients
- Issuing of subsequent clinical appointments
- Chaired group sessions with frontal teaching, coordinated by professional figures (neurophysiopathology technician, physiotherapist, and nurse), strengthening concepts and behaviors learned in intensive training, and to encourage interindividual comparisons of common issues for patients

	Training group	Personalized interventions
Scheduled meetings according to a fixed timetable	To form groups according to criteria of homogeneity of patients Group sessions coordinated by physiotherapist and nurse to reinforce concepts learned in intensive training and to stimulate dialog on common concerns of patients	To collect data on parameters of clinical follow-up of each patient To read CPAP counter hours to evaluate actual use of CPAP To decide with physician the next polysomnographic controls for re-evaluating the effective CPAP pressure needed

**Figure 2** Long-term training.

**Abbreviation:** CPAP, continuous positive airway pressure.

**When to use CPAP**

To be effective, treatment should always be used when sleeping

This also applies during the afternoon nap

Face mask should remain on for duration of sleep

When you fall asleep, do not forget to activate the ramp of the device for CPAP ventilation; the ramp function is used to deliver the pressure slowly over 20 minutes before reaching the preset value, so you can sleep without being disturbed by the device pressure delivered

If you wake up and you take off the mask, you must return it to the face and re-enable the ramp before sleep.

**Benefits of CPAP**

There are many reasons to use CPAP:

You will feel less tired, less sleepy, and full of energy

Risk of cardiovascular and cerebrovascular diseases, such as hypertension, heart attack, and stroke, will decrease.

**Any problems with use of CPAP**

Call the center that has prescribed CPAP

Most problems can be easily resolved

If the device does not work call the manufacturers

If you break the mask or a component of the circuit, refer to the center that has prescribed CPAP

In any case, do not stop using CPAP without contacting the reference center.

**Figure 3** Brochure on guidelines for CPAP use given to patient.

**Abbreviation:** CPAP, continuous positive airway pressure.

- Collection of data for clinical follow-up on: body mass index for evaluation of weight loss; Epworth Sleepiness Scale score for evaluation of daytime sleepiness; and actual CPAP use assessed using the CPAP counter
- Establishing a control polysomnographic pressure with the physician to enable re-evaluation of any new effective CPAP titration.

## Results

All 202 patients with obstructive sleep apnea enrolled in this study completed their intensive adaptive training and started CPAP home ventilation. The main anthropometric characteristics and polysomnographic data for the study population are summarized in Table 1. The patients

comprised 159 males and 43 females, with a mean age of  $57 \pm 12$  years, body mass index of  $36 \pm 8$ , AHI of  $45 \pm 22$  events per hour, and an Epworth Sleepiness Scale score of  $14 \pm 5$ . Three months after the beginning of ventilation (average pressure  $10 \pm 2$  cm H<sub>2</sub>O), CPAP adherence was 82%. Ten patients decided to terminate CPAP treatment (in this group basal Epworth Sleepiness Scale was  $12 \pm 3$ ) and 26 were lost to follow-up. Adherence to CPAP was 80% one year after the long-term support program. Four patients decided to terminate CPAP treatment. Two years after the start of treatment and at one year since the last session of the support program, long-term adherence to ventilation was 43%. Seventy-eight patients decided to terminate CPAP treatment (in this group basal Epworth

- Try to wear a mask (out of circuit) while awake for one hour per day
- Try to breathe through the mask (connected to the circuit) keeping your mouth closed, breathing while watching television, or reading the newspaper, awake for an hour per day
- Try to use CPAP during the afternoon nap
- Try to use CPAP during the first 3–4 hours of night sleeping
- Try to use CPAP all night

Go to the next step every two days, once you can wear the mask without anxiety.

**Figure 4** Approach to CPAP therapy in the event of claustrophobia.

**Abbreviation:** CPAP, continuous positive airway pressure.

In the event of claustrophobia, gradual steps are recommended (Figure 4)

#### **Loss of humidification**

Because of CPAP, the inhaled air dries and extra humidification is required.

In most cases, a humidifier system is used at the beginning of the CPAP circuit, but its effectiveness is limited and less than a humidifier or heater. Occasionally, excessive humidity can irritate the nasal mucosa and sinuses and the air temperature may be excessive. Personalized adjustments are recommended and should prevent the formation of condensation inside the nasal mask.

#### **Temperature**

If the air from CPAP is too cold, you can warm up more the air in the bedroom. If this is not enough, you can use a humidifier/heater.

#### **Nasal allergies**

Sometimes allergies can be increased by use of nasal CPAP. Also allergenic factors, if present in the environment, should be removed with an air purifier. CPAP should be kept off the ground. The filters should be changed frequently and very thin additional filters can be added to the circuit. Humidifiers should be used only with demineralized water (not distilled). The use of antihistamines or topical steroids via a nasal spray can be useful.

#### **Nasal dryness**

Nasal wash with saline is effective at bedtime.

#### **Nasal congestion**

You should check for the presence of turbinate hypertrophy and allergies: cyclic use of steroids (nasal sprays or, if less important, nasal patches that facilitate opening of the wings of the nose).

#### **Irritation of nasal mucosa**

You must use a humidifier/heater, or adjust the system in use. Topical medications, such as oil or Vaseline®, are useful.

#### **Mask pressure**

The mask should not be too narrow. You must choose the right type that fits perfectly to the face and prevents loss of air. You can choose various types and models. Attention must be paid to signs of nasal irritation or ulceration of the nasal skin: you must use appropriate spacers to reduce the pressure of the mask on the nose. Where appropriate, consider using special nasal masks.

#### **Skin allergies**

They are often caused by detergents used to clean the mask. You must rinse thoroughly after use of detergents. Frequent change of cleaning products is recommended.

**Figure 5** Most common problems in CPAP use.

**Abbreviation:** CPAP, continuous positive airway pressure.

Sleepiness Scale was  $14 \pm 4$ ) and 32 were lost to follow-up. The average hours of CPAP use at three months were 7.3 hours per night, seven hours per night at one year, and five hours per night at two years. Daytime sleepiness measured by the Epworth Sleepiness Scale was  $6 \pm 4$  at three months and  $5 \pm 4$  at one and two years. The degree of patient satisfaction was reported as follows: 60% of patients felt very satisfied with CPAP, 32% were sufficiently satisfied, and 8% were poorly satisfied at three months. At one year, 65% of patients felt very satisfied,

28% were sufficiently satisfied, and 7% were poorly satisfied. At two years, 49% of patients felt very satisfied, 3% were sufficiently satisfied, and 48% were poorly satisfied. To assess the causes of noncompliance with ventilation, we evaluated the difference between basic sleepiness measured by the Epworth Sleepiness Scale and basal AHI in subjects who spontaneously suspended CPAP and patients who had continued the treatment. We did not find any statistically significant difference between the two groups.

<p><b>Key features:</b></p> <ul style="list-style-type: none"> <li>• Group sessions (10–15 people) coordinated by at least two trained professionals (physician, polysomnography technicians, nurses, physiotherapists)</li> <li>• Each meeting lasts approximately 90 minutes</li> </ul> <p><b>Work plan:</b></p> <ul style="list-style-type: none"> <li>• Lectures with a simple and immediate language</li> <li>• Group discussions, frequently asked questions</li> <li>• Learning evaluation</li> </ul> <p><b>Topics:</b></p> <ul style="list-style-type: none"> <li>• What are apneas</li> <li>• Why they occur</li> <li>• What are the symptoms</li> <li>• Risks if untreated</li> <li>• Benefits if treated</li> <li>• What the treatments are</li> <li>• Alternatives to CPAP</li> <li>• Most common problems with home CPAP</li> </ul> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• To encourage daily use of CPAP</li> <li>• To improve comfort and adherence with CPAP treatment</li> </ul>
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**Figure 6** Educational program for home CPAP therapy in the long term.  
**Abbreviation:** CPAP, continuous positive airway pressure.

## Discussion

We investigated the effectiveness and importance of an educational protocol on adherence to CPAP in the short term (three months) and long term (one and two years) after the beginning of night ventilation. Our data seem to show the effectiveness of our educational protocol on appropriate adherence to ventilation at three months and one year of CPAP treatment. This result seems to be linked to the educational program performed in intensive mode during hospitalization and to the long-term support program at three months and one year after discharge from hospital. At two years, one year after suspension of our program, adherence to CPAP was reduced in our patients.

The aim of this study was to test a method of organizing and applying educational support for long-term night ventilation in patients with obstructive sleep apnea syndrome, in order to verify if a more efficient and reliable follow-up system could prolong CPAP use. One of the potential criticisms of this study is that it is a methodological protocol to

increase CPAP compliance in obstructive sleep apnea syndrome patients, therefore does not take into consideration reasons why patients stopped using CPAP or psychological variables to enhance CPAP compliance.

Various types of CPAP machines are available, and can monitor the effectiveness of treatment, losses from the mask, persistence of snoring, and residual apneas/hypopneas. These models call our attention to recognizing these parameters and correcting them if possible. This supporting system seems to be closely linked to the success of adherence with ventilation.<sup>22</sup> Intervention cannot be based only on solving technical problems, but must be related to socioeconomic and psychological factors, which may affect the ability of the patient to manage his/her health problems and are closely linked with daily use of CPAP.<sup>23,24</sup>

CPAP therapy shows its effectiveness for most patients, but its costs are high. According to this discussion, more restrictive criteria in the US are required for reimbursement of CPAP, such as demonstrated adherence with ventilation.<sup>14</sup>

The definition of adherence with minimum ventilation on a nightly basis is an even more complex issue. Several studies have demonstrated a need for daily use of CPAP for at least 4–6 hours per night to have an improvement in symptoms and daytime sleepiness.<sup>25</sup> It is still rather unclear how many hours of night use are needed to reduce cardiovascular risk. Campos-Rodriguez et al<sup>26</sup> have shown that those patients who use CPAP for at least 2–5 hours every night have a reduced risk of mortality and morbidity compared with those who use it one hour per night.

Intensive adaptive training appeared to provide good adherence in the short term (three months), reaching compliance levels in excess of 80%, associated with an average use of more than seven hours per night and with high levels of subjective satisfaction reported by patients. These results seem to coincide with the literature. Budhiraja et al<sup>3</sup> have shown that the first 3–7 days of treatment are closely linked with the subsequent use of the CPAP ventilator after 30 days.

McArdle et al<sup>27</sup> reported that 68% of patients continued treatment at five years. In fact, long-term compliance with night ventilation is unlikely and is linked to the support system of the center. Therefore, our long-term support program, running for three months and one year, could achieve good compliance, even over a long period, with 80% adherence and daily use of the ventilator for at least seven hours per night at one year. Without our educational support program, we could see a sharp drop in adherence during the second year. The initial experience and educational reinforcement seemed to play an important role on early adherence to ventilation, but this effect seems to be lost in the long term, suggesting the need to continue the motivational support.

It must be stressed that our program was designed mainly for a rehabilitation facility, but its intent was to open up discussion with all the organizations that deal with cardiorespiratory sleep disorders. In an increasingly cost-conscious environment, costs can be minimized by training of specialized teams to manage groups of patients with whom they stay in contact also by periodic telephone calls. We are aware that our study has some limitations. We considered a mainly male population referred to a single medical center. It was not possible to identify reasons why some patients had abandoned the program. The study population presented with moderate to severe AHI during sleep and, it is known that the severity of the apneic framework is one of the factors affecting compliance with ventilation. Importantly, this was a retrospective study and did not include a control group in the protocol.

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## Disclosure

The authors report no conflicts of interest in this work.

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