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Management of obstructive sleep apnea in Europe – A 10-year follow-up

Ingo Fietze [a, b, c], Naima Laharnar [a, *], Panagiotis Bargiotas [d], Ozen K. Basoglu [e], Zoran Dogas [f], Marta Drummond [g], Francesco Fanfulla [h], Thorarinn Gislason [i, j], Haralampos Gouveris [k], Ludger Grote [l], Holger Hein [m], Poul Jennum [n], Pavol Joppa [o], Klaas van Kralingen [p], John Arthur Kvamme [q], Carolina Lombardi [r], Ondrej Ludka [s], Wolfgang Mallin [t], Oreste Marrone [u], Walter T. McNicholas [v], Stefan Mihaicuta [w], Josep Montserrat [x], Giora Pillar [y], Athanasia Pataka [z], Winfried Randerath [aa], Renata L. Riha [ab], Gabriel Roisman [ac], Tarja Saaresranta [ad], Sophia E. Schiza [ae], Pawel Sliwinski [af], Juris Svaza [ag], Paschalis Steiropoulos [ah], Renauld Tamisier [ai], Dries Testelmans [aj], Georgia Trakada [ak], Johan Verbraecken [al], Rolandas Zablockis [am], Thomas Penzel [a, an], on behalf of ESADA

[a] *Interdisciplinary Center of Sleep Medicine, Charité – Universitätsmedizin Berlin, Germany*
[b] *Department of Medicine, The Fourth People' Hospital of Guangyuan City, China*
[c] *The Federal State Autonomous Educational Institution of Higher Education I. M. Sechenov, First Moscow State Medical University of the Ministry of Health of the Russian Federation, Moscow, Russia*
[d] *Sleep and Motion Laboratory, Medical School, University of Cyprus, Nicosia, Cyprus*
[e] *Department of Chest Diseases, Ege University, Faculty of Medicine, Izmir, Turkey*
[f] *Sleep Medicine Center, Department of Neuroscience, University of Split, School of Medicine, Split, Croatia*
[g] *Sleep and Non-Invasive Ventilation Unit, Hospital São João, Medicine Faculty of Porto University, Porto, Portugal*
[h] *Respiratory Function and Sleep Unit, Clinical Scientific Institutes Maugeri IRCCS, Pavia, Italy*
[i] *Medical Faculity, University of Iceland, Reykjavik, Iceland*
[j] *Landspitali University Hospital, Reykjavik, Iceland*
[k] *Sleep Medicine Center & Department of Otolaryngology, University Medical Center, Mainz, Germany*
[l] *Centre for Sleep and Wake Disorders, Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden*
[m] *Sleep Disorders Center, Reinbek/Geesthacht, Germany*
[n] *Dansk Center for Sovnmedicin, Klinisk neurofysiologisk afdeling, Rigshospitalet, Glostrup, Denmark*
[o] *Department of Respiratory Medicine and Tuberculosis, Faculty of Medicine, P.J.Safarik University and L. Pasteur University Hospital, Kosice, Slovakia*
[p] *SEIN Sleep-Wake Centre Heemstede, the Netherlands*
[q] *Sleep Laboratory, ENT Department, Førde Central Hospital, Førde, Norway*
[r] *Sleep Disorders Center, Dept. Medicine and Surgery, University of Milano-Bicocca & Instituto Auxologico Italiano, IRCCS, Dept. of Cardiology, S. Luca Hospital, Milan, Italy*
[s] *Dep. of Internal Medicine, Geriatrics and Practical Medicine, University Hospital Brno and Faculty Medicine, Masaryk University, Brno, Czech Republic*
[t] *LKH Graz II, Standort Enzenbach, Gratwein - Strassengel, Austria*
[u] *CNR Institute for Research and Biomedical Innovation, Palermo, Italy*
[v] *Department of Respiratory and Sleep Medicine, St. Vincent's Hospital Group, University College Dublin, Dublin, Ireland*
[w] *Victor Babes University of Medicine and Pharmacy, Timisoara, Romania*
[x] *Hospital Clinico Respiratorio, Barcelona, Spain*
[y] *Sleep Clinic, Carmel Hospital, Technion Faculty of Medicine, Haifa, Israel*
[z] *Respiratory Failure Unit, Aristotle University of Thessaloniki, G. Papanikolaou Hospital, Thessalonika, Greece*
[aa] *Institute of Pneumology at the University of Cologne, Bethanien Hospital, Solingen, Germany*
[ab] *Department of Sleep Medicine, Royal Infirmary Edinburgh, Little France, UK*
[ac] *Sleep Disorders Center, Antoine-Beclere Hospital, Clamart, France*
[ad] *Division of Medicine, Department of Pulmonary Diseases, Turku University Hospital and Department of Pulmonary Diseases and Clinical Allegology, University of Turku, Turku, Finland*
[ae] *Sleep Disorders Unit, Department of Respiratory Medicine, Medical School, University of Crete, Crete, Greece*
[af] *2nd Department of Respiratory Medicine, Institute of Tuberculosis and Lung Diseases, Warsaw, Poland*
[ag] *Department of Anaesthesiology and Sleep Laboratory, Riga Stradins University, Riga, Latvia*
[ah] *Sleep Unit, Department of Pneumonology, Medical School, Democritus University of Thrace, Alexandroupolis, Greece*

* Corresponding author. Dipl.-Psych. Interdisciplinary Sleep Center, Charité – Universitätsmedizin Berlin, Campus Charité Mitte, Charitéplatz 1, 10117, Berlin, Germany.

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[ai] Grenoble Alpes University, Inserm, CHU Grenoble Alpes, Grenoble, France
[aj] Sleep Disorders Centre, University Hospital Gasthuisberg, Leuven, Belgium
[ak] Department of Clinical Therapeutics, Division of Pulmonnary Medicine, National and Kapodistrian University of Athens, School of Medicine, Athens, Greece
[al] Multidisciplinary Sleep Disorders Centre, University Hospital Antwerp and University of Antwerp, Edegem, Belgium
[am] Center of Pulmonology and Allergology, Clinic of Chest Diseases, Immunology and Allergology, Institute of Clinical Medicine, Faculty of Medicine, Vilnius University, Vilnius, Lithuania
[an] Saratov State University, Saratov, Russia

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ABSTRACT

Objective: In 2010, a questionnaire-based study on obstructive sleep apnea (OSA) management in Europe identified differences regarding reimbursement, sleep specialist qualification, and titration procedures. Now, 10 years later, a follow-up study was conducted as part of the ESADA (European Sleep Apnea Database) network to explore the development of OSA management over time.
Methods: The 2010 questionnaire including questions on sleep diagnostic, reimbursement, treatment, and certification was updated with questions on telemedicine and distributed to European Sleep Centers to reflect European OSA management practice.
Results: 26 countries (36 sleep centers) participated, representing 20 ESADA and 6 non-ESADA countries. All 21 countries from the 2010 survey participated. In 2010, OSA diagnostic procedures were performed mainly by specialized physicians (86%), whereas now mainly by certified sleep specialists and specialized physicians (69%). Treatment and titration procedures are currently quite homogenous, with a strong trend towards more Autotitrating Positive Airway Pressure treatment (in hospital 73%, at home 62%). From 2010 to 2020, home sleep apnea testing use increased (76%–89%) and polysomnography as sole diagnostic procedure decreased (24%–12%). Availability of a sleep specialist qualification increased (52%–65%) as well as the number of certified polysomnography scorers (certified physicians: 36%–79%; certified technicians: 20%–62%). Telemedicine, not surveyed in 2010, is now in 2020 used in diagnostics (8%), treatment (50%), and follow-up (73%).
Conclusion: In the past decade, formal qualification of sleep center personnel increased, OSA diagnostic and treatment procedures shifted towards a more automatic approach, and telemedicine became more prominent.

1. Introduction

Practical guidelines for the management of obstructive sleep apnea (OSA) have been established worldwide [1–3]. Ten years ago, we examined the diversity of clinical practice in Europe for the first time by including the members of a European network (the former COST Action B26 Group) [4]. Worldwide, more than 900 million adults exhibit an increased apnea-hypopnea index (AHI) level, and more than 400 million suffer from at least a moderate degree of OSA severity (AHI> 15 events/h) [5]. Also, the past two decades have shown a strong increase of OSA prevalence by 14–55% depending on age subgroup with the rising trend still continuing [6]. However, only around 20% of those affected have been recognized, diagnosed, and treated to date [7–10].

Sleep medicine has been further established and recognized in the past 10 years. This is also shown by the fact that sleep-related diseases may receive a separate chapter in the new ICD-11 (International Classification of Diseases 11th Revision) [11]. However, the initial expansion in sleep laboratories and sleep centers seems to be over, at least in Europe, which stands in contradiction to the growing need. While sleep medical care still seems to be secured by the established structures, the gap between the increasing need and existing structures is still widening [12–14]. There is a lack of sleep medicine specialists, new outpatient structures, and new billing models with the sponsoring institutions. Approaches to solve these problems include the establishment and expansion of home sleep apnea testing (HSAT) [15] and telemedicine-based technologies in the diagnosis and treatment of OSA [16,17]. Telemedicine found its way into sleep medicine around 10 years ago [18–20]. One of the very first approaches as early as 1994 used a telephone circuit and a computer-controlled support system to improve OSA treatment by improving lifestyle through teleguidance on nutrition and exercise [21].

The aim of the present survey was to determine how management of OSA has changed due to increasing demand and availability of new technologies, e.g. telemedicine-based technologies, within the past 10 years. We contacted the original European sleep centers that participated in the 2010 survey but also included some new sleep centers that were previously not involved. Questions about diagnostics, scoring, reimbursement, treatment, and certification were reissued and the questionnaire was supplemented with questions about telemedicine.

2. Methods

2.1. Questionnaire

The main core of the 2010 questionnaire was used again but with a few additional updated questions [4]. The questionnaire included questions on diagnostics, reimbursement, scoring, treatment, and sleep certification/qualification (Supplementary Fig. 1). We added new questions about the use of telemedicine in diagnostics, initiation of therapy, and follow-up. The first part of the questionnaire (Questionnaire – Part I) contains questions about diagnostic and therapeutic management of OSA. The second part of the questionnaire (Questionnaire – Part II) contains technical questions about handling and evaluation of diagnostics and therapy.

2.2. Procedures and participants

The survey took place from September 2019 until July 2020 and focused on the time before the COVID-19 period. We used the same

procedure as in 2010: The English version of the questionnaire was sent out by email with the request to complete it by a sleep specialist/expert according to the procedures in their sleep center. As an example, a completed questionnaire from Berlin (Germany) was attached. We aimed to include all participating countries from the 2010 survey for a direct comparison. In 2010, the EU-COST Action B26 network was used for recruitment. However, in 2007 ESADA (European Sleep Apnea Database) emerged as a joint project within the European Union COST Action B26 network of nationally appointed sleep apnea experts. Since then, it has established itself with currently 39 contributing centers across Europe and data from over 34,000 patients [22].

For our 2020 follow-up study, we contacted sleep centers of the active member countries of the current ESADA network. We also contacted sleep centers that originally participated in the 2010 survey but are no longer part of the European Network (Austria, Cyprus, Denmark, Iceland, Israel, and The Netherlands). In total, we contacted representatives from 39 sleep centers in 26 European countries. At least one sleep center in each country participated, only 3 sleep centers did not respond. Finally, 26 countries (36 sleep centers) participated (Fig. 1). These included the original 21 countries from 2010 (currently part of ESADA: Belgium, Czech Republic, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Poland, Slovakia, Spain, Sweden, United Kingdom; not part of ESADA: Austria, Cyprus, Denmark, Iceland, Israel, The Netherlands) and 5 new countries that are part of ESADA but have not been involved in 2010 (Croatia, Norway, Portugal, Romania, Turkey). As no patients were involved, no ethical approval of an institutional review board was needed.

2.3. Data analysis

For five countries (Belgium – Antwerp/Leuven, France – Grenoble/Paris, Germany – Berlin/Hamburg/Mainz/Sollingen, Greece – Alexandroupolis/Athens/Crete/Thessaloniki, Italy – Milano/Palermo/Pavia) we received multiple responses from several sleep center representatives. In these cases, we merged the answers to provide a figure representing the entire country and not just the separate sleep centers. In case of contradictory answers, we contacted again the center's representatives for clarifications. Statistical analysis was performed using Excel (Microsoft Excel for Microsoft 365 MSO) and SPSS (IBM SPSS Statistics, Version 20). All 26 countries (including the 5 countries not surveyed in 2010) were analyzed. We used descriptive statistics and chi-square tests for the comparisons, significance level was set at 0.05. Following, only p-values that reached significance (or a close approximation) are presented.

3. Results

Supplementary Table 1 presents a summarized overview of the results with a direct comparison of the 2010 and 2020 data. The top part compares the 21 countries surveyed at both time points; the lower part includes the five new countries only surveyed in 2020.

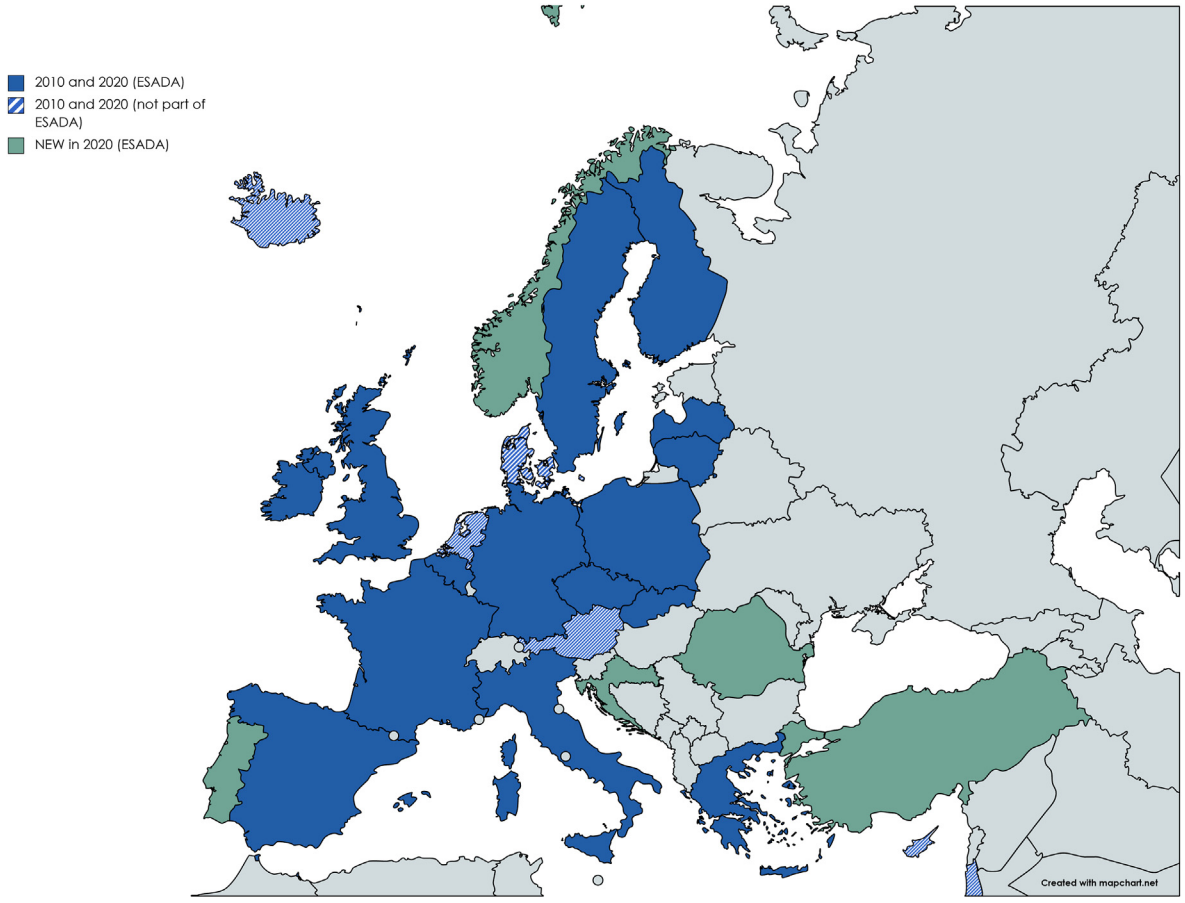

Fig. 1. European countries participating in the 2020 survey. Note: Countries marked in blue color (n=21) have participated both in 2010 as well as in 2020 (15 countries marked in dark blue are part of the European Sleep Apnea Database - ESADA network and six countries marked in light blue are currently not part of ESADA). In green color are the countries that did not participate in 2010 but are currently part of the ESADA network and participated in 2020 (n=5). . (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

3.1. Important changes in OSA diagnostics in Europe

Our survey revealed that the diagnosis of OSA is increasingly being carried out by specialists. Among the centers surveyed in 2020, 69% stated that a somnologist (certified sleep specialist) performs the diagnostics. In 2010, most diagnostic examinations (86%) were completed by specialized physicians (not somnologists). HSAT has become more important in OSA diagnostics over the years with an increase in its application by 13%. While the combined use of both HSAT and polysomnography (PSG) has increased by 10%, the use of PSG as sole diagnostic procedure for OSA decreased by 12% (Fig. 2).

Also, the quality of HSAT-recorded biosignals has increased significantly over the past decade. Compared to 2010, the following signals are significantly and increasingly being registered (Fig. 3): thoracic *(p=0.02)* and abdominal efforts *(p=0.001)*, oximetry *(p=0.01)*, body position *(p=0.02)*, and snoring sounds *(p=0.01)*. The automatic scoring of the HSAT recordings has increased by 13% (2010: 29%; 2020: 42%). In addition, two sleep laboratories (France, Latvia, 8%) reported use of telemedicine for sleep apnea diagnostics (France, Latvia).

Scoring of PSG, the gold standard recording technique in sleep medicine, is predominantly performed by technicians (81% for 2020 versus 67% in 2010), whereas scoring is less frequently performed by physicians (73% instead of 81%, respectively, Fig. 4).

In 2010, the so-called clinical (57%) or research definition (10%) or both (24%) were used as scoring criteria for hypopneas. Today, the so-called 1A rule is primarily used (73%) and in essence replaced the clinical definition. The 1A rule is defined by the American Academy of Sleep Medicine, AASM 2012a, including a 3% oxygen desaturation with concomitant arousal being possible but not necessary [23].

The quality standards of the sleep evaluation and scoring has increased significantly in recent years, a fact reflected in the sleep certification process (Fig. 5). In 2010, only 36% of the sleep centers stated that the physicians who scored the data were sleep-certified, while in 2020 this number has significantly increased to 79% being certified ($p=0.043$). There is also a significant leap in certification among the technicians (from 20% to 62%, $p=0.035$) and at least an increasing trend among nursing professionals (from 14% to 50%, $p>0.05$). The percentage of countries with a general sleep physician qualification in their country has increased from 52% (2010) to 65% (2020). While in 2010, this sleep-specific qualification was mainly granted by a National Sleep Society (8x National Sleep Society, 1x Chamber of Physicians, 2x University), in 2020 it is also quite often granted by the Chamber of Physicians (12x National Sleep Society, 9x Chamber of Physicians, 3x University, 2x Others).

The reimbursement of sleep medicine services has improved slightly. For HSAT, the coverage increased from 62% (2010) to 73% (2020) of the costs; for PSG, the coverage increased from 71% to 85% of the costs; for the follow-up, the coverage increased from 62% to 77% of the costs. The minimum to maximum reimbursed revenue situation is as follows: In 2010, the reimbursement for HSAT was between a minimum of 70€ (Sweden) to a maximum of 538€ (Cyprus). The reimbursement for PSG was between a minimum of 20€ (Slovakia) to a maximum of 400€ (Denmark). In 2020, the HSAT reimbursement amount remained similar between 11€ (Turkey) to 572€ (Lithuania). However, the reimbursement revenue for PSG with 20€ (Turkey) to 900€ (The Netherlands) showed a definite increase.

3.2. Important changes in OSA therapy in Europe

The frequency of both hospital monitoring (with HSAT, PSG, or neither) and hospital positive airway pressure titration (continuous: CPAP; auto-titrating: APAP), in particular hospital CPAP titration ($p=0.05$), has decreased (Fig. 6). Moreover, while in 2010 hospital titration with CPAP and APAP was offered equally, in 2020 hospital titration with APAP is more common in Europe (54% CPAP, 73% APAP). Hospital titration with either HSAT or PSG is offered in most centers, currently in 92% compared to 48% in 2010 *(p=0.001)*. This corresponds to a standardization and represents a quality feature of a center. Consequently, there were changes in home titration as well. Home titration with APAP and HSAT has increased from 38% (2010) to 42% (2020) and APAP with telemedicine is now offered in 50% of the countries.

In general, a combination of APAP, CPAP, BPAP (bi-level positive airway pressure) and ASV (adaptive servo-ventilation) therapies are used for long-term home treatment in Europe (2010–2020): APAP: 86%–89%; CPAP: 95%–85%; BPAP: 76%–89%, ASV and others: 33%–81%. However, the trend towards more APAP is noticeable. The ratio CPAP to APAP therapy was 70%–30% in 2010 and changed to 38% CPAP to 52% APAP and 10% others in 2020.

Telemedicine (Fig. 7) as the method for home PAP titration is offered by 50% of the participating laboratories (Cyprus, Czech

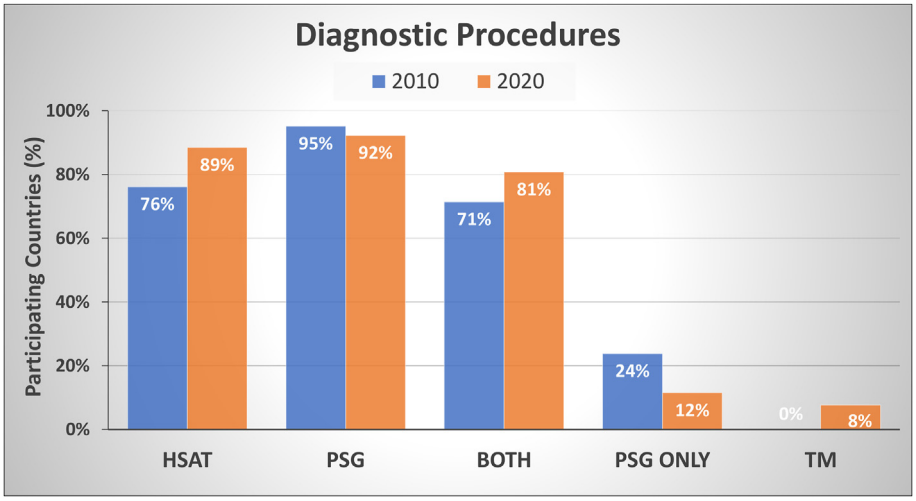

Fig. 2. Diagnostic procedures for obstructive sleep apnea: Comparison of the 2010 and 2020 responses (percentage of participating countries, 2010: n=21, 2020: n=26). HSAT=home sleep apnea testing; PSG=polysomnography; TM=telemedicine. Chi-square tests were performed for group comparison, significance level was set at 0.05. Only significant p-values are displayed.

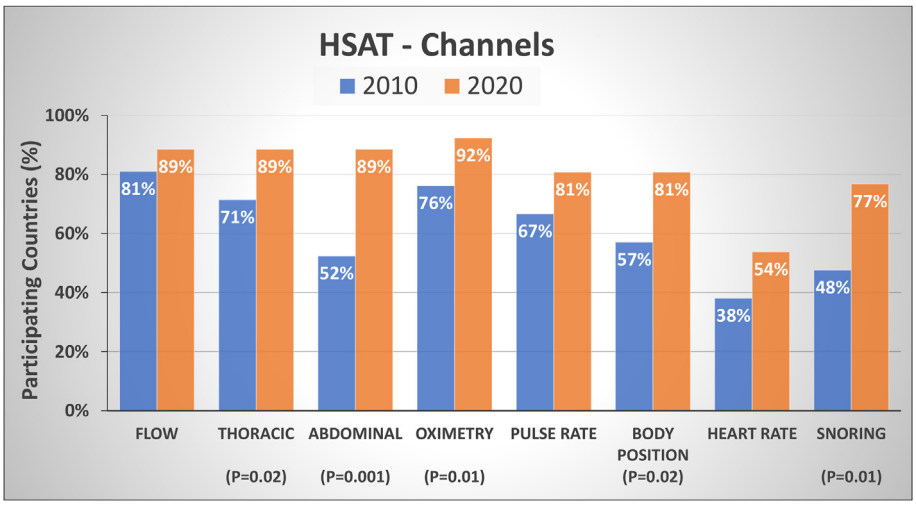

Fig. 3. Regular use of parameters during diagnostic home sleep apnea testing (HSAT channels): Comparison of the 2010 and 2020 responses (percentage of participating countries, 2010: n=21, 2020: n=26).
HSAT=home sleep apnea testing. Chi-square tests were performed for group comparison, significance level was set at 0.05. Only significant p-values are displayed.

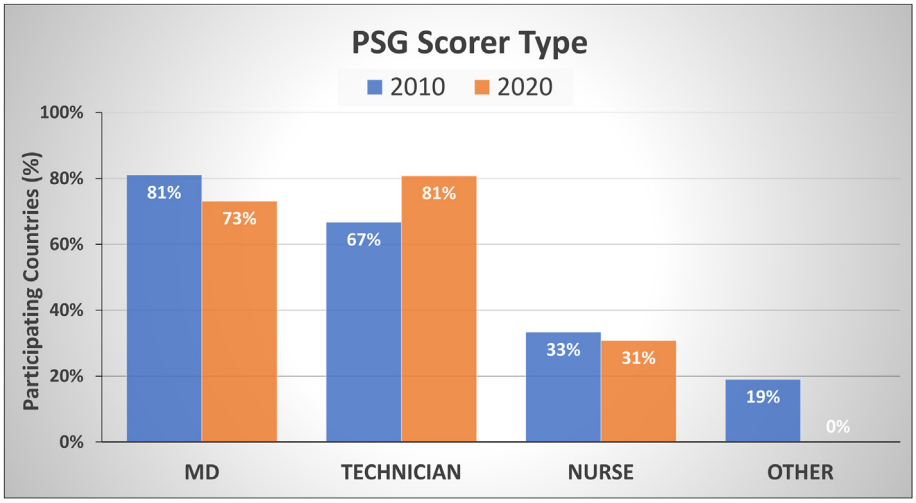

Fig. 4. Scoring practice for polysomnography (PSG) in 2010 and 2020 (percentage of participating countries, 2010: n=21, 2020: n=26). PSG=polysomnography; MD=medical doctor. Chi-square tests were performed for group comparison, significance level was set at 0.05. Only significant p-values are displayed.

Republic, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Latvia, Spain, The Netherlands, UK), and it is already offered by 73% (all except Austria, Croatia, Israel, Norway, Poland, Slovakia, Turkey) for follow-up examinations.

4. Discussion

Our comprehensive survey can demonstrate several new developments in the management of OSA in Europe during the past 10 years. First, formal qualification of sleep center personnel has substantially increased. Second, OSA diagnostic and treatment procedures became more ambulatory by including more outpatient-HSAT compared with in-hospital PSG. Analysis of sleep recordings and PAP titration procedures rely more on automated algorithms. And third, telemedicine is a new, already widely used approach for diagnostics, but especially for treatment initiation and treatment follow-up. The data show a trend towards simplifying OSA management while increasing the quality of care, which meets the increasing need with limited resources [24].

A particular strength of this follow-up survey is that 100% of the countries surveyed 10 years ago took part again. In addition, we contacted other centers from countries that had not yet been surveyed, mainly to capture the current management in Europe even more comprehensively, especially with regard to the various regions.

4.1. Advances in sleep medicine qualification and training

As in other regions of the world, sleep apnea diagnostics and therapy are carried out by medical doctors and staff trained in sleep medicine. They are essentially certified sleep specialists; in Europe these are called somnologists. Currently, almost 70% of sleep centers report that either a somnologist or a specialized physician is responsible for performing diagnostics. Ten years ago, 14% were physicians and 86% were specialized physicians also trained in sleep medicine. In the USA, the first sleep certification and examinations have been carried out in 1978 by the former Examination Committee of the Association of Sleep Disorders Centers (now

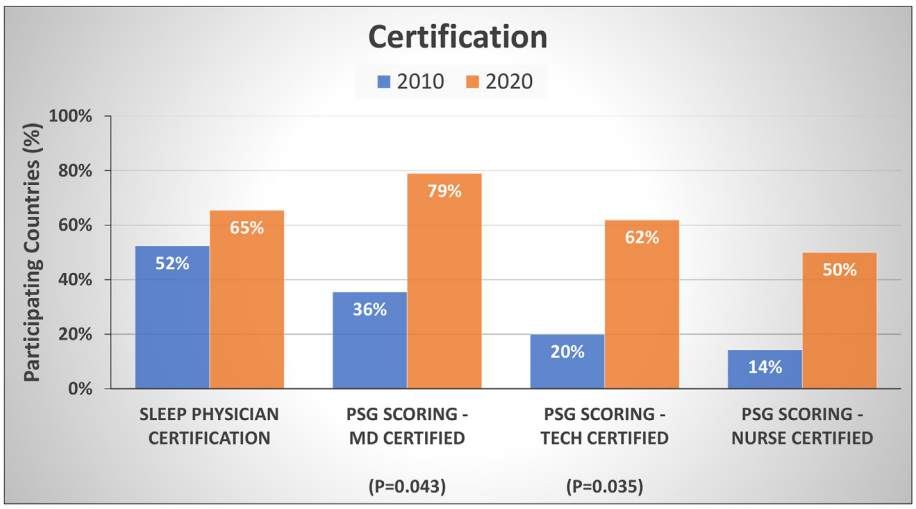

Fig. 5. of certified staffing in sleep medicine centers around Europe: Comparison of the 2010 and 2020 responses (percentage of participating countries, 2010: n=21, 2020: n=26). PSG=polysomnography; MD=medical doctor/ physician; Tech=medical technician. Chi-square tests were performed for group comparison, significance level was set at 0.05. Only significant p-values are displayed.

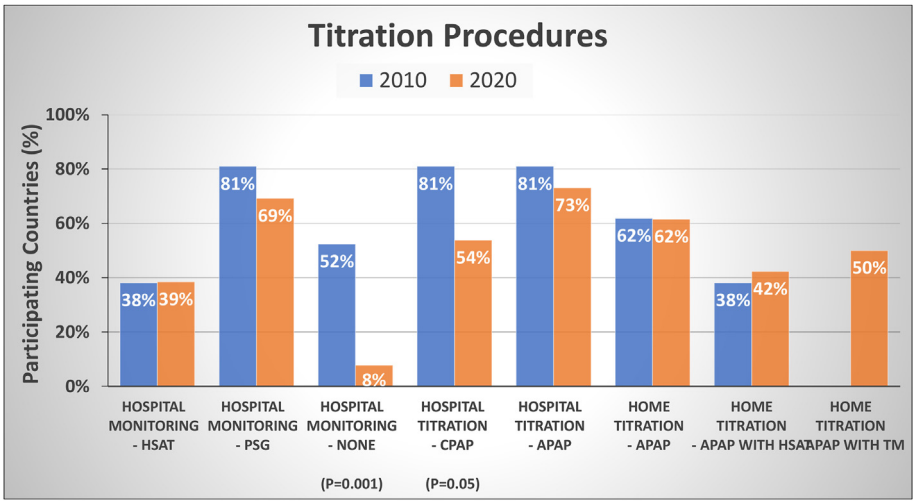

Fig. 6. Titration procedures for Positive Airway Pressure treatment in Europe: Comparison of the 2010 and 2020 responses (percentage of participating countries, 2010: n=21, 2020: n=26).
HSAT=home sleep apnea testing; PSG=polysomnography; CPAP=continuous positive airway pressure; APAP=automatic positive airway pressure; TM=telemedicine. Chi-square tests were performed for group comparison, significance level was set at 0.05. Only significant p-values are displayed.

American Academy of Sleep Medicine). In Europe, the certification of a sleep specialist, called somnologist, only exists since 2012. Since then, regular examinations of somnologists are commissioned by the European Sleep Research Society (ESRS) [25–27], a fact that may also contribute to the improvement of personnel qualification in sleep medicine. The sleep qualification of physicians is important for a standardized evaluation of the HSAT or PSG data. Today, 79% of the sleep centers use physicians certified in sleep medicine, 62% use certified sleep technicians and 50% use certified nurses for the evaluation. This is a significant leap in quality for all three professional groups, brought on by the ESRS and the European national sleep societies and authorities.

The fact that the qualification of medical technical staff is important is also illustrated by the fact that sleep specialists are rare in Europe. In the US, one sleep specialist accounts for every 43,000 inhabitants. In Europe, this proportion is even smaller. In Germany, a proportion of 1–70,000 inhabitants is estimated [25]. Therefore, there is a need for trained staff that is not inferior to the sleep specialist physician for the care of OSA patients. Clinical studies have shown no differences in clinical outcomes or in compliance with therapy between sleep specialist physicians and personnel trained in sleep medicine [28]. OSA is among the most common chronic conditions in the middle-aged population [5–10] and those who suffer from OSA are usually well-known in primary care as they often suffer from other chronic conditions as well. The high prevalence of residual daytime sleepiness among patients who at first seem adequately treated with CPAP is a reminder that doctoral involvement is still needed for individual patient evaluation of residual daytime sleepiness [29]. Better methods for evaluation sleepiness, understanding of its causes and improved treatment are urgently needed [30].

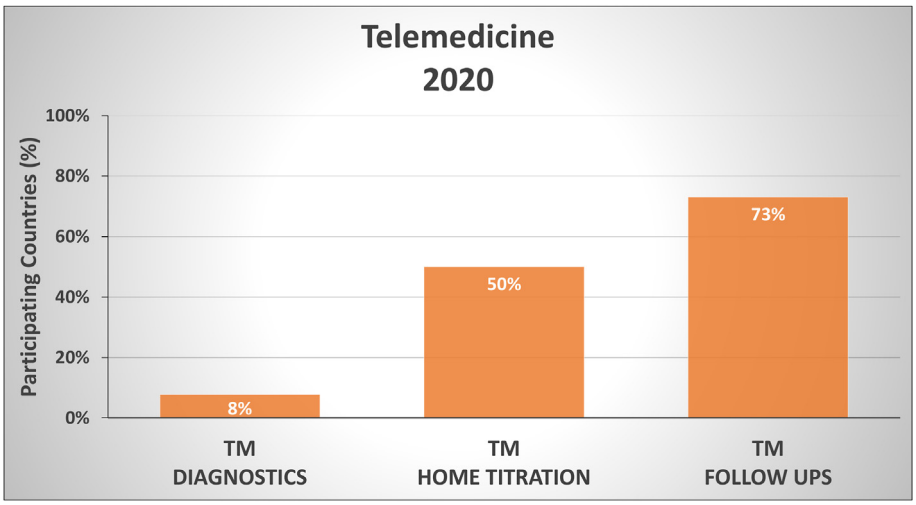

Fig. 7. Use of telemedicine (TM) during diagnostics, treatment, and follow-up in Europe in 2020 (prior to the COVID-19 pandemic, n=26 countries surveyed). TM=telemedicine.

4.2. Trend towards automatic diagnostics

As far as the diagnosis of OSA is concerned, our survey shows an increase in HSAT (home sleep apnea testing) with a concomitant increase in measurement quality due to the recording of more biosignals or parameters and the above-mentioned increase in qualified evaluation. The PSG is used less frequently, which is confirmed in our survey of 36 centers. Only 12% of the centers rely on the PSG alone for diagnostics and do not use HSAT. In the 2019 AASM guidelines for treatment of OSA, it is stated that a HSAT or PSG is a prerequisite for initiating therapy [3]. However, recent studies have shown high sensitivity and high specificity for HSAT (sensitivity: 79%; 95% confidence interval 71%–86%; specificity: 79%; 63%–89%; area under the receiver operating characteristic curve exceeding 0.85) [31]. However, the false-negatives for OSA increase when patients have a high prior probability of disease (about 25%–50% of OSA negatives were false-negatives). Therefore, in certain cases such as unexplained sleepiness combined with suspected OSA, we recommend that a negative home study may need to be confirmed by PSG to thoroughly exclude OSA and then, investigate alternative causes for sleepiness. This approach to OSA diagnosis is accurate and cost-effective.

While in-laboratory PSG still remains the gold standard for OSA diagnosis, the use of HSAT has increased in clinical practice, especially for patients with a high prior probability of OSA. Studies have shown positive evidence for the diagnosis of moderate to severe OSA by using HSAT (manually scored type III, unattended portable monitor) and an AHI of 15 events/h or higher [32]. However, evidence for mild OSA is still lacking. The practice guidelines recommend HSAT only for a suspected severe OSA and in absence of cardiorespiratory diseases or insomnia. Still, there is also evidence of a high diagnostic accuracy of HSAT for suspected moderate OSA, for patients with comorbid obstructive lung disease, or for patients with heart failure [32]. This suggests even more potential for the HSAT. In the future, HSAT may become a much more essential part of OSA diagnosis, not least because of its easier use and cost-effectiveness. HSAT also saves personnel resources by use of automatic evaluation which has improved in the past years. With 42% of countries in our survey using currently automatic HSAT scoring, a definite increase compared to 2010 (29%) is observed. The clear trend towards HSAT and automatic scoring not only makes sense in terms of practicability but is also more cost-effective and allows more patients to be diagnosed in a shorter time. On the other hand, there is a quality leak here, since the automatic evaluation is not suitable for diagnosis, treatment decision and assessment of treatment efficiency [15]. It is essential for the raw HSAT data to be reviewed and interpreted by a physician who is either board-certified in sleep medicine or qualified for HSAT application or overseen by a board-certified sleep medicine physician.

However, it will not and should not displace PSG resources, because there are still plenty of patients with a high comorbidity, with a combination of different sleep disorders, with a health risk and/or the need for monitoring during the day (sleepiness, circadian sleep disorders, respiratory insufficiency etc.) or with a non-diagnostic HSAT (technically inadequate or AHI <5 events per hour). These require attended PSG and an evaluation by qualified personnel, which is well reflected in our survey. In 73% of the centers, a physician is still involved in the evaluation, although the use of technicians has increased. As far as PSG scoring is concerned, we are still a long way from a valid automatic scoring. However, the visual scoring becomes more uniform. Our survey shows that 73% of the laboratories now use a uniform definition of hypopnea, the so-called 1A rule (AASM 2012a definition) [23], which is primarily applied in clinical use but has not yet been documented or referred to as a clinical definition.

In addition to HSAT and/or PSG, diagnostics naturally also include anamnesis, assessment of the phenotype (e.g. of the upper respiratory tract) and questionnaires such as the STOP-Bang or the Berlin questionnaire [33]. However, our survey did not cover those additional diagnostic steps.

4.3. Shifts towards automatic treatment

As far as therapy is concerned, hospital-based PAP titration has decreased. From the authors' point of view, the provision of the PSG is an important quality feature for a sleep medicine center and distinguishes it from a sleep medicine practice. Both, home APAP titration and in-laboratory PAP titration are recommended in the current guidelines [3]. The final choice of the approach may be based on access, clinical patient condition, cost-effectiveness, patient preference, sleep clinician judgment, etc. Both approaches are comparable in terms of effectiveness in relation to OSA severity, adherence, sleepiness, and quality of life. If asked, the patient will most probably choose the more convenient, accessible, and cost-effective method, especially if this also includes education, mask training, etc. [34]. From our point of view, it is important for the

training of sleep physicians and technicians to learn the in-lab manual PAP titration. This is necessary as there still are patients diagnosed and treated in the sleep laboratory. Regarding the ventilation mode that is used in Europe, in general, both modes, CPAP and APAP, are recommended in all centers. Both methods are also comparable in terms of effectiveness, sleepiness, quality of life, cognitive function, and side effects, with the advantage of the APAP that it can react to changing pressure requirements over time in response to acute or chronic changes (e.g. body weight changes, body position, alcohol, etc.). A specific patient preference has not yet been clearly seen, although there are indications of an APAP preference [28]. Our survey revealed a clear preference of the centers for APAP titration, both in-lab and at-home. BPAP can be considered when high pressures are required or in case of pressure intolerance. Here, the reduction of expiratory pressure may contribute to better adherence. With regard to effectiveness, adherence, sleepiness and quality of life, BPAP and CPAP are also comparable. However, patients are more likely to choose CPAP over BPAP. Our data show that the BPAP titration is offered in 23 of the surveyed countries, but only accounts for a small percentage in actual treatment.

For long-term therapy, sleep centers in Europe now offer less CPAP and more APAP and bi-level devices. The current supply ratio is 52% APAP to 38% CPAP. Ten years ago, the ratio was 1:3. In the current survey we explored the use of other therapy modes in more detail. While 81% of countries offer the use of other therapy modes including mostly ASV, the actual application is low by approximately 3% compared to the other options. This may have to do with the evidence from the SERVE-HF clinical trial that revealed no benefit of ASV treatment for central sleep apnea in patients diagnosed with heart failure [35].

4.4. Shifts towards telemedicine

It is becoming more and more evident that telemedicine is not inferior to the conventional in-lab approach and may even be superior in terms of adherence [36]. In Europe, sleep centers from Spain were the pioneers in applying telemedicine in sleep [37]. Before an initiation of PAP therapy, patient education should take place and telemedicine should be used during the initiation. With patient education and/or telemedicine, adherence and sleepiness are better [38]. Both are also desired by patients [34]. Telemedicine now has an established position in sleep medicine, although this was not the case 10 years ago. Our results show that telemedicine is included in diagnostics already in 8% of surveyed countries. It also supports in-home titration and is used by 50% of the centers and, plays a major role in follow-up and is used in 73% of the surveyed countries.

That is important, because there is very strong evidence that the first days up to two weeks of therapy are important for long-term compliance. Patil et al. [34] encourage that the therapy should be closely monitored, and that follow-up should be based on individual needs and circumstances [39]. Follow-up is recommended on a yearly basis, which is certainly not the case in Europe, as our data show. It has been shown that continuing patient care via Internet and other digital formats may help to significantly increase adherence [38]. All surveyed centers state that they follow up with their patients, the first time of follow-up varies from one month to one year. The therapy control is important, because research increasingly supports an association between greater PAP use and improved outcomes. There is evidence that nighttime PAP use of 4 or more hours reduces new-onset hypertension risk or cardiovascular events. Additionally, PAP use improves health-related quality of life and daytime sleepiness in patients without severe sleepiness [38]. Early detection of side effects and problems associated with PAP-therapy is another important aspect that makes use of telemedicine in PAP follow-up necessary. PAP therapy may lead to mild adverse effects, including mask discomfort, nocturnal awakenings, nasal congestion, or oro-nasal dryness.

It should be mentioned that the survey took place before the COVID-19 pandemic. There are separate surveys that investigated the impact of the pandemic on sleep medicine and telemedicine [40–43]. A survey by Grote et al. [42] during the first wave of COVID-19 in Europe was able to show that at the early stage of the COVID-19 pandemic telemedicine did not significantly boost sleep medicine services in Europe. Basically, fewer patients were cared for and the proportion of telemedicine patients remained constant at around one third. One possible reason is the high proportion of German sleep centers in the survey. In Germany, sleep medical care for OSA patients is still largely traditionally carried out in the sleep laboratory. The most likely reason was the reported reduction of overall staffing in the sleep centers and the incapacity to restructure sleep medicine services from traditional to more telemedicine-based services. In fact, studies and recommendations during later stages of the pandemic advocated the principal benefits of telemedicine technologies for the re-opening of sleep medicine activities for both diagnosis and treatment of OSA.

4.5. Conclusion

We found remarkable and gratifying preliminary evidence that in Europe the quality of sleep medicine care is increasingly being impacted by better personal qualifications. Additionally, the scientifically based feasibility of the HSAT approach is being increasingly implemented in practice, the technical progress of therapy (e.g. APAP mode) gains ground into clinical practice, and the interest in and application of telemedicine is justifiably on the rise. Such surveys, especially in a longitudinal design, are important to investigate and document whether international recommendations and guidelines are implemented approximately in the same way among different countries.

Declaration of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed at …

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2022.06.001.

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