

Practice Parameters for the Use of Autotitrating Continuous Positive Airway Pressure Devices for Titrating Pressures and Treating Adult Patients with Obstructive Sleep Apnea Syndrome: An Update for 2007

An American Academy of Sleep Medicine Report

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These practice parameters are an update of the previously published recommendations regarding the use of autotitrating positive airway pressure (APAP) devices for titrating pressures and treating adult patients with obstructive sleep apnea syndrome. Continuous positive airway pressure (CPAP) at an effective setting verified by attended polysomnography is a standard treatment for obstructive sleep apnea (OSA). APAP devices change the treatment pressure based on feedback from various patient measures such as airflow, pressure fluctuations, or measures of airway resistance. These devices may aid in the pressure titration process, address possible changes in pressure requirements throughout a given night and from night to night, aid in treatment of OSA when attended CPAP titration has not or cannot be accomplished, or improve patient comfort. A task force of the Standards of Practice Committee of the American Academy of Sleep Medicine has reviewed the literature published since the 2002 practice parameter on the use of APAP. Current recommendations follow: (1) APAP devices are not recommended to diagnose OSA; (2) patients with congestive heart failure, patients with significant lung disease such as chronic obstructive pulmonary disease; patients expected to have nocturnal arterial oxyhemoglobin desaturation due to conditions other than OSA (e.g., obesity hypoventilation syndrome); patients who do not snore (either naturally or as a result of palate surgery); and patients who have central sleep apnea syndromes are not currently candidates for APAP titration or treatment; (3) APAP devices are not currently recommended for split-night titration; (4) certain APAP devices may be used during attended

titration with polysomnography to identify a single pressure for use with standard CPAP for treatment of moderate to severe OSA; (5) certain APAP devices may be initiated and used in the self-adjusting mode for unattended treatment of patients with moderate to severe OSA without significant comorbidities (CHF, COPD, central sleep apnea syndromes, or hypoventilation syndromes); (6) certain APAP devices may be used in an unattended way to determine a fixed CPAP treatment pressure for patients with moderate to severe OSA without significant comorbidities (CHF, COPD, central sleep apnea syndromes, or hypoventilation syndromes); (7) patients being treated with fixed CPAP on the basis of APAP titration or being treated with APAP must have close clinical follow-up to determine treatment effectiveness and safety; and (8) a re-evaluation and, if necessary, a standard attended CPAP titration should be performed if symptoms do not resolve or the APAP treatment otherwise appears to lack efficacy.

Keywords: Obstructive sleep apnea; continuous positive airway pressure; CPAP; sleep disordered breathing; autotitrating; APAP

Citation: Morgenthaler TI; Aurora RN; Brown T; Zak R; Alessi C; Boehlecke B; Chesson AL; Friedman L; Kapur V; Maganti R; Owens J; Pancer J; Swick TJ; Standards of Practice Committee of the AASM. Practice parameters for the use of autotitrating continuous positive airway pressure devices for titrating pressures and treating adult patients with obstructive sleep apnea syndrome: An update for 2007. *SLEEP* 2008;31(1):141-147.

1. INTRODUCTION

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) IS A STANDARD, SAFE, AND EFFICACIOUS TREATMENT FOR THE OBSTRUCTIVE SLEEP APNEA SYN-

DROME (OSA), a common disorder with established detriment to quality of life and adverse consequences for cardiovascular health.¹ Most of the published literature supporting CPAP therapy derives from trials where the treatment pressure is established by direct inspection of sleep and breathing parameters during attended polysomnographic recording while adjusting pressures to find a setting that essentially eliminates apneas and hypopneas in all sleep stages and body positions. In addition to allowing direct observation by trained technologists to guide pressure selection, titration under attended polysomnography allows for interventions to adjust mask fit, eliminate leak, and help the patient adapt to the initial CPAP experience.²

However, as noted in the previous review and practice parameters paper, there are some assumed or potential limitations associated with PSG-directed CPAP determinations. These include the cost and inconvenience of repeat PSG due to in-

Disclosure Statement

This is not an industry supported study. The authors have indicated no financial conflicts of interest.

Submitted for publication November, 2007

Accepted for publication November, 2007

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Table 1—AASM Classification of Evidence

Evidence Levels	Study Design
I	Randomized, well-designed trials with low alpha and beta error*
II	Randomized trials with high alpha and beta error*
III	Nonrandomized concurrently controlled studies
IV	Nonrandomized historically controlled studies
V	Case series

Adapted from Sackett¹⁰

*Alpha (type I error) refers to the probability that the null hypothesis is rejected when in fact it is true (generally acceptable at 5% or less, or $P < 0.05$). Beta (type II error) refers to the probability that the null hypothesis is mistakenly accepted when in fact it is false (generally trials accept a beta error of 0.20). The estimation of type II error is generally the result of a power analysis. The power analysis takes into account the variability and the effect size to determine if sample size is adequate to find a difference in means when it is present (power generally acceptable at 80%-90%).

Table 2—AASM Levels of Recommendations

Term	Definition
Standard	This is a generally accepted patient care strategy that reflects a high degree of clinical certainty. The term <i>standard</i> generally implies the use of Level I evidence, which directly addresses the clinical issue, or overwhelming Level II evidence.
Guideline	This is a patient care strategy that reflects a moderate degree of clinical certainty. The term <i>guideline</i> implies the use of Level II evidence or a consensus of Level III evidence.
Option	This is a patient care strategy that reflects uncertain clinical use. The term <i>option</i> implies inconclusive or conflicting evidence or conflicting expert opinion.

Adapted from Eddy¹²

complete titrations, the potential bias of in-laboratory versus in-home environment, and the potential to prescribe pressures that are not suitable due to the inherent limited sampling introduced when titration takes place over only one, or in the case of split-night studies, one-half night of recording. Pressure requirements may change over time due to variability in weight, change in underlying medical conditions, or resolution of upper airway edema caused by repetitive apneas.³⁻⁵ One night of titration to eliminate respiratory events that occur during REM sleep or in supine positions may yield a therapeutic pressure estimate that is higher than that needed on average for effective therapy.^{6,7} Although some have suggested that higher pressures may hinder compliance in certain patients, in general there is little evidence to suggest that higher pressures systematically lead to worse compliance.^{8,9} Nonetheless, the desire to improve the efficacy and comfort of treatment and to simplify or improve pressure titration has inspired the development of autotitrating positive airway pressure (APAP) devices.⁹ The technology and use of APAP devices was reviewed in the evidence-based review and practice parameters published in 2002.⁷ Since that time, though there has been little advance in technology, more experience and research using APAP devices suggested a need for an update of the practice parameters.

The purpose of this practice parameter paper is to present updated recommendations for using APAP to determine the need for or to provide treatment for OSA. The American Academy of Sleep Medicine (AASM) has previously published practice parameters for CPAP and bilevel positive airway pressure (BPAP) therapy, and the recommendations here do not modify those guidelines.¹ The AASM also has previously published practice parameters on the determination of CPAP pressure for the treatment of OSA.² The recommendations here supplement those previous guidelines for using APAP to titrate CPAP or treat OSA.

2. METHODS

The Standards of Practice Committee (SPC) of the AASM commissioned among its members four individuals with ex-

pertise in the use of APAP to conduct this review. These content experts were appointed in June, 2006 to review and grade evidence in the peer-reviewed scientific literature regarding the use of APAP. A search for articles on treatment of obstructive sleep apnea with autotitrating CPAP (APAP) was conducted using EMBASE, Ovid MEDLINE(R), Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, and the Cochrane Clinical Trial Registry, first on August 25, 2006, and updated on November 7, 2006. Key words for searches included autoCPAP, automatic CPAP, autotitrating CPAP, autoreset, auto PAP, and autoadjusting CPAP. Each search was run separately and findings were merged. When the search was limited to articles published in English and regarding humans, a total of 167 articles were identified. Abstracts from these articles were reviewed to determine if they met inclusion criteria. Articles were included for evaluation if they had more than 9 subjects and if they compared APAP use with standard PSG directed CPAP therapy, a standard alternate therapy (oral appliance, surgery), or another APAP device. The articles had to address at least one of eight "PICO" questions (acronym standing for Patient, Population or Problem, provided a specific Intervention or exposure, after which a defined Comparison is performed on specified Outcomes) that were decided upon ahead of the review process.¹⁰ While the PICO questions do not map one-to-one with the practice parameters, they were designed to generate information that would be useful in updating the existing practice parameters. Articles meeting these criteria in addition to those identified by pearling (i.e., checking the reference sections of search results for articles otherwise missed) provided 22 articles for review and grading (see accompanying evidence table).

The grading of evidence was according to the suggestions of Sackett (Table 1). All evidence grading was performed by independent review of the article by two members of the task force. Areas of disagreement were addressed by the task force until resolved. The strength of recommendations was determined by the entire AASM SPC as standards, guidelines, or options, as defined in Table 2. Overall, there were 8 Level I studies, 10 Level II studies, 1 Level III study, and 1 Level IV study. One study had bearing on the review but was not graded, as it did not directly address any of the PICO questions (See Table 3).

Table 3—Summary of Evidence Grading for Pertinent Questions

PICO Questions*	Number of Articles (22†)	Oxford Ratings**
How accurate is APAP in diagnosing OSA?	0	-
Is APAP effective in determining an optimal fixed CPAP when used in a monitored/in-laboratory setting?	4	I-1 II-1 III-1 NS-1
Do APAP devices used in the sleep laboratory for titration perform similarly?	3	I-2 II-1
Is APAP used outside the sleep laboratory effective in determining an optimal CPAP pressure for chronic fixed CPAP?	8	I-3 III-3 IV-1 NS-1
Is APAP efficacious in chronic treatment of OSA?	11	I-5 II-6
Is APAP efficacious in chronic treatment of UARS in an unmonitored home setting?	0	-
What are the outcomes of APAP applied to OSA suspects (but where the diagnosis is not yet certain, i.e., intention to treat analysis)	1	II-1
Can APAP be used to adjust CPAP pressures or in lieu of CPAP in patients not tolerating or benefiting from CPAP?	0	-

* PICO is an acronym made up of the components of a question framed about a given Patient, Population or Problem provided a specific Intervention or exposure after which a defined Comparison is performed on specified Outcomes.

** Adapted from Eddy¹²

† Some references applied to more than one PICO question

NS = not specified

The Board of Directors of the AASM approved these recommendations. All members of the AASM Standards of Practice Committee and Board of Directors completed detailed conflict-of-interest statements and were found to have no conflicts of interest with regard to this subject.

These practice parameters define principles of practice that should meet the needs of most patients in most situations. These guidelines should not, however, be considered inclusive of all proper methods of care or exclusive of other methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding propriety of any specific care must be made by the physician in light of the individual circumstances presented by the patient, available diagnostic tools, accessible treatment options, and resources.

The AASM expects these guidelines to have an impact on professional behavior, patient outcomes, and, possibly, health care costs. These practice parameters reflect the state of knowledge at the time of publication and will be reviewed, updated, and revised as new information becomes available.

3. RECOMMENDATIONS

3.1. APAP is not recommended to diagnose OSA. (Standard)

Treatment for OSA must be based on a prior diagnosis of OSA by an established method.¹³ APAP devices are not intended for diagnostic purposes. This recommendation, although reworded, is unchanged from the previous parameter paper.⁶ We found no new evidence addressing the use of autotitrating devices for the diagnosis of OSA.

3.2. Patients with congestive heart failure, significant lung disease such as chronic obstructive pulmonary disease, patients expected to have nocturnal arterial oxyhemoglobin desaturation due to conditions other than OSA (e.g., obesity hypoventilation syndrome), patients who do not snore (either naturally or as a result of palate surgery), and patients who have central sleep apnea syndromes are not currently candidates for APAP titration or treatment. (Standard)

This recommendation is unchanged from the previous parameter paper.⁶ Most studies evaluating APAP, regardless of the technology used, exclude such patients because the sensors and algorithms identifying respiratory events may not be sensitive or specific under these circumstances.

3.3. APAP devices are not currently recommended for split-night titration. (Standard)

This recommendation is unchanged from the previous parameter paper.⁶ None of the reviewed studies examined APAP under conditions of an initial diagnostic period followed by a titration period in the same overnight study.

3.4. Certain APAP devices may be used during attended titration with polysomnography to identify a single pressure for use with standard CPAP for treatment of moderate to severe OSA. (Guideline)

This recommendation is unchanged from the previous parameter paper, except that the severity of OSA is now specified.⁶ One potential use of APAP is to identify a single pressure

for use with a standard CPAP device for subsequent treatment of OSA. The prior recommendation had been based on Level I and II evidence. Based upon that review, APAP devices using methods that monitor snoring, apnea or hypopnea by airflow, flow contour, and/or impedance by the forced oscillation technique may effectively determine a pressure to reduce sleep disordered breathing events to the same extent as standard CPAP. The updated review did not reveal new evidence directly comparing APAP titrations against technologist-directed PAP titrations over a single night. However, four studies (1 Level I, 1 Level II, 1 Level III, 1 not graded) evaluated different aspects of APAP effectiveness using polysomnography. One Level II randomized crossover study compared clinical outcomes (change in Epworth Sleepiness Scale [ESS], adherence, and subjective preference) between patients randomly assigned fixed CPAP based upon a single night APAP titration or to chronic APAP therapy.¹⁴ There was no difference in improvement of ESS or measures of adherence, but APAP was more often the preferred treatment. Additionally, one Level I crossover design study compared PSG-directed CPAP titration in patients with moderate to severe OSA with three different APAP devices during PSG over 4 consecutive nights.¹⁵ The devices using flow limitation in addition to vibration to determine pressure changes performed similarly to CPAP; the device using only vibration did not perform as well. There was no significant difference in control of the apnea hypopnea index (AHI) between CPAP and two of the APAP units tested (both algorithms based on flow limitation plus vibration), but there was one APAP unit that achieved significantly less control of AHI and arousals (vibration only).¹⁵ The maximum, mean, and 95th percentile pressures also varied between one of the APAP devices and the other two. Lloberes et al compared nighttime PSG-directed CPAP titration with daytime PSG- and APAP-directed pressure titration. They found that daytime APAP-directed titration yielded a higher treatment pressure recommendation than PSG-directed methods but that the clinical outcomes for ESS and PAP adherence were similar.¹⁶ All reviewed studies were performed in patients with moderate to severe OSA; there are no data for use in patients with mild OSA.

Several studies evaluated the differences in therapeutic pressure determinations between differing APAP devices (2 Level I,^{15,17} 1 Level II¹⁸). One study compared the 50th and 95th percentile pressure levels during one night of PSG in patients with OSA and found differences between a flow-sensing device and a forced oscillating technique device.¹⁷ Another study found that the 95th percentile was higher with a flow-sensing device than with a forced oscillating technique device (9.9 vs. 7.0 cm H₂O).¹⁸ The same was true for the 50th percentile pressures, and additionally, downloaded pressure tracings were visually different. This study was limited in that it did not provide any measure of sleep or actual control of breathing events. Together, these three studies do not actually provide an evaluation of these measures for choosing a fixed CPAP level, but they provide evidence that use of percentile measures to determine effective pressure levels may have inherent limitations and be device specific. Evidence for APAP titration is specific to each device, including the particular version of software and device version. Additionally, as pointed out in the prior review, the optimized treatment pressure is not necessarily the pressure below

which 95% of all titration pressures fall (the 95th percentile).⁷ This is because a single night of titration may not find an adequate sampling of body position and sleep stage for pressure to be selected purely on a percentile basis. Just as in technician-directed PAP titrations, a careful review of the whole PSG is recommended to determine the optimal pressure.

3.5. Certain APAP devices may be initiated and used in the self-adjusting mode for unattended treatment of patients with moderate to severe OSA without significant comorbidities (CHF, COPD, central sleep apnea syndromes, or hypoventilation syndromes). (Option)

This is a change from the prior practice parameter paper. The prior practice parameter (3.6) stated that use of unattended home APAP treatment “in CPAP-naïve patients is not currently established.”¹⁶ Our present review found 5 Level I¹⁹⁻²³ and 6 Level II^{14,24-28} studies pertinent to this treatment strategy. The reviewed evidence did not address patients with milder OSA (all subjects with AHI>15, except in one study with AHI>10²¹). The studies, although of increasing methodologic soundness, have strengths and weaknesses in addressing this parameter.

In general, all study populations were predominantly male with moderate to severe OSA and without central sleep apnea, CHF, COPD, or other disorders associated with hypoventilation. Five studies evaluated patient groups that were completely CPAP naïve (1 Level I and 4 Level II), and four (2 Level I, and 2 Level II) evaluated patients exposed only to CPAP titration but otherwise unfamiliar with CPAP therapy. In two studies, the study subjects were not CPAP naïve prior to APAP use, and the meta-analysis¹⁹ was heterogeneous in this respect. One study selected only patients requiring fixed CPAP>10 cm H₂O,²⁹ and one study recruited patients with high variability in pressure requirements during CPAP titration.¹⁴ Another study compared APAP to treatment with titrated BPAP in patients with “difficult to treat” OSA, defined as (1) CPAP≥12 cm H₂O, (2) intolerance of CPAP treatment during one attended full-night CPAP titration, or (3) baseline central respiratory disturbances comprise ≥10% of the AHI, which increased further under CPAP.²⁰ Four protocols started APAP at home after in-laboratory PAP titrations but did not use the information gained in setting the APAP device settings.^{14,20,29,30} One study initiated therapy at home after clinic instruction in APAP use in half of the patients and initiated APAP use in the hospital in the remainder.²⁵ One was a meta-analysis that did not state the conditions under which patients were started on APAP.¹⁹ There was no significant difference in outcome of the four studies (1 Level I¹⁹ 3 Level II^{24,25,28}) that assessed the effect of APAP vs. CPAP on improvement of AHI after 2 to 24 months of therapy. Of six studies evaluating improvement in ESS, 5 found no difference^{14,19,24,25,28} and 1 found slightly more improvement³⁰ in patients using APAP vs. fixed PAP. In four crossover studies, the majority of patients preferred treatment with APAP vs. fixed PAP. Overall, most studies document similar compliance between CPAP and APAP. Only one study showed superior compliance in patients using APAP vs. CPAP.²⁹ Mean pressures were consistently lower with APAP vs. CPAP, but in one study, the 95th percentile pressure of APAP after 6 weeks exceeded the fixed CPAP pressure determined by 1-night home APAP titration.²⁸ There were also similar outcomes for improvement in measures of quality of life. Taken together, these studies form an increasing body

of evidence indicating that in populations resembling those tested and using specific devices, there is substantial clinical equivalency between home-initiated chronic APAP therapy and attended in-lab titrated PAP guided therapy for treatment of patients with moderate to severe OSA.

3.6. Certain APAP devices may be used in an unattended way to determine a fixed CPAP treatment pressure for patients with moderate to severe OSA without significant comorbidities (CHF, COPD, central sleep apnea syndromes, or hypoventilation syndromes). (Option)

This is a new practice parameter. The findings of the prior review⁷ included one Level II³¹ and 4 Level IV³²⁻³⁵ studies that related to unattended APAP titrations to determine a fixed CPAP treatment level. One Level IV³⁴ study using a device no longer clinically marketed was not successful in finding an effective pressure (P_{eff}), but three Level IV^{32,33,35} studies and one Level II³¹ study found 1-2 days of unattended APAP titration effective in arriving at an P_{eff} comparable to PSG-directed CPAP titration (PSG-CPAP). Berkani et al (Level IV) and Fletcher et al (Level IV) applied APAP in an unmonitored setting to CPAP naïve patients found that the derived P_{eff} brought the AHI ≤ 10 in 80% and 77.7% of patients. Series et al (Level IV) found P_{eff} from 1 or 2 weeks of unattended APAP titration similar to P_{eff} from PSG-CPAP titration. Finally, Lloberes et al (Level II) found that a partially attended (in hospital, with the possibility of a nurse correcting mask fit if noted) APAP titration yielded equivalent P_{eff} to attended PSG-CPAP derived P_{eff} . In this latter study, the authors emphasized the importance of visual scoring of the pressure recordings to determine P_{eff} .

The updated search found additional supportive evidence (3 Level I,^{19,22,36} 3 Level II,^{30,37,38} 1 Level IV³⁹). One Level I study randomized patients to three different titration methods: PSG-CPAP, unattended APAP titration for 1-3 nights, or a formula-driven empirical pressure that was subsequently adjusted based on clinical variables.³⁶ Patients in all three groups received standardized instruction and 20 minutes of exposure to CPAP during an afternoon session for mask fit and acclimatization. Successful unattended titration of APAP required a minimum of 1 night with at least 6 hours of total recording, and at least 5 hours with a mean mask leak <0.4 L/sec. Successful titration was accomplished in 1-3 attempts in 96% of 119 patients. P_{eff} was determined visually by inspection of raw data with a low leak and was taken as the 90th percentile pressure from those segments. This study did not directly compare treatment pressures between methods within the same patient, but instead compared clinical outcomes when treatment was based on different titration methods. There was no statistical difference in the AHI, arousal index, oxygenation during sleep, ESS, PAP adherence, or Functional Outcomes of Sleep Questionnaire (FOSQ) scores between groups titrated with APAP vs. PSG-CPAP, but the physical and mental axis of the SF36 and the EuroQoL Index (a non-disease specific instrument for measuring health-related quality of life) improved slightly less in APAP titrated patients compared with PSG-CPAP titrated patients. This study provided the strongest support for this parameter. Senn et al studied 29 patients in a randomized crossover trial comparing 1 month of therapy on a fixed CPAP setting derived

as the 90th percentile of pressure from 2 weeks of APAP with 1 month of therapy using two different APAP devices.²² Subjective and objective measures of sleepiness improved similarly in all three treatment arms, and a cardiorespiratory study at the end of the treatment period found all three treatment modalities provided good and similar control of apneas, hypopneas, and oxygenation parameters. However, this study did not compare outcomes in patients treatment with APAP directed CPAP settings to those of patients treated with CPAP settings determined by PSG. The meta-analysis by Ayas contains reference to APAP-directed CPAP settings, but was not designed to directly assess this use of APAP.

The studies reviewed for this review show equivalence in some, but not all parameters in patient outcomes when titration was based on unmonitored APAP as compared with PSG-CPAP titration. The available evidence supporting this practice is improving, but several issues remain to be settled. The required duration of APAP monitoring required, the best particular derived pressure (i.e., 90th percentile, 95th percentile, etc.), and which APAP algorithms and software provide accuracy all remain to be determined in most cases. It is important to stress that the cited evidence was specific to each device (devices are listed in the evidence table), including the particular version of software and device version, and that pressure determination should be made by experienced sleep specialists after examination of the raw pressure titration data for each patient. For these reasons, the committee did not find consensus that the available evidence supported a guideline recommendation. Polysomnography directed CPAP titration is still the standard method for determination of effective CPAP pressure.

3.7. Patients being treated with fixed CPAP on the basis of APAP titration or being treated with APAP must have close clinical follow up to determine treatment effectiveness and safety. This is especially important during the first few weeks of PAP use. (Standard)

This is in agreement with the prior practice parameter (labeled [7] in the prior document).⁶ Methods to assess the patient may include questionnaires measuring sleepiness and continued snoring, follow-up polysomnograms or cardiorespiratory studies, assessment of physical conditions such as an increase in weight, and capturing information stored on the APAP or CPAP devices, including time on device, time at pressure, pressure and leak profiles, and residual apneas/hypopneas (if available). As noted in the recent CPAP and BPAP therapy practice parameters article, there are data to suggest that follow-up soon after initiating PAP is associated with better outcomes of long term adherence.¹ While this has not been explicitly evaluated in patients using APAP, the same admonition seems reasonable.

3.8. A reevaluation and, if necessary, a standard attended CPAP titration should be performed if symptoms do not resolve or if the APAP treatment otherwise appears to lack efficacy. (Standard)

This is unchanged from the prior practice parameter (labeled [8] in the prior document).⁶ Unresolved clinical symptoms should prompt a clinical reevaluation with attention to issues

such as mask fit, mask leak, use of device, weight change, and other clinical observations. A download of information from the APAP devices may reveal useful information, such as excessive mask leak, or an excess of apneas or hypopneas, which may guide decisions for further evaluation or treatment. If necessary, a standard in-laboratory CPAP titration with polysomnography should be performed to document or determine the efficacy of the CPAP or APAP treatment.^{1,40}

4.0 AREAS FOR FUTURE RESEARCH

4.1 In order for APAP to better apply to usual clinical circumstances, studies are needed that clarify which patients can and cannot be served by APAP devices, with particular attention to subjects with mild OSA or comorbidities.

4.2 Since different technologies are used, at times with variable results, further research may be able to determine which technologies are most appropriate for specific patient groups. Development of industry standards in design, technical performance against standard flow profiles, and reporting would be beneficial and would assist practitioners in recognition and understanding of the underlying technologies.

4.3 The optimal way to derive the P_{eff} from attended and unattended APAP titrations is not standardized. More research is needed to determine which parameters are most important, how much mask leak is tolerable, and what durations of monitoring provide the best titrations. Similarly, since most available research does not find pressure a major determinant of patient acceptance and adherence, defining which patient specific factors will be most predictive of significant gains with APAP is of importance in deciding patient assignment to treatments.

4.4 Economic evaluations involving the use of APAP in titration or chronic therapy compared with PSG-CPAP, oral appliances, or surgery are few or lacking. The place of APAP therapy in the sleep specialist's armamentarium is dependent on a better understanding of cost-benefit analysis of using these advanced technologies.

4.5 Most APAP devices have accompanying software that allows downloading of series data to a computer. The parameters reported vary from device to device, and the best use of the parameters is not yet the subject of research. Study is needed to validate the accuracy of certain parameters (e.g., APAP-determined residual AHI). Study may also illuminate which parameters are most helpful in guiding therapy, so that those factors can be standardized.

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