EE144

APAP AND TELEMONITORING FOR INITIATION AND FOLLOW-UP OF OSA THERAPY IN GERMANY: ECONOMIC AND ENVIRONMENTAL EVALUATION

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What was known

- OSA is a highly prevalent chronic sleep disorder [1] associated with major health and social consequences [2]
- In Germany, polysomnography in the sleep lab is required for initiation of PAP therapy [6] and is seen as a bottleneck in the treatment pathway
- With the rising prevalence of OSA and the availability of APAP and telemonitoring systems, the traditional sleep lab-centered model has been challenged as unnecessarily expensive and inefficient [8-10]

What is new

- This research demonstrates that introducing a new patient pathway with APAP and telemonitoring in Germany would be feasible from an economic perspective
- The proposed and evaluated digitally enabled patient pathway has considerable cost-saving potential of around 49%
- Finally, the investigated APAP and telemonitoring pathway can reduce CO_2 footprint by up to 59% and generally increase efficiency for providers and patients

Background

Obstructive sleep apnea (OSA) is a highly prevalent chronic sleep disorder [1] associated with major health and social consequences [2]. Sequelae and complications of untreated OSA include cardiovascular disease (CVD) and stroke, increased all-cause and CVD mortality, metabolic disease, work-place and traffic accidents [2]. Untreated OSA poses a heavy economic burden to both healthcare system and society [2]. Positive airway pressure (PAP) therapy is a highly effective treatment strategy that significantly reduces cardiovascular and all-cause mortality [3-5].

In Germany, polysomnography (PSG) in the sleep lab is required for initiation of PAP therapy for the treatment of OSA through a directive by the Federal Joint Committee (G-BA) and in-person therapy follow-up in the sleep lab at six months is strongly recommended [6,7]. With the rising prevalence of OSA and the availability of auto-PAP (APAP) and telemonitoring (TM) systems, the traditional sleep lab-centered model has been challenged as unnecessarily expensive and inefficient for the evaluation and treatment of OSA patients [8-10].

Objective

The primary objective of this study was to assess the economic impact of introducing APAP with TM in the home of the patient for PAP initiation and therapy follow-up from a German payer perspective.

The secondary objective was to assess the environmental impact in terms of CO_2 footprint of changing the patient pathway from a sleep lab-centered strategy to a mainly home-based strategy.

Methods

Systematic literature reviews, and reviews of European and US guidelines and HTA reports [6,7,9,10,11-17] were conducted to draft patient pathway with APAP therapy initiation and TM follow-up in the home of the patient and to inform model input parameters. Standard of care (SOC) pathway was developed according to the directive on sleep disordered breathing by the G-BA and the clinical guideline by the German Sleep Society (DGSM) [6,7,11]. OSA differential diagnosis to confirm PAP indication, PAP therapy initiation and therapy follow-up at six months were considered according to German guidelines and literature review [6,7,9,10,11-17].

Final adaption and validation of patient pathways was conducted during workshops with key opinion leaders from the DGSM. The validated patient pathways are depicted in Figure 1 A-B.

To estimate total costs and CO_2 footprint, SOC and APAP + TM pathways were implemented as a deterministic decision-tree in Excel. The final decision tree is depicted in Figure 2. Transition probabilities for the decision tree were based on data from studies identified during literature review. Main base-case input variables to derive model transition probabilities for SOC and APAP + TM pathways are summarized in Table 1.

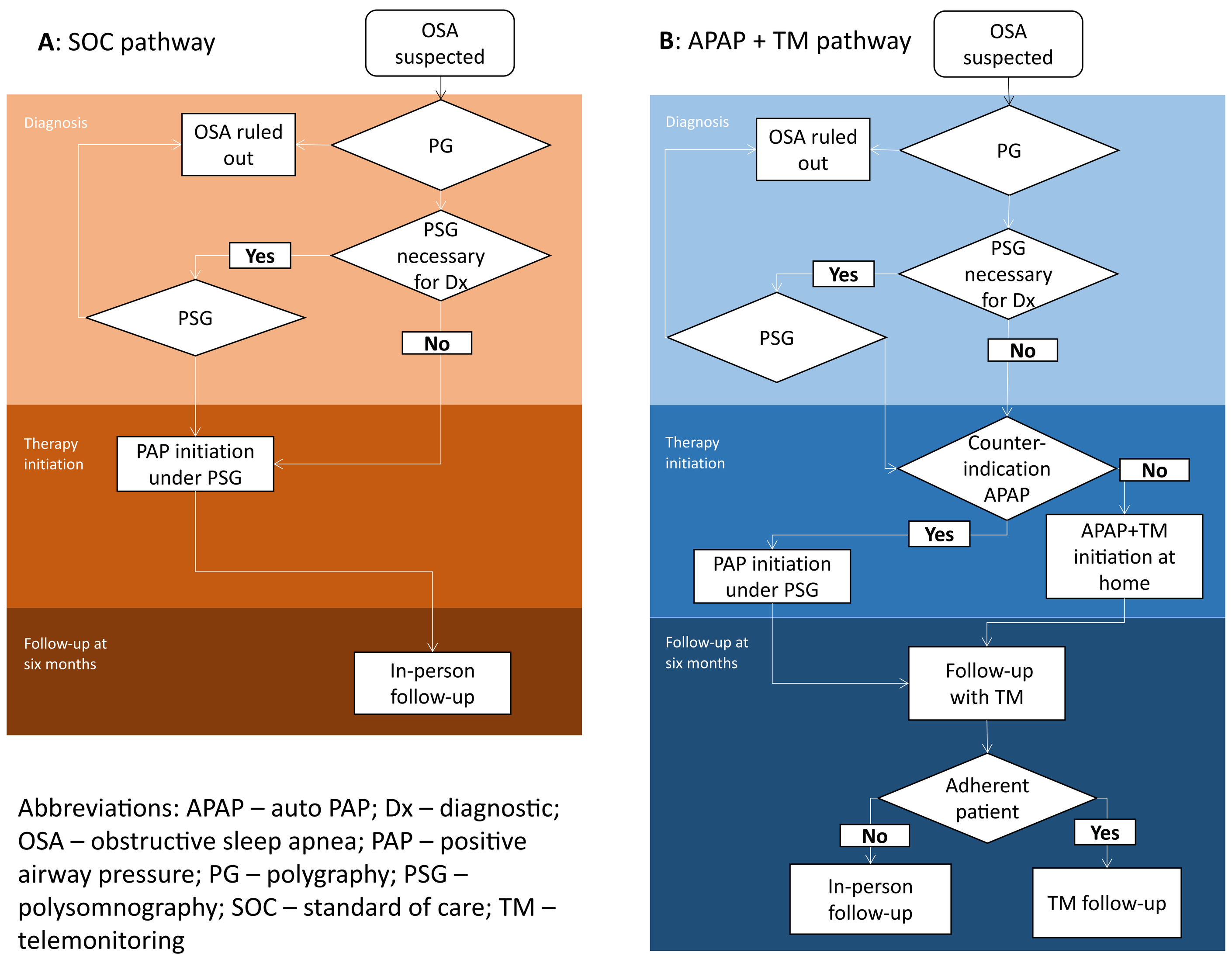
Table 1: Main model input variables to derive transition probabilities

Input variable	Value	Source
Share of patients with suspected OSA that receive an OSA diagnosis after differential diagnosis	0.85	[18]
Share of patients that are referred to diagnostic PSG after initial PG	0.20	[18]
Share of patients with counterindication for APAP therapy	0.20	[18]
Share of patients that do not require an in-person sleep lab follow-up under telemonitoring	0.75	[19]

Abbreviations: APAP – auto PAP; OSA – obstructive sleep apnea; PG – polygraphy; PSG – polysomnography

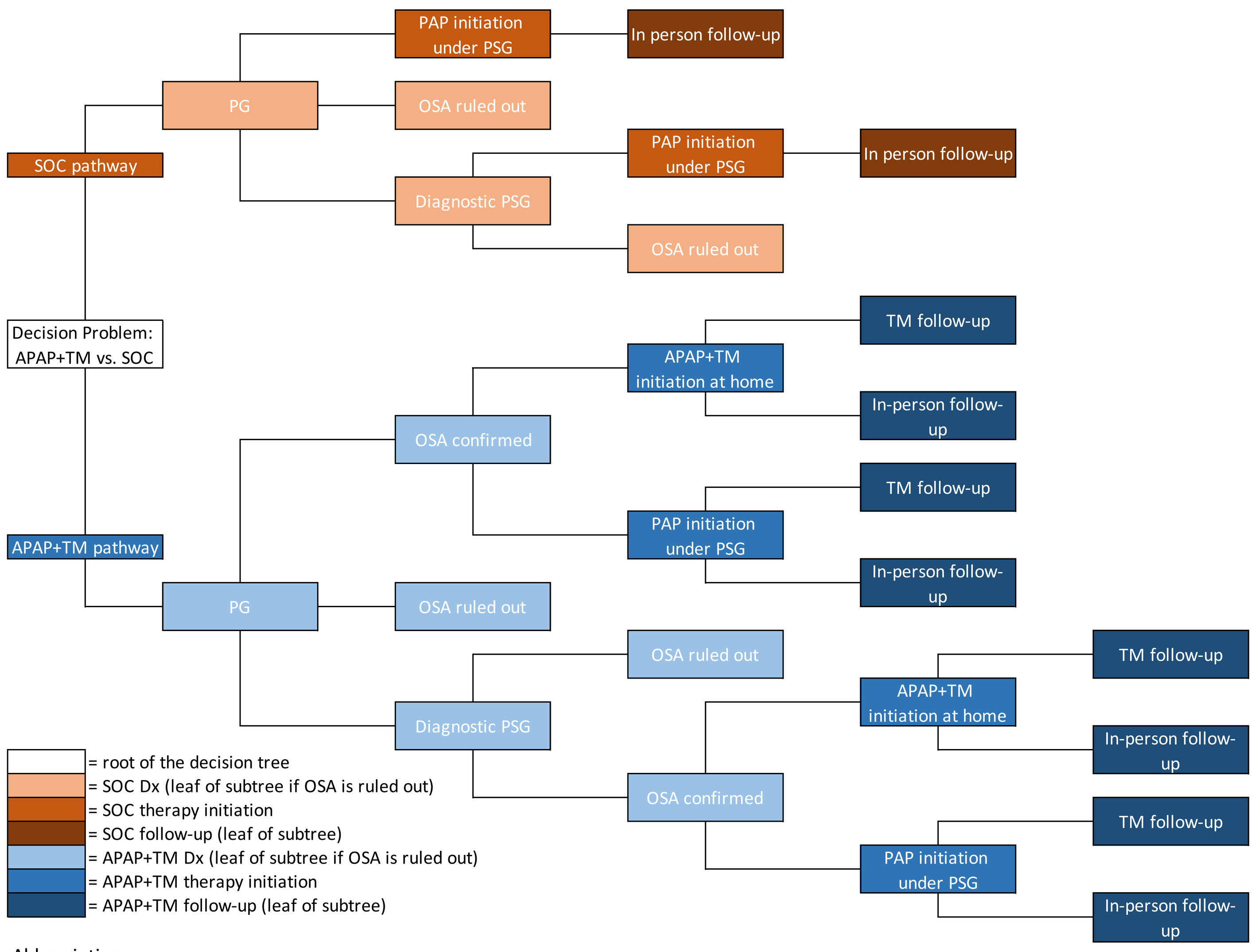
PG, PSG, therapy follow-up and PAP device costs were based on official German reimbursement catalogues [20,21]. Additional costs for the provision of APAP devices and TM services relied on confidential discussion with industry stakeholders and were validated by the literature review.

Figure 1 A-B: Validated SOC and APAP + TM patient pathways



Abbreviations: APAP – auto PAP; Dx – diagnostic; OSA – obstructive sleep apnea; PAP – positive airway pressure; PG – polygraphy; PSG – polysomnography; SOC – standard of care; TM – telemonitoring

Figure 2: Decision tree implemented in Excel



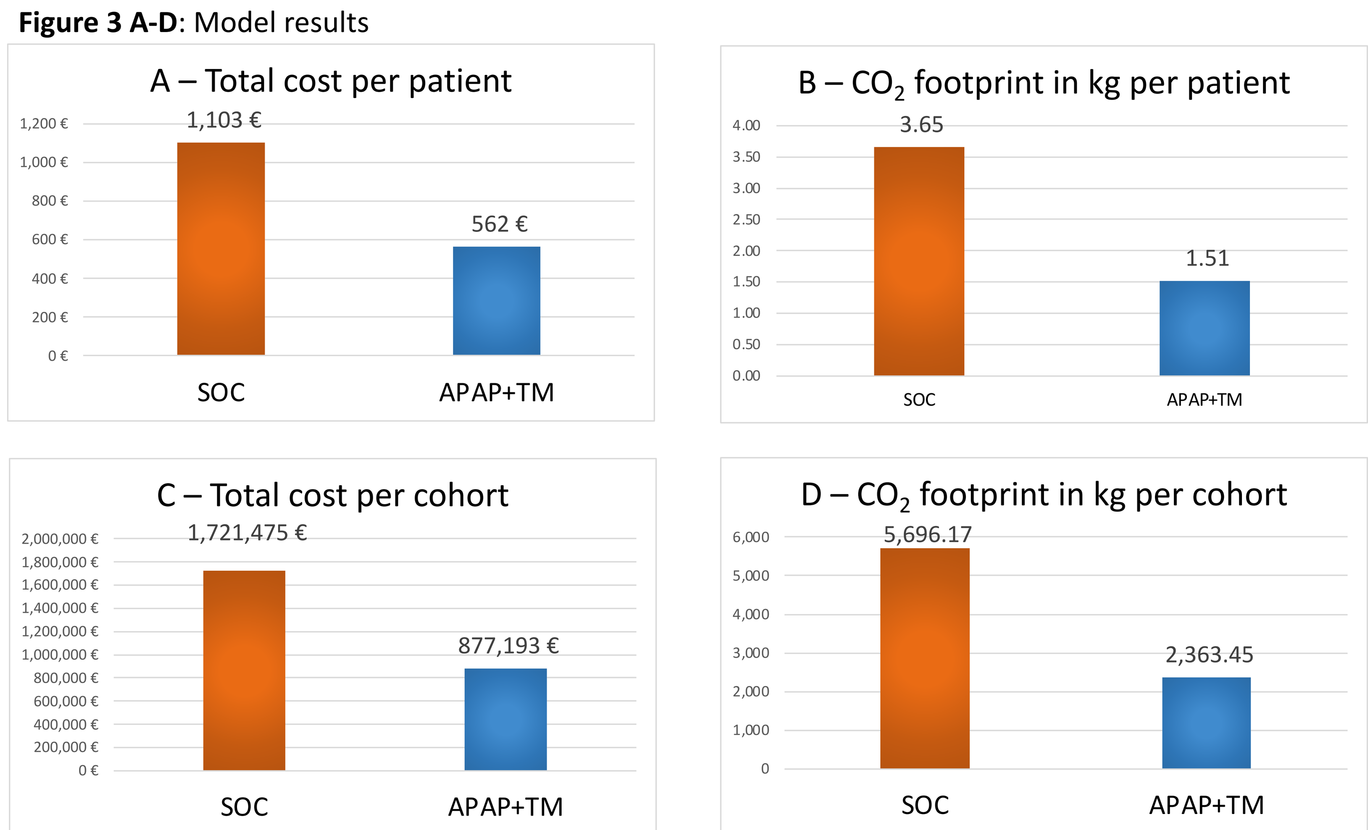
Abbreviations:
APAP - auto PAP; Dx - diagnostic;OSA - obstructive sleep apnea; PAP - positive airway pressure; PG - polygraphy; PSG - polysomnography; SOC - standard of care; TM - telemonitoring

Table 3: Base case economic and environmental model results

Outcome	SOC	APAP+TM	Delta
Total costs, per patient	1,103 €	562 €	541 €
Total costs, per cohort	1,721,475 €	877,193 €	844,079 €
CO_2 footprint, per patient	3.65 kg	1.51 kg	2.14 kg
CO_2 footprint, per cohort	5,696.17 kg	2,363.45 kg	3,331.92 kg

Abbreviations: APAP – auto PAP; CO_2 – carbon dioxide; kg – kilogram; SOC – standard of care; TM – telemonitoring

Figure 3 A-D: Model results



Abbreviations: APAP – auto PAP; CO2 – carbon dioxide; kg – kilogram; SOC – standard of care; TM – telemonitoring

Methods continued

Mean CO_2 emissions per kilometer (km) travelled and mean travel distance to the sleep lab were sourced from German governmental publications [20,21]. CO_2 emissions along the patient pathway were estimated as a product of mean travel distance to the sleep lab in km, mean CO_2 emission per km and mean total visits to the sleep lab.

Cost and environmental input variables at the level of chance nodes of the decision tree are outlined in Table 2.

Table 2: Cost and environmental model input variables

Input variable	Value	Source
Initial PG	109.95 €	[20]
Diagnostic PSG	740.64 €	[20]
PAP initiation under PSG	740.64 €	[20]
APAP initiation at home	20.83 €	[20]
In-person follow-up at sleep lab, including full-service fee for 6 months PAP provision	253.16 €	[20,21]
TM follow-up, including full-service fee for 6 months APAP provision	172.55 €	[20,21]
Mean CO_2-Emissions per sleep lab visit	1.02 kg	[22,23]

Abbreviations: APAP – auto PAP; CO_2 – carbon dioxide; kg – kilogram; PG – polygraphy; PSG – polysomnography; SOC – standard of care; TM – telemonitoring

A cohort of suspected OSA cases undergoing PG and subsequently eligible for PAP therapy was constructed based on data from Benjafield et al. [24], the German Federal Office for Statistics [25] and confidential data on file. This cohort of 1,561 new PAP eligible patients reflects a typical German sickness fund population.

Standard roll-back procedure on the decision tree was conducted to calculate base case economic and environmental outcomes on the cohort and patient level.

Results

In the base case 80% of patients were eligible for APAP initiation at home and 75% of patients were followed-up by TM without additional visit to the sleep lab. Mean total costs per patient were 1,103 € in the SOC pathway and 562 € in the APAP + TM pathway (delta: 541 €; 49% reduction). Costs included differential diagnostics, therapy initiation, follow-up at six months after therapy initiation and full-service fee for PAP/APAP device provision. On the cohort level, total costs were 877,193 € for APAP + TM and 1,721,475 € for SOC (delta: 844,079 €; 49% reduction).

CO_2 footprint for visits to the sleep lab was 3.65 kg for the SOC pathway and 1.51 kg for the APAP + TM pathway (delta: 2.14 Kg; 59% reduction). On the cohort level, total CO_2 footprint was 5,696.17 kg for SOC and 2,363.45 kg for APAP + TM (delta: 3,331.92 kg; 59% reduction).

The cohort level represents total costs and CO_2 footprint for diagnosis and initial six months of therapy for newly suspected and subsequently PAP treated OSA patients per year of a typical German sickness fund.

Patient- and cohort-level economic and environmental results are summarized in Table 3 and Figure 3 A-D.

Conclusions

Introducing a new patient pathway with APAP and TM in Germany would be feasible from an economic perspective. The new pathway would create cost savings of 541 € per patient, mostly due to saved PSG nights (saving 49% of SOC total costs) and reduce CO_2 emissions by 2.14 kg per patient due to saved travel for visits to the sleep lab (saving 59% of SOC total CO_2 emissions).

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References

[1] Benjafield AV, Ayas NT, Eastwood PR, et al. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. The Lancet Respiratory Medicine. 2019;7(8):687-698.
[2] Knauert 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(1):17-27.
[3] Fu Y, Xia Y, Yi H, Xu H, Guan J, Yin S. Meta-analysis of all-cause and cardiovascular mortality in obstructive sleep apnea with or without continuous positive airway pressure treatment. Sleep Breath. 2017;21(1):181-189.
[4] Pepin JL, Bailly S, Rinder P, et al. Relationship between CPAP termination and all-cause mortality: a French nationwide database analysis. Chest. 2022.
[5] Woehrle H, Schoebel C, Oldenburg O, et al. Low long-term mortality in patients with sleep apnoea and positive airway pressure therapy: analysis of a large German healthcare database. Somnologie. 2020;24(3):151-158.
[6] G-BA. Richtlinie Methoden vertragsärztliche Versorgung. 2022.
[7] Suck BA, Arzt M, Fietze I, et al. Teil-Aktualisierung S3-Leitlinie Schlafbezogene Atmungsstörungen bei Erwachsenen, AWMF-Registernummer 063-001 – Deutsche Gesellschaft für Schlafforschung und Schlafmedizin (DGSM). Somnologie. 2020;24(3):176-208.
[8] Kunisaki KM, Khalil W, Koffel E, Pfannes L, Koeller E, MacDonald R, Greer N, Wilt TJ. The Comparative Effectiveness, Harms, and Cost of Care Models for the Evaluation and Treatment of Obstructive Sleep Apnea (OSA): A Systematic Review [Internet]. Washington (DC): Department of Veterans Affairs (US); 2016 Sep. PMID: 28715166.
[9] NICE. Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s [NG202]. National Institute for Health and Care Excellence. www.nice.org.uk/guidance/ng202. Published 2021. Accessed October 2022.
[10] Roberfroid D, De Laet C, Devos C, Thiry N. Organisation of diagnosis and treatment of obstructive sleep apnoea syndrome: an international comparison. Health Services Research (HSR). Belgian Health Care Knowledge Centre (KCE). https://kce.fgov.be/en/publications/all-reports/organisation-of-diagnosis-and-treatment-of-obstructive-sleep-apnoea-syndrome-an-international. Published 2020. Accessed October 2022.
[11] DGSM and DGfSuS. S3 Leitlinie Nicht erholsamer Schlaf/Schlafstörung Kapitel „Schlafbezogene Atmungsstörungen bei Erwachsenen", AWMF-Registernummer 063-001. https://www.awmf.org/uploads/tx_szleitlinien/063-001l_S3_SBAS_2017- 08_2_verlaengert_und_Hinweis_Teil-Aktualisierung_2020-07.pdf. Published 2017. Accessed October 2022.
[12] NICE. Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s. Evidence review D: Diagnostic tests for OSAHS, OHS and COPD–OSAHS overlap syndrome. NICE guideline NG202, Diagnostic evidence review. National Institute for Health and Care Excellence. https://www.nice.org.uk/guidance/ng202/evidence/d-diagnostic-tests-for-osahs-ohs-and-copdosahs-overlap-syndrome-pdf-9204444688. Published 2021. Accessed October 2022.
[13] British Lung Foundation. Obstructive Sleep Apnoea (OSA) Toolkit for commissioning and planning local NHS services in the UK. https://www.blf.org.uk/sites/default/files/OSA_Toolkit_2015_BLF_0.pdf. Published 2015. Accessed October 2022.
[14] Patil SP, Ayappa IA, Caples SM, Kimoff RJ, Patel SR, Harrod CG. Treatment of Adult Obstructive Sleep Apnea with Positive Airway Pressure: An American Academy of Sleep Medicine Clinical Practice Guideline. J Clin Sleep Med. 2019;15(2):335-343.
[15] Patil SP, Ayappa IA, Caples SM, Kimoff RJ, Patel SR, Harrod CG. Treatment of Adult Obstructive Sleep Apnea With Positive Airway Pressure: An American Academy of Sleep Medicine Systematic Review, Meta-Analysis, and GRADE Assessment. J Clin Sleep Med. 2019;15(2):301-334.
[16] Kapur VK, Auckley DH, Chowdhuri S, et al. Clinical Practice Guideline for Diagnostic Testing for Adult Obstructive Sleep Apnea: An American Academy of Sleep Medicine Clinical Practice Guideline. J Clin Sleep Med. 2017;13(3):479-504.
[17] Lloberes P, Duran-Cantolla J, Martinez-Garcia MA, et al. Diagnosis and treatment of sleep apnea-hypopnea syndrome. Spanish Society of Pulmonology and Thoracic Surgery. Arch Bronconeumol. 2011;47(3):143-156.
[18] Bravata DM, Lightner N, Yaggi HK, Miech EJ. Economic Assessment of 4 Approaches to the Diagnosis and Initial Treatment of Sleep Apnea. Respir Care. 2018 Jan;63(1):50-61.
[19] Fernandes M, Antunes C, Martinho C, Carvalho J, Abreu T, Oliveira A, Pinto P, Bárbara C. Evaluation of telemonitoring of continuous positive airway pressure therapy in obstructive sleep apnoea syndrome: TELEPAP pilot study. J Telemed Telecare. 2021 Jul;27(6):353-358.
[20] Einheitlicher Bewertungsmaßstab (EBM) Stand: 2. Quartal 2022. In. Berlin: KBV Kassenärztliche Bundesvereinigung; 2022.
[21] Hilfsmittelverzeichnis
[22] Schelewsky M, Follmer R, Dickmann C. CO2-Fußabdrücke im Alltagsverkehr. Umweltbundesamt 2020. https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2020_12_03_texte_224-2020_co2- fussabdruecke_alltagsverkehr_0.pdf Accessed October 2022.
[23] Neumeier S. Haus- und Facharzterreichbarkeit in Deutschland. vhw FWS 1 / Januar – Februar 2018. https://www.vhw.de/fileadmin/user_upload/08_publikationen/verbandszeitschrift/FWS/2018/1_2018/FWS_1_2018_Neumeier.pdf Accessed October 2022.
[24] Benjafield AV, Ayas NT, Eastwood PR, Heinzer R, Ip MSM, Morrell MJ, Nunez CM, Patel SR, Penzel T, Pépin JL, Peppard PE, Sinha S, Tufik S, Valentine K, Malhotra A. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. Lancet Respir Med. 2019 Aug;7(8):687-698.
[25] DESTATIS. Datenreport 2021.