# The effect of positive and negative message framing on short term continuous positive airway pressure compliance in patients with obstructive sleep apnea

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**Background:** Continuous positive airway pressure (CPAP), the best available treatment for obstructive sleep apnea (OSA), requires long-term compliance to be effective. Behavioral interventions may be used to improve adherence to CPAP. We aimed to investigate whether positive or negative message framing impacts on CPAP compliance in patients with OSA, when compared to standard care.

**Methods:** Consenting patients with confirmed OSA were randomly allocated to receive along with their CPAP either positively or negatively framed messages (Pos; Neg), or standard care (Con). Standardized motivational messages were read out to patients during an initial teaching session and through weekly telephone calls. Patients' compliance data were reviewed 2 and 6 weeks following CPAP initiation.

**Results:** We randomized 112 patients to groups that were matched for age, BMI, and OSA severity. The positively framed group (Pos) showed greater CPAP usage after 2 weeks (total use  $53.7\pm31.4$  hours) as compared to the negatively framed and the control group ( $35.6\pm27.4$  and  $40.8\pm33.5$  hours, P<0.05); however, no differences were seen at 6 weeks. There were more dropouts in the control group than in either framed groups (Pos n=5; Neg n=8; Con n=11; P<0.05).

**Conclusions:** Positively framed messages can improve CPAP adherence in patients with OSA in the short-term; however, strategies for implementing its long-term use need to be developed.

Keywords: Behavioural intervention; sleepiness; sleep-disordered breathing

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### Introduction

Obstructive sleep apnea (OSA) syndrome is a highly prevalent and under-diagnosed disorder (1-3) characterized by recurrent episodes of upper airway obstruction, which leads to sleep fragmentation, increased sympathetic activity, systemic inflammation and oxidative stress (4). OSA leads to daytime sleepiness, impaired functional capacity and quality of life, and moreover to an increased risk of cardiovascular and metabolic disease (5-7).

The best available treatment for OSA is currently continuous positive airway pressure (CPAP), which is aimed to ensure the upper airway patency during sleep (8). However, CPAP frequently remains a long-term treatment requiring good compliance to avoid long term consequences (9). Many patients have difficulties in maintaining long-term CPAP compliance and hence additional strategies need to be employed to improve this.

Patients' education and training can be key intervention to increase long-term adherence to CPAP therapy (10), as they provide relevant information about the condition, the consequences of OSA and the benefits of CPAP therapy thus aiding patients in making an informed choice about their treatment (11).

Health related information can be presented in terms of either risk or benefit (12), with framed messages presenting this information to the patient in either a positive or a negative manner. To date the role of motivational message framing on adherence to CPAP treatment has been tested previously only in a uncontrolled study (13). Hence, we set out this prospective randomized study to challenge the hypothesis that compliance to CPAP therapy, defined as average CPAP daily usage and percentage of nights with CPAP use for more than 4 hours, in patients with OSA can be improved by delivering positively and negatively framed message as compared to standard care.

#### Methods

# Patients

Consecutive patients referred to the Sleep Disorders Centre at Guy's & St. Thomas' Hospitals, London, United Kingdom for suspected OSA were prospectively screened using nocturnal pulse oximetry (Pulsox 300i, Konica Minolta Sensing Inc., Tokyo, Japan) for two consecutive nights at home. Patient who were found to have both a 4% oxygen desaturation index (4% ODI)  $\geq$ 5 hour<sup>-1</sup> and typical symptoms of sleep apnoea [Epworth Sleepiness Scale (ESS) >10 points] (14) or a 4% ODI

greater than 15 hour<sup>-1</sup> were invited for CPAP treatment and issued with an autoset CPAP device (APAP, S8/S9, ResMed Ltd, Sydney, Australia) for home use.

Exclusion criteria were mental or physical disability precluding compliance with the protocol for the duration of the study, and non-feasible trial follow-up. The local institutional review board approved the study (registration number: 2013-3801). The study data and collection were performed between July 2013 and April 2014.

# Protocol

Patients were randomly assigned to one of the three groups: the first received positively framed messages in addition to CPAP, the second received negatively framed messages in addition to CPAP, and a control group entailed patients who received best standard care with CPAP, but no framed messages. The three groups were matched for age, sex and BMI.

In the positively and negatively framed groups, framed messages were read out to the patients during their CPAP collection appointment. The same investigator was in charge to read the messages without adding any evaluative comments and without interruption. As part of the clinical team the sleep technicians were in charge of explaining the CPAP machines. Laminated labels with the printed framed messages (positive or negative) were attached to the tube of the CPAP machines (see online supplement). The same messages were repeated once during weekly phone calls that were performed only for this purpose: the researcher was calling the patients and reading the messages after introducing himself. Any other questions by the patients during these phone calls were directed to the clinical team.

Patients assigned to the control group were followed according to the best standard care. This entailed an APAP collection session during which expert sleep technicians explained the importance of treating OSA and introduced APAP. All patients were instructed on the use of their devices and one-to-one sessions were offered for patients experiencing difficulties. After 2 weeks, all patients were reviewed for troubleshooting and compliance assessment. Fixed pressure CPAP was issued at this stage and all patients were reminded of the importance of treating OSA and the benefits of CPAP treatment.

# 2-week follow up

After two weeks of CPAP therapy patients were invited to return to the sleep centre to have their compliance data downloaded from the device and to exchange the APAP for a fixed pressure CPAP machine (ResMed Ltd., Sydney, Australia). During this appointment, an ESS score and data from the APAP secure digital (SD) card [residual apnoeahypopnoea index (AHI); total and daily usage time; air leak and pressure over the last 14 days] were recorded. Fixed CPAP pressure was established according to the downloaded data (typically 95<sup>th</sup> percentile of average nocturnal pressure), and a fixed pressure CPAP machine was issued.

#### Phone calls

Following fixed pressure CPAP issue, patients were phoned weekly and read the framed health messages (up to a total of 6 phone calls per patient, see Supplementary). The phone calls typically lasted 2–3 minutes and were non-interactive. Patients listened to the messages and were asked not to discuss clinical issues with the person phoning to avoid an advantage over the standard care group. However, all clinical questions or complaints were directed to the clinical team (sleep specialists or qualified technicians) who phoned the patient back to address any clinical concerns. After three unsuccessful attempts to phone a patient, no further attempts were made until the next week's call was due. The control group did not receive weekly phone calls, other than from the clinical team, as part of their standard care.

# 6-week follow up

After a total of 6 weeks of CPAP use (2 weeks APAP, and 4 weeks fixed pressure CPAP) patients returned the SD cards via mail or attended for a further appointment. Patients who attended in person were re-assessed by one of the clinical technicians and the ESS score was recorded. Data on the residual AHI, total and daily usage time, air leak and pressure was downloaded from SD cards presented during clinic appointments or from those mailed to the sleep disorders centre.

#### Sample size calculation

Trupp *et al.* (13) defined CPAP adherence as a usage of >4 hours per night over a 30-day period of home therapy. The mean percentage of usage was 52% for their total study cohort (median 53%) and the difference between positive and negative framing group was 21 percentage points (42.15% *vs.* 63.14%, P=0.033). With the expected standard variation of 20%, a power of >0.8, and two-sided testing with an alpha of

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0.05, the sample size analysis comparing framing to standard care determined that we would need to include at least 31 patients in each group to avoid a type II error. Following minimization, we recruited more patients (positive framing group n=36, negative framing group n=37, control group n=39) into our study to generate matched groups.

# Statistical analysis

Data are reported as mean [standard deviation (SD)], if not otherwise indicated. Normally distributed variables were compared using parametric tests, while non-normally distributed data were compared with non-parametric tests. More specifically, Chi-square tests and one-way analyses of variance (ANOVAs) were used to compare characteristics of participants across the different groups using Dunn's correction. Within-group data (pre- and post-CPAP initiation) were compared using the Wilcoxon paired test, while within group variables were compared using the Student t-test for paired data. Spearman's rank correlation coefficient was calculated for non-normally distributed variables. Linear regression was performed to define identify predictors of CPAP compliance including classical predictors such as age, sex and BMI, and sleep-disordered breathing related potential predictors factors such as baseline ESS and 4% ODI (more sleepy patients and patients with severe OSA tend to have greater compliance with CPAP as they observe a greater amelioration of their experience a greater improvement in their symptoms) (9), alongside APAP pressure (we suspected that a higher pressures can become more uncomfortable in patients treated with CPAP) and short-term APAP compliance (average daily usage and total hours used). All variables that showed non-normal distribution were log-transformed prior to being entered in the linear regression model. For all tests, a value of P<0.05 was considered significant. Statistical analysis of the data was performed using GraphPad Prism (Version 5.02, GraphPad Software Inc., San Diego, CA, USA) and SPSS (IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY, USA).

# Results

A total of 112 patients were allocated to three matched groups, 36 patients in the positively framed messages group, 37 in the negatively framed messages group, and 39 in the control group (*Figure 1*).

The majority of patients were middle-aged, male and



Figure 1 Flowchart of the enrolled patients.

obese with moderate-severe OSA (*Table 1*). No significant differences were observed across the three groups in demographic, anthropometric, or clinical variables, or in OSA severity indices.

# 2-week follow-up results

After 2 weeks of APAP treatment, OSA was controlled with a mean pressure of 13.2 (3.0) cmH<sub>2</sub>O. The residual AHI on APAP was low [median, 2.3 (1–5.82) hour<sup>-1</sup>], and the air leak on the interface was acceptable [1.5 (4.8) L·sec<sup>-1</sup>], with no differences observed among the groups.

All patients had a beneficial symptomatic response [ESS baseline 11.0 (6.0) vs. ESS at 2 weeks 9.2 (5.9) points, P<0.0001] with no significant differences among groups.

Patients allocated to the positive framed messages group used APAP more frequently; their number of days of APAP usage for longer than 4 hours was significantly higher when compared with both the negative framing group and the control group. Similarly, the total number of days of APAP usage was higher in the positive group, as well as the total number of hours of APAP usage (*Table 2*).

After the initial 2 weeks of APAP treatment, 15 patients stopped treatment, 4 from the positive framed group, 6 from the negative framed group and 5 from the control group (P=0.74).

## 6-week follow-up results

After 6 weeks of CPAP treatment, compliance data showed

no differences between groups. CPAP average daily usage was similar in the three groups, 3.1 (2.7) hours in the control group, 2.6 (2.2) hours in the negative group and 3.5 (2.7) hours in the positive group (P=0.624), total hours of usage were 151.9 (112.9) hours, 118.5 (97.4) hours and 132.8 (113.8) hours, respectively (P=0.679). Further compliance data are summarised in *Table 3*.

There was no difference between 2 and 6 months compliance for each of the three groups. A total of 24 patients were lost to follow up at 6 weeks, either because they had returned their machine or because they could not be contacted, 5 in the positive framed group, 8 in the negative framed group, and 11 in the control group (P<0.05 for comparison between positively framed and control group; please refer to the online supplement for more information on the success rate of the follow up phone calls).

# Correlations and regression analysis

There was a significant correlation between the CPAP compliance at 2 weeks and at 6 weeks in all three groups (*Figure 2*). A linear regression analysis revealed that the independent predictors of CPAP compliance (*Tables 4,S1,S2,S3*) were the average daily APAP use at 2 weeks (P<0.001), and the total hours of APAP use at 2 weeks (P=0.006) for average daily CPAP use (hours) and total hours of CPAP use at 6 weeks, respectively ( $R^2$ =0.467 and  $R^2$ =0.309).

Sex resulted as a predictor for both compliance parameters at 6 weeks; BMI was an additional independent predictor for average daily CPAP use at 6 weeks. No

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P value

0.08

0.61

0.46

0.79

0.90 0.90

0.80

0.91

0.24

0.44

Demographic	Positive (n=36)	Negative (n=37)	Control (n=39)	
Age (years)	46.7 (12.2)	47.1 (11.7)	53.5 (12.5)	
Sex (male/female)	25/11	28/9	31/8	
Ethnicity (Caucasian/Black/Asian/mixed race/others)	24/7/2/3/0	20/9/4/2/2	29/3/2/3/2	
BMI (kg/m <sup>2</sup> )	36.0 (8.3)	36.3 (7.6)	37.3 (11.7)	
ODI 3% (h <sup>-1</sup> )	31.3 (19.2)	29.7 (20.8)	31.2 (21.4)	
ODI 4% (h <sup>-1</sup> )	24.7 (19.2)	23.9 (20.1)	25.8 (19.7)	
ESS (/24 points)	10.8 (5.3)	11.2 (6.2)	11.9 (6.1)	
Mean nocturnal oxygen saturation, SpO <sub>2</sub> (%)	93.3 (3.2)	94.0 (2.5)	93.6 (2.6)	
Pulse rise index (h <sup>-1</sup> )	42.6 (18.3)	34.0 (20.0)	39.0 (19.8)	
Nocturnal average pulse rate (min <sup>-1</sup> )	70.9 (9.9)	71.0 (9.9)	66.9 (9.6)	

Table 1 Patient characteristics at baseline

Data are presented as mean (SD). BMI, body mass index; ESS, Epworth sleepiness scale; ODI, oxygen desaturation index; SD, standard deviation.

#### Table 2 Compliance, daily usage and adherence data at 2-week follow up

Variables	2-week follow up					
variables	Control group	Negative group	Positive group	P value		
APAP use for more than 4 hours (% of days)	35.2 (34.4)	34.8 (33.3)	51.6 (33.1)	0.058		
APAP use for more than 4 hours (days)	4.9 (3.2)	4.8 (3.5)	7.2 (4.2)	0.078		
APAP use for less than 4 hours (days)	3.8 (3.3)	3.8 (3.2)	3.9 (3.2)	0.987		
APAP not used (days)	5.0 (4.5)	5.1 (5.2)	2.8 (3.7)	0.081		
APAP average daily usage (hours)	2.8 (2.4)	2.5 (2.1)	3.7 (2.3)	0.096		
APAP total hours used	40.8 (33.5)	35.6 (27.4)	53.7 (31.4)	<0.05		

Data are presented as mean (SD). P values are calculated using ANOVA for 3 groups. APAP, autoset positive airway pressure; SD, standard deviation.

Table 3 Compliance, daily usage and adherence data at 6-week follow up

Variables	6 weeks follow up					
variables	Control group	Negative group	Positive group	P value		
CPAP use for more than 4 hours (% of days)	50.1 (34.2)	46.1 (32.5)	45.7 (30.5)	0.877		
CPAP use for more than 4 hours (days)	21.1 (16.3)	19.7 (17.7)	19.2 (16.9)	0.678		
CPAP use for less than 4 hours (days)	9.7 (8.9)	12.0 (9.0)	13.1 (9.0)	0.388		
CPAP not used (days)	10.4 (12.0)	9.2 (11.6)	8.2 (8.4)	0.878		
CPAP average daily usage (hours)	3.1 (2.7)	2.6 (2.2)	3.5 (2.7)	0.624		
CPAP total hours used	132.8 (113.8)	118.5 (97.4)	151.9 (112.9)	0.679		

Data are presented as mean (SD). P values are calculated using ANOVA for 3 groups. CPAP, continuous positive airway pressure; SD, standard deviation.



Figure 2 Correlation between ADU of CPAP at 2 and 6 weeks in the positive framing group (A), negative framing group (B) and control group (C). ADU, average daily usage; CPAP, continuous positive airway pressure.

independent predictors were identified when 2 weeks compliance data were included in the model as dependent variables. Ethnicity did not result as a significant predictor of 6 weeks' average daily usage (standardized beta coefficient, 0.114, P=0.404) or total hours used (standardized beta coefficient, -0.224, P=0.110).

# Discussion

To the best of our knowledge this is the first randomised and controlled study examining the impact of positively and negatively framed messages regarding CPAP usage on CPAP adherence and likelihood of continuation of therapy

**Table 4** Linear regression for average daily CPAP use (hours) at 6 weeks as a dependent variable ( $R^2$ =0.477), the significant predictors were APAP usage at 2 weeks, sex and air leak

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Independent variable	Standardised beta coefficient	P value
Sex	0.343	0.010
Age	-0.131	0.260
ESS <sup>§</sup>	-0.081	0.461
BMI <sup>§</sup>	-0.284	0.050
Oxygen desaturation index $§$	-0.124	0.346
APAP pressure <sup>§</sup>	0.086	0.474
Air leak <sup>§</sup>	0.256	0.041
2 weeks APAP average daily usage $^{\$}$	0.513	<0.001
8		

<sup>s</sup>, variable log transformed. CPAP, continuous positive airway pressure; ESS, Epworth sleepiness scale; BMI, body mass index; APAP, autoset positive airway pressure.

in OSA patients. We found that both these components of patients' compliance to treatment can be enhanced at the short-term by positively framed messages. In particular, framing messages around CPAP therapy helped to avoid loss to follow up as compared to the standard care group; moreover, the use of positively framed messages was associated with a reduction in the dropout rate of CPAP users by more than 50% at 6 weeks. Compliance data at 2 weeks are closely related to results at 6 weeks, indicating that the importance of fully engaging OSA patients during the initial period of CPAP therapy.

# Clinical significance

Maintaining long-term compliance with CPAP therapy remains a challenging task (15). Several healthcare systems have begun to implement automated electronic tracking systems following the American Thoracic Society recommendations (16), to better track longterm compliance. Previous investigators have found that education and support of patients on CPAP by the use of educational videos, phone calls, and home visits, can improve CPAP compliance (17). In line with those findings our data also support the view that framed messages during CPAP initiation can reduce the number of drop outs that from a service, although a lasting effect on compliance and usage time between different framing messages and

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standard care at 6 weeks of treatment could not be detected. Nonetheless, our results are consistent with earlier findings that revealed that short-term compliance with CPAP can predict long-term usage (18). Non-compliance should therefore be detected early on, and addressed adequately. Patients who struggle within the first two weeks require additional support to overcome problems with CPAP use.

Whilst Trupp et al. (13) found that negatively framed messages were associated with better CPAP compliance, our data revealed that positively framed messages increased short-term compliance. This difference might be explained by the observation that 'gains and losses' due to treatment are not equally perceived by patients: some patients experience a stronger emotional response from a 'loss' than they would from a similar 'gain' in their health status and vice versa. Potential differences in the cohorts studied, including race (19), socio-economic status (20), social factors (21) as well as the involvement of the spouse in the treatment (22), might have further contributed to these different findings. In our study 'ethnicity' was no predictor of CPAP usage but this could be due to the relatively low number of patients in the three subgroups. Cultural differences between populations could also conceivably affect CPAP compliance, although there are no published data specifically addressing this issue.

Of note, our study recruited consecutive patients with OSA in a tertiary referral centre starting on CPAP treatment, at variance with many studies were patients were highly selected for co-morbidities, intellectual capacity, geographic access and health consciousness (23). Moreover, we randomised patients to have a matched control group representing patients followed according to our standardised clinical protocol. In contrast, prior studies (13) had no control group and included only patients with a history of cardiovascular disease. Thus, it may be postulated that this subgroup of patients would be more receptive to negatively framed messages, considering the cardiovascular implications of untreated OSA.

A recently published controlled trial randomised patients beginning with CPAP therapy to receive either standard care, or an educational program that included a 25-minute educational video, an information booklet, a 20-minute patient-centred face-to-face motivational interview and a 10-minute phone call on day 2 of CPAP use (24). Although CPAP adherence decreased at 3 months, compliance remained significantly higher in the intervention arm (P<0.001). These results support the contention that engaging the patient during the initial period around CPAP setup is key for the success of treatment. In order to achieve improved CPAP adherence, dedicated time for education of the patients using repeated and multi-modal interventions can improve long-term use. Our data complement these findings, pointing out the importance of the initial twoweeks period following CPAP initiation.

Changing behaviour to support long-term medical therapy is difficult and suitable interventions are likely to require a complex approach. The use of framing messages (positively or negatively) can lead to variable outcomes in different scenarios, which might depend on comorbidities. Potentially, this intervention can significantly impact on healthcare delivery, quality of life and care-delivery related costs (12). Multiple confounders can influence the patients' decision to continue with therapy other than the framing effect. A recent Cochrane review analysed 35 studies (involving 16,342 participants) in which two different types of framing were used to impact on patient behaviour related to various health conditions (non-OSA). Effects of attribute (positive vs. negative) and of goal (gain vs. loss) framing of the same health information were studied and the authors concluded that there is little if any consistent effect on health consumers' behaviour (25) However, the studies included were heterogeneous and it was suggested that there is a clear framing effect in selected conditions. Considering the complexity of the different determinants and the lack of high-quality evidence (Table 5), further research is required supporting the use of behavioral interventions in patients with OSA on CPAP.

# Limitations

In the current study, patients were not assessed using full polysomnography when first diagnosed. In the UK, it is standard to perform either respiratory polygraphyies or, frequently, nocturnal pulse oximetries to diagnose OSA, which is following evidence-based guidance according to the National Institute of Health and Clinical Excellence (NICE) (32). Our approach did not deliver messages using videos or further information booklets; more intense educational programs may be more successful in establishing a lasting effect on CPAP compliance. We also acknowledge that a non-message-based call for the control group would have been helpful to make the group more comparable with the positively and negatively framing groups. However, the study was designed to compare the intervention with standard medical care ('usual care'). The design of our study was restricted, and the focus was medical rather than psychological in orientation. Due to the complexity

<b>TADIE 5</b> Main Denavioral interventions to improve CEAE in patients with O.5.	Table 5 Main	behavioral	interventions	to improve	CPAP in	patients	with	OSA
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Type of intervention	Control	Duration (weeks)	Results	Ref.
Two 45-minute sessions of CBT and education on consequences of OSA and efficacy of CPAP	Two 45-minute sessions involving discussion on sleep architecture	12	At 12 weeks longer run time of 3.2-h per night and improved performance on vigilance testing	(26)
Two 45-minute sessions of MET, one booster phone call	Usual care	52	Adherence declined over time for all groups	(27)
45-minute individual education session and three 30-minute sessions of MIT	45-minute educational session + usual care	52	Greater adherence in the MIT group at 3 months (4.63 vs. 3.16 h, P=0.005)	(28)
Slide presentation, written information on OSA and CPAP, two one-hour group sessions of CBT	Usual care	4	Higher adherence in the CBT group (2.9 hours difference) at 28 days	(29)
Written personalized feedback report framed according MET	Written information from the AASM	12	No significant differences	(30)
Side effects management module and information exchange on OSA and CPAP incorporated in the automated telephone linked communication system, designed around the concept of MIT, which allowed one to assess and enhance CPAP compliance	General education on unrelated health topics via automated telephone linked communication system	52	CPAP use was 1 h/night higher than in the control subjects at 6 months and 2 h/night higher at 12 months	(31)

CPAP, continuous positive airway pressure; OSA, obstructive sleep apnea; CBT, cognitive-behavioural therapy; MET, motivational enhancement therapy; MIT, motivational interviewing therapy; AASM, American Academy of Sleep Medicine.

of the parameters used for the intervention it is important to recognise the multiple factors associated with the development of framed messages (33-35). For instance, individuals respond differently to equivalent messages depending on whether they are framed to emphasize benefits (gain-framed) or costs (lossframed). However, patients' decision is influenced by several different factors involving the health behavior in question (36) (if behavior has a relatively certain outcome, individuals are more persuaded by gain-framed messages), motivational readiness (37) (patients in a stage of pre-contemplation have little intention to become active and are therefore less likely to respond to a message), credibility of the source of messages (38) (framing effects were not observed when the message source had low credibility) and mood induction (39) (fearful individuals tend to make more pessimistic decisions due to high perception of risk, low certainty, and lack of personal control).

The results of this study might have been further influenced by the fact that the same information that was presented during the appointments could have been perceived by different patients in different ways, leading to a receiver-dependent bias. The sample of patients studied was relatively small, and loss to follow up further reduced the total number of patients included in the final analysis. However, the number of patients who dropped out after the first two weeks was higher in the negative and in the control group, which suggests that motivating patients with positive framed messages may avoid an early drop out from the CPAP service. It was not possible to establish for sure whether patients were lost to treatment once they were lost to follow up. We had been unable to contact some patients after the 6 weeks period, meaning that adherence data about the difference between groups should therefore be interpreted with caution. However, in studies on patients with OSA treated with CPAP patients lost to follow up are commonly considered to be non-compliant (40). Lastly, CPAP compliance was on average lower than the recommended 4 hours/night. This could, in part, contribute to a reduced effect of the intervention between the three groups, but it reflects the level of compliance commonly observed in patients who are treated with CPAP.

# Conclusions

Positively framed messages are a simple and inexpensive

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method to improve early CPAP compliance in patients with OSA and to reduce the drop-out rate at follow up by more than 50% compared to standard clinical care. However, the beneficial impact of framed messages after an initial 2-week period of CPAP use is limited and resources should be used to focus on the initial period around CPAP setup to encourage, educate, and engage with patients.

Further studies are required to identify receptive patient groups to framed messages and to describe detailed items analyses on which aspects of the positively or negatively framed messages are most effective. Future research needs to focus on the impact of framing on different comorbidities of patients with OSA such as hypertension or diabetes. Framed messages could be used as part of a multi-modal approach to construct a patient-based and individualised educational program during early CPAP use.

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# Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* The study was approved by local institutional review board (No. 2013-3801) and written informed consent was obtained from all patients.

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