

## Letters to the Editor

**Telematic Multi-physician Decision-making for Improving CPAP Prescription in Sleep Apnoea**

**Toma de decisiones compartida por vía telemática para mejorar la prescripción de la CPAP en la apnea del sueño**

Dear Editor:

Continuous positive airway pressure (CPAP) is the most common therapeutic modality for obstructive sleep apnoea (OSA). However, deciding whether a patient should be treated with CPAP is not a simple process, in light that a large number of complex clinical variables need to be considered in the decision process.<sup>1</sup> This difficulty is particularly apparent among mild–moderate OSA patients, since quality of life is scarcely affected, CPAP compliance is relatively low, and treatment effectiveness is unclear.<sup>2–4</sup> Although setting a threshold in the apnea–hypopnea index (AHI) is the most usual criterion for CPAP prescription in OSA, current clinical guidelines do not provide the treating physician with unambiguous rules. Consequently, virtually universal disagreement in decision making about implementation of CPAP therapy<sup>5</sup> has been considered as inevitable. In fact, a conventional consultation process among physicians evaluating OSA patients is viewed as impractical and not routinely implementable considering the high prevalence of OSA,<sup>6</sup> therefore resulting in a considerable number of patients being then referred for initiation of CPAP therapy.<sup>7</sup> However, consultation among colleagues can be markedly facilitated and become cost-effective using telematics.<sup>8</sup> Nevertheless, this approach has not been used until now to improve decision-making in CPAP prescription.

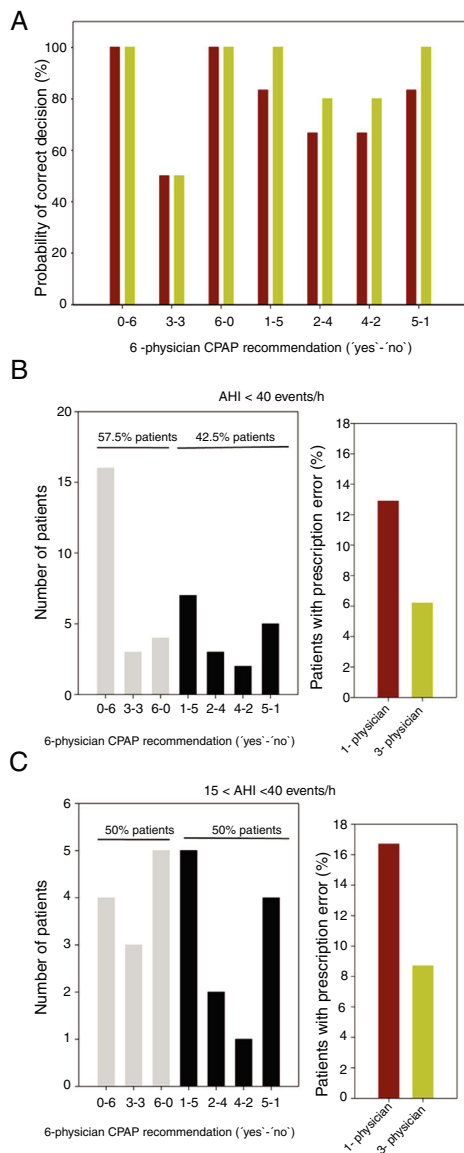
We herein describe a novel model of telematic physician consultation (TPC) in the context of decision making regarding the need for CPAP therapy, and use real-world data to provide a proof of concept of its feasibility and potential benefits. In TPC, the physician who treats a patient has the external support of 2 independent specialists to decide on CPAP treatment. While this approach seems straightforward and reasonable, whether it is feasible and improves decision-making in routine OSA patients has not been assessed. To this effect, we randomly selected 40 patients with mild–moderate OSA (AHI < 40 events/h) from the database of a clinical trial (NCT02779894; ClinicalTrials.gov) that included a general population of patients with OSA.<sup>9</sup> All the clinical and sleep study variables ( $\approx 60$ ) of each patient were placed anonymously on a specially designed website that was only accessible to 6 experienced sleep physicians from different Spanish hospitals, who were then asked to provide their recommendations about CPAP prescription: ‘yes’ or ‘no’ (‘no’ could be both a clear negative to CPAP or no prescription until additional patient evaluation). For each possible combination of ‘yes’–‘no’ recommendations we first theoretically calculated the probability of correct decision when the latter was

made by 1 or 3 physicians; second, we experimentally determined how the ‘yes’–‘no’ recommendations were distributed among the patients, and finally we computed the expected value of correct decision corresponding to 1- or 3-physician decision on CPAP initiation.

As the correct decision for each patient is unknown, we assumed that it was better estimated by the majority of the recommendations of the 6 physicians. Consequently, among the 7 possible ‘yes’–‘no’ recommendations (0–6, 1–5, 2–4, 3–3, 4–2, 5–1 and 6–0), the decision on CPAP treatment was considered correct only for recommendations 4–2, 5–1 and 6–0. For each of the 7 combinations ‘yes’–‘no’, the probability that a single physician would recommend the correct decision is 6/6, 5/6, 4/6, 3/6, 4/6, 5/6 and 6/6 (i.e. 100%, 83.3%, 66.7%, 50%, 66.7%, 83.3% and 100%), respectively (Fig. 1A). To calculate the probability of a correct CPAP prescription decision when taken by the majority of 3 physicians, we considered that among the 20 different possible combinations of 3 recommendations from 6 physicians ( $C(6,3) = 6!/(3!(6-3)!)$ ), the number of combinations that yields a positive result (2 or 3 physicians recommending CPAP) are 0, 0, 4, 10, 16, 20 and 20 for the above 7 ‘yes’–‘no’ recommendations, respectively. Therefore, the probability of correct decision is: 100%, 100%, 80%, 50%, 80%, 100% and 100%, respectively (Fig. 1A). As expected, only when the 6-physician recommendation is unanimous (0–6 or 6–0) or when it is a tie (3–3) there is no statistical advantage when the decision is made by 3 or 1 physicians. Otherwise, decision-making by 3 physicians instead of 1 physician alone increases the correct decision probability (Fig. 1A).

To calculate the real-life impact in the decision-making of 1 or 3 physicians, the theoretical probability analysis in Fig. 1A was combined with the actual distribution of the spectrum of real-data recommendations of the 6 external physicians on the 40 mild–moderate OSA patients (a total of 240 decisions), shown in Fig. 1B. The left panel in this figure reflects the variability in physician agreement as regards therapeutic decision on CPAP.<sup>9</sup> In 42.5% of the patients, the 6-physician recommendation was one for which using the 3-physician decision approach reduces the prescription error versus the 1-physician approach (Fig. 1A). When considering the actual distribution of the recommendations (Fig. 1B) and the corresponding probability of correct decisions (Fig. 1A), the error frequency in CPAP prescription decision would be considerably reduced from 12.9% to 6.2% of the patients (Fig. 1B). Interestingly, when the analysis was limited to the 24 patients with moderate OSA ( $15 < \text{AHI} < 40$  events/h), the decision-making error when switching from 1-physician to 3-physician prescription was also reduced by  $\approx 50\%$ : from 16.7% to 8.7% of patients (Fig. 1C).

This study provides a solid proof of concept on the feasibility and potential improvements achieved by our novel proposal of telematic multi-physician decision-making approaches for improving CPAP treatment decision in OSA. If the attending physician is supported by the opinion of 2 independent colleagues, unnecessary



**Fig. 1.** (A) Probability of correct CPAP prescription when the decision is taken by 1 physician (brown columns) or by a 3-physician group (green columns), for the different 7 possible ('yes'-'no') recommendations from 6 physicians (0-6, 1-5, 2-4, 3-3, 4-2, 5-1 and 6-0). In case of unanimous (0-6 or 6-0) or draw (3-3) recommendations there is no statistical advantage when the decision is taken from 3 or 1 physicians. In the other cases, 3-physician decision is advantageous as compared with 1-physician decision. (B) Left: Distribution of 6-physician recommendations for the 40 patients with mild-moderate OSA (AHI < 40 events/h). Gray: recommendations resulting in no statistical advantage when the decision is made by 3 or 1 physicians; Black: recommendations for which decision-making by 3 instead of 1 physician increases correct decision probability. Right: Expected error in CPAP prescription when the decision is taken by 3 physicians (green column) instead 1 physician (brown column). (C) Same as in (B) but only for moderate OSA patients (15 < AHI < 40 events/h).

CPAP prescription may be avoided in  $\approx 8\%$  of mild-moderate OSA patients. Such changes in clinical decision would have a considerable impact both in cases in which CPAP was prescribed to patients not requiring the treatment (patient inconvenience and unnecessary treatment costs ( $\approx 320$  US\$/year<sup>10</sup>) and in cases where patients requiring CPAP would not be treated (reducing adverse health consequences of untreated OSA and associated opportunity costs (2700–5200 US\$/year<sup>11</sup>). Considering that the incidence of new CPAP prescriptions is  $\approx 25$  per 10,000 inhabitants per year,<sup>7</sup> and that in  $\approx 70\%$  of OSA patients the disease is mild-moderate,<sup>6</sup> it can be estimated that TPC, if implemented as proposed here,

would avoid prescription errors in  $\approx 175,000$  patients per year in the OCED countries (1.25 billion inhabitants), likely resulting in beneficial reductions in healthcare costs, even after TPC implementation. Indeed, the increases in the effectiveness of CPAP prescription would entail only very modest cost increments per patient, corresponding to  $\approx 15$  min of off-line telematic assessment by 2 sleep specialists.

In conclusion, the implementation of an updated telematic version of the consultation among physicians could provide considerable cost-effective improvements in the prescription of CPAP in OSA, a proposal that we believe should be substantiated in the future by specifically designed clinical trials including a wide-spectrum population to provide statistically powered conclusions. Notably, the approach described here can be readily transposed to other unresolved issues in OSA diagnosis and treatment,<sup>12</sup> in which complex decision-making could benefit from a straightforward approach of inter-physician consultation.

### Financial

Supported in part by the Spanish Ministry of Economy and Competitiveness (SAF2017-85574-R, DPI2017-83721-P; AEI/FEDER, UE), and the CERCA Program of Generalitat de Catalunya. D.G. is supported by NIH grant HL130984.

### References

- Epstein LJ, Kristo D, Strollo PJ Jr, Friedman N, Malhotra A, Patil SP, et al. Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. *J Clin Sleep Med.* 2009;5:263–76.
- Janson C, Nöges E, Svedberg-Randt S, Lindberg E. What characterizes patients who are unable to tolerate continuous positive airway pressure (CPAP) treatment? *Respir Med.* 2000;94:145–9.
- Bixler EO, Vgontzas AN, Gaines J, Fernandez-Mendoza J, Calhoun SL, Liao D. Moderate sleep apnoea: a "silent" disorder, or not a disorder at all? *Eur Respir J.* 2016;47:23–6.
- McNicholas WT. Obstructive sleep apnoea of mild severity: should it be treated? *Curr Opin Pulm Med.* 2017;23:506–11.
- Masa JF, Corral J, Pereira R, Duran-Cantolla J, Cabello M, Hernández-Blasco L, et al. Spanish Sleep Network. Therapeutic decision-making for sleep apnea and hypopnea syndrome using home respiratory polygraphy: a large multicentric study. *Am J Respir Crit Care Med.* 2011;184:964–71.
- Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. *Lancet Respir Med.* 2015;3:310–8.
- Povitz M, Kendzerska T, Hanly PJ, Bray Jenkyn K, Allen B, George CFP, et al. Profile of CPAP treated patients in Ontario, Canada, 2006–2013: a population-based cohort study. *Sleep Med.* 2018;51:22–8.
- Baptista S, Teles Sampaio E, Heleno B, Azevedo LF, Martins C. Web-based versus usual care and other formats of decision aids to support prostate cancer screening decisions: systematic review and meta-analysis. *J Med Internet Res.* 2018;20:e228.
- Lugo VM, Torres M, Garmendia O, Suarez-Giron MC, Ruiz C, Carmona C, et al. Concordancia intra e inter-especialista en la decisión terapéutica para el Síndrome de Apneas del Sueño. Intra- and inter-physician agreement in Therapeutic Decision for Sleep Apnea Syndrome. *Arch Bronconeumol.* 2019 Apr 4;pii: S0300-2896, 30097-3.
- Català R, Villoro R, Merino M, Sanganís S, Colomé L, Hernández Flix S, et al. Cost-effectiveness of continuous positive airway pressure treatment in moderate-severe obstructive sleep apnea syndrome. *Arch Bronconeumol.* 2016;52:461–9.
- Knauer M, Naik S, Gillespie MB, Kryger M. Clinical consequences and economic costs of untreated obstructive sleep apnea syndrome. *World J Otorhinolaryngol Head Neck Surg.* 2015;1:17–27.
- Randerath W, Bassetti CL, Bonsignore MR, Farre R, Ferini-Strambi L, Grote L, et al. Challenges and perspectives in obstructive sleep apnoea: report by an ad hoc working group of the Sleep Disordered Breathing Group of the European Respiratory Society and the European Sleep Research Society. *Eur Respir J.* 2018;52:pii:1702616.

Ramon Farré<sup>a,b,c,\*</sup>, Daniel Navajas<sup>a,b,d</sup>, David Gozal<sup>e</sup>, Josep M. Montserrat<sup>b,c,f</sup>

<sup>a</sup> Unitat de Biofísica i Bioenginyeria, Facultat de Medicina i Ciències de la Salut, Universitat de Barcelona, Barcelona, Spain

<sup>b</sup> CIBER de Enfermedades Respiratorias, Madrid, Spain

<sup>c</sup> Institut Investigacions Biomèdiques August Pi Sunyer, Barcelona, Spain

<sup>d</sup> Institut for Bioengineering of Catalonia, The Barcelona Institute of Science and Technology, Barcelona, Spain

<sup>e</sup> Department of Child Health, University of Missouri School of Medicine, Columbia, MO 65201, USA

<sup>f</sup> Sleep Lab, Hospital Clínic-Universitat de Barcelona, Barcelona, Spain

\* Corresponding author.

E-mail address: [rfarre@ub.edu](mailto:rfarre@ub.edu) (R. Farré).

<https://doi.org/10.1016/j.arbres.2019.03.017>  
0300-2896/

© 2019 SEPAR. Published by Elsevier España, S.L.U. All rights reserved.

## Prueba de marcha de 6 minutos y las carreras secretas



### Six-Minute Walk Tests and the Secret Races

Estimado Director:

El ser humano es competitivo por naturaleza. Compite por comida, por techo, por bienestar. Incluso, compite por abstracciones. ¿O acaso son los deportes un bien básico para la vida?

Muchos de nosotros competimos diariamente en lo que el escritor argentino Alejandro Dolina denominó «carreras secretas»<sup>1</sup>: «Se trata de elegir en la calle a una persona de caminar ágil, y proponerse alcanzarla antes de llegar a un punto establecido. Está rigurosamente prohibido correr», relata en su reglamento Dolina. ¿Quién no pensó alguna vez «Al que va adelante con saco rojo lo supero antes de llegar a la esquina»? Los problemas comienzan cuando el táctico competidor se da cuenta y acelera el paso, situación que puede derivar en épicas gestas urbanas.

Esta conducta es inherente a la naturaleza humana. Posiblemente con esto en mente, el primer consenso sobre prueba de marcha de 6 minutos indicaba expresamente no acompañar al paciente<sup>2</sup>. Sorprendentemente, el más reciente consenso ERS/ATS indica que «el técnico no debería acompañar al paciente durante la prueba, sino que debiera caminar detrás, de manera que las mediciones (...) puedan ser registradas sin influir el movimiento del paciente»<sup>3</sup>.

La estandarización de las pruebas debe procurar eliminar cualquier situación que implique un sesgo. Cuando este no pudiera ser evitado, debe al menos ser comentado en el reporte final. ¿Se debe incluir en el reporte las características físicas del técnico que condujo la prueba? ¿Será igual la distancia y la velocidad caminada si al paciente lo sigue alguien detrás que si no lo sigue nadie? ¿Será igual si el seguidor es un fornido enfermero de 2 m y 120 kg que si es una grácil asistente de 50 kg? ¿Y qué sucederá si el técnico tiene un gesto poco amistoso o si su voz no impone respeto?

Todas las guías, aún la más reciente, enfatizan que la prueba de marcha de 6 minutos es al propio paso del paciente (*self-paced*) y

que la variable principal es la distancia caminada, medida en valores absolutos. Posiblemente, una razón válida para que el paciente sea acompañado por el técnico es si se considera que el paciente corre peligro de caídas, en cuyo caso, se debería re-considerar si el paciente debe realizar la prueba.

Otra posible razón sería el transporte de un oxímetro voluminoso (peso > 1 kg), pero en ese caso, la persecución de un objetivo secundario (SpO<sub>2</sub> mínima) sesgaría al objetivo primario (distancia caminada), algo metodológicamente impropio.

Por último, en pacientes con oxigenoterapia permanente, el paciente podría no estar en condiciones de transportar su propia fuente de oxígeno; esta debiera ser transportada por el técnico. En ese caso, sería más razonable que la portación de la fuente de oxígeno sea efectuada por quien habitualmente acompaña al paciente en sus salidas (familiar, kinesiólogo, asistente). Su paso puede no coincidir con el del técnico, y esto empobrecería la correlación con las actividades de la vida diaria del paciente. En ese caso, el acompañante debe ser registrado y se debe procurar que sea la misma persona que participe de las pruebas subsiguientes.

### Bibliografía

1. Dolina A. El libro del fantasma. Buenos Aires: Ed. Colihue; 1999.
2. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: Guidelines for the six-minute walk test. *Am J Respir Crit Care Med.* 2002;166:111–7.
3. Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. *Eur Respir J.* 2014;44:1428–46.

Santiago C. Arce

Instituto de Investigaciones Médicas A. Lanari, Universidad de Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina  
Correo electrónico: [arcesantiago@fibertel.com.ar](mailto:arcesantiago@fibertel.com.ar)

<https://doi.org/10.1016/j.arbres.2019.05.002>  
0300-2896/

© 2019 SEPAR. Publicado por Elsevier España, S.L.U. Todos los derechos reservados.