

## RESEARCH ARTICLE



# Sleep medicine catalogue of knowledge and skills – Revision

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## Abstract

The 'catalogue of knowledge and skills' for sleep medicine presents the blueprint for a curriculum, a textbook, and an examination on sleep medicine. The first catalogue of knowledge and skills was presented by the European Sleep Research Society in 2014. It was developed following a formal Delphi procedure. A revised version was needed in order to incorporate changes that have occurred in the meantime in the International Classification of Sleep Disorders, updates in the manual for scoring sleep and associated events, and, most important, new knowledge in sleep physiology and pathophysiology. In addition, another major change can be observed in sleep medicine: a paradigm shift in sleep medicine has taken place. Sleep medicine

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is no longer a small interdisciplinary field in medicine. Sleep medicine has increased in terms of recognition and importance in medical care. Consequently, major medical fields (e.g. pneumology, cardiology, neurology, psychiatry, otorhinolaryngology, paediatrics) recognise that sleep disorders become a necessity for education and for diagnostic assessment in their discipline. This paradigm change is considered in the catalogue of knowledge and skills revision by the addition of new chapters.

## PREAMBLE

The first 'catalogue of knowledge and skills' for sleep medicine was published in 2014 (Penzel et al., 2014). Since then, there have been updates of the International Classification of Sleep Disorders (AASM, 2014) and sleep scoring rules (Berry et al., 2020), and an increased knowledge of the pathophysiological mechanisms of sleep disorders. Moreover, more medical disciplines are involved in the care of patients with sleep disorders and these clinicians need an additional pathway to their original specialty that includes the role of sleep disorders. These considerations necessitate a major revision of the catalogue of knowledge and skills that includes major changes in structure. Table 1 shows the adapted structure of the catalogue and this new table will form the basis for educational material and for examination questions.

## 1 | INTRODUCTION

Sleep medicine needs a comprehensive education of physicians, psychologists, scientists and technologists actively working in this interdisciplinary field of medicine. Sleep medicine is a small, but strongly interdisciplinary field that requires knowledge of sleep-related aspects in pneumology, cardiology, endocrinology, neurology, neurophysiology, psychiatry, psychology, otorhinolaryngology, and paediatrics. A clinician wanting to specialise in sleep medicine should have some knowledge in all these fields with a special focus on sleep-related issues. The purpose of this catalogue of knowledge and skills is to identify sleep-related issues from all these fields. A sleep medicine textbook did follow the outline of the first catalogue of knowledge and skills (Bassetti et al., 2014).

From the early emergence of sleep medicine as a clinical subject, when interested physicians focussed on the most prevalent disorders, such as insomnia and sleep-disordered breathing, these specialists came from their original speciality, typically psychiatry, neurology, and pneumology, and learned the basics of the complementary fields. These clinicians worked to develop sleep medicine as a discipline in its own right and succeeded to create a subspecialty that is recognised by the responsible medical authorities in many countries. In recent years, a new development has been observed. Physicians wish to remain in their own discipline, but also wish to learn more about sleep and related fields in order to diagnose and treat the patients with sleep disorders that they see in their

department. These physicians do not primarily wish to become sleep physicians, but wish to add specific knowledge of sleep-related aspects in order to expand their own speciality to manage these new patients. These two tendencies are reflected by the updated catalogue of knowledge and skills. While the catalogue, as presented in a condensed way in Table 1, starts with the core sleep physiology (Chapter A), the methodology (Chapter B), and then sleep disorders, as systematically ordered in the International Classification Of Sleep Disorders (Chapters C–H), it is now expanded by an important second part. This second part reflects the view of the different disciplines on their patients with sleep disorders. The first chapter in the second part is on paediatric sleep disorders (Chapter I). In the previous version of the catalogue, there was no separate chapter on paediatric sleep disorders (Penzel et al., 2014). Instead, paediatric aspects were distributed all over other chapters. Now, these aspects are taken together in one new chapter. Then follow the specific chapters reflecting the topics relevant to other large medical fields such as pulmonology, internal medicine, psychiatry, neurology, and geriatrics (Chapters J–N). The final chapter, which was also present in the previous version, gives an overview on societal, research, and organisational aspects important for sleep medicine (Chapter O). The new, revised catalogue of knowledge and skills is the blueprint for an updated textbook on sleep medicine (Bassetti et al., 2021).

With these changes, the new catalogue is not only an update about new knowledge and new content, but also reflects the evolution of sleep medicine as a discipline, now spreading out to the large specialties of medicine in general. Certainly, other fields including occupational medicine, obstetrics, and dental medicine are interested in getting more involved in sleep disorders and these fields may evolve in the future.

Overall, the catalogue of knowledge and skills serves as a blueprint for education in sleep medicine and for creating the sleep medicine examination. The implementation of this revised catalogue materialises in the second edition of the textbook on sleep medicine (Bassetti et al., 2021) that mirrors this revised catalogue of knowledge and skills.

## 2 | METHODS

The medical content of the catalogue of knowledge and skills is designed based on the usual pillars of medical education. This starts with physiological background, diagnostic methodologies, followed

**TABLE 1** Outline of the new catalogue of knowledge and skills. Chapter numbers are given and comments compare this version against the first version presented in 2014 (Penzel et al., 2014)

A. Physiological basis of sleep	Comments
1. The neurophysiology and neurobiology of wakefulness and non-rapid eye movement (NREM) sleep	Changes
2. The neurophysiology and neurobiology of paradoxical (REM) sleep	Changes
3. Adaptation of bodily functions to sleep	Update
4. Theories on the functions of sleep	Update
5. Sleep and psychology (cognitive and emotional processes)	New
6. Effects of acute and chronic sleep deprivation	Update
7. Sleep and dreaming	Update
8. Aging and sleep: sleep in all stages of human development	Changes
9. Gender differences in sleep	Update
10. Circadian biology / Chronobiology	New
11. Effects of various pharmacological treatments on sleep	New
<b>B. Assessment of sleep disorders and diagnostic procedures</b>	Update
1. Classification of sleep disorders	Update
2. The clinical interview and clinical examination	Update
3. Measuring: Monitoring sleep and wakefulness	Update
4. Other tests and examinations	Update
5. Biomarkers for disturbed sleep	New
<b>C. Insomnia</b>	Update
1. Nosological classification, definitions, and epidemiology	Update
2. Pathophysiology	Changes
3. Clinical picture and diagnosis	Update
4. Comorbidities and special populations	Update
5. Treatment	Update
5.1. Current guidelines	Changes
5.2. Cognitive behavioural therapy for insomnia and other psychotherapeutic approaches	Update
5.3. Pharmacological treatment	Update
5.4. Evidence-based efficacy of alternative interventions	Changes
<b>D. Sleep-related breathing disorders</b>	Update
1. Nosological classification, definitions, and epidemiology	Update
2. Pathophysiology	Update
3. Clinical picture and diagnosis	Update
4. Obstructive sleep apnoea and comorbidities: a specific focus on cardio-metabolic comorbidities	Changes
5. Treatment	Update
<b>E. Hypersomnias of central origin</b>	Update
1. Nosological classification, definitions, and epidemiology	Update
2. Aetio-Pathophysiology	Update
3. Clinical picture and diagnosis	Update
4. Treatment	Update
5. Miscellaneous topics	Update
<b>F. Circadian rhythm sleep disorders</b>	Update
1. Nosological classification, definitions, and epidemiology	Update
2. Pathophysiology	Update
2.1 Shift work	New
2.2 Delayed sleep-wake phase disorder	New

(Continues)

TABLE 1 (Continued)

2.3 Non-24-hr sleep-wake disorder	New
3. Clinical picture and diagnosis	New
4. Comorbidities	New
5. Health risks	New
6. Treatment	New
<b>G. Parasomnias</b>	New
1. Nosological classification, definitions, epidemiology	New
2. Pathophysiology and psychopathology	New
3. Clinical findings	New
4. Special populations and comorbidities	New
5. Treatment	New
6. Miscellaneous topics	New
<b>H. Sleep-related movement disorders</b>	New
1. Nosological classification, definitions, and epidemiology	New
2. Pathophysiology	New
3. Clinical picture and diagnosis	New
4. Comorbidities	New
5. Treatment	New
<b>I. Paediatric sleep disorders</b>	New
1. Chronic Insomnia	New
2. Specific features of parasomnias	New
3. Obstructive sleep apnea	New
4. Sleep-related movement disorders	New
5. Narcolepsy	New
6. Sleep in neurodevelopmental disorders	New
<b>J. Sleep and pulmonology</b>	New
1. Overview and pathophysiology	New
2. Obstructive sleep apnoea and chronic obstructive pulmonary disease overlap	New
3. Sleep-disordered breathing and asthma	New
4. Sleep-disordered breathing and interstitial lung disease (ILD)	New
5. Hypoventilation disorders	New
<b>K. Sleep and internal medicine</b>	New
1. Cardiovascular diseases: heart failure, coronary artery disease, arrhythmias, and hypertension	New
2. Endocrine diseases: diabetes mellitus, diseases of the thyroid, acromegaly, polycystic ovarian syndrome	New
3. Nocturia	New
4. Cancer	New
5. Chronic fatigue and pain syndromes	New
6. Sleep in critically ill patients	New
<b>L. Sleep and psychiatry</b>	New
1. Overview	New
2. Substance use disorders	New
3. Schizophrenia spectrum disorders	New
4. Affective disorders	New
5. Anxiety disorders	New
6. Other psychiatric disorders	New
<b>M. Sleep and neurology</b>	New

(Continues)

**TABLE 1** (Continued)

1. Overview	New
2. Epilepsy	New
3. Parkinsonian syndromes	New
4. Dementias	New
5. Stroke	New
6. Headache	New
7. Multiple sclerosis and other autoimmune disorders	New
8. Neuromuscular disorders	New
N. Sleep and geriatrics	New
1. Sleep in the elderly	New
2. Sleep disorders in the elderly	New
O. Societal, economic, organisational, and research aspects	Update
1. Demographic and socioeconomic aspects of sleep disorders	Update
2. Forensic aspects of sleep medicine	Update
3. Organisation of Sleep Medicine Centres	Update
4. Training initiatives in sleep medicine	Update
5. Research design and quantitative methods	Update
6. Shift work, sleep, and sleepiness	Changes

Comments: "Changes" denotes that the chapter underwent major restructuring in terms of title and content. "New" denotes that the chapter is entirely new; these chapters cover parts which were only briefly mentioned in other chapters of the initial catalogue of knowledge and skills. Table 2 gives an overview of the distribution of ECTS points as redistributed according to the new structure.

**TABLE 2** ECTS points with an overview of the distribution of ECTS points as redistributed according to the new structure

Chapter	MD		Master's		Technologists and nurses	
	Credits T	Credits P	Credits T	Credits P	Credits T	Credits P
A	2	0	2	0	1.5	0
B	2		2		6	
C	1		1		0.5	
D	1		1		1.5	
E	1		1		0.5	
F	1		1		1	
G	1		1		0.5	
H	1		1		0.5	
I	1		1		1	
J	0.75	0	0.75	0	0.75	
K	0.75		0.75		0.75	
L	0.75		0.75		0.75	
M	0.75		0.75		0.75	
N	0.5		0.5		0.5	
O	0.5		0.5		0.5	
Total	15	45	15	45	15	45

Credits P, practical skills acquired primarily by supervised training; Credits T, theoretical knowledge; MD, Doctor of Medicine.

by all major diagnostic entities, and ends with organisational aspects and societal impacts. As a result, the initial version of the catalogue of knowledge and skills began with a chapter on physiology

(A) assessment of sleep disorders (B), followed by the chapters as specified in the international classification of sleep disorders, insomnia (C), sleep-related breathing disorders (D), hypersomnias of

central origin (E), circadian rhythm sleep disorders (F), parasomnias (G), sleep-related movement disorders (H), miscellaneous sleep-related conditions and disorders (I), and finally ended with societal, economic, organisational and research aspects of sleep medicine (J). The exact contents for each chapter were consented using a Delphi round with 110 sleep experts from 25 countries.

The initial time and resource planning in the catalogue of knowledge and skills (Penzel et al., 2014) was created based on the general concept of medical and scientific education as elaborated by the Bologna process for unifying education between countries. This layout resulted in a training schedule for obtaining a medical certificate for sleep medicine or a Master's certificate for sleep medicine/sleep research with a 1-year period required of academic full-time training. This corresponds to 1,500–1,800 hr of training hours. The Bologna process has established a credit point system, the European Credit Transfer and Accumulation System (ECTS), to enable scholars to obtain their training from different institutions and transfer parts or modules, and to spread the training in terms of time used over extended periods of time. One academic year corresponds to 60 ECTS points. This ECTS system proved to be practical if a part-time training is envisioned or if training is performed part time alongside a regular job. The outline of the content and the corresponding ECTS points were initially consented by the Delphi round in the first version of the catalogue of knowledge and skills.

Based on this previous work, the revision considered curricula on sleep medicine in Europe, which were created during the intervening period. The updates in terms of sleep medicine knowledge were also considered. Furthermore, and most important, the change of view as outlined in the introduction was considered. In the present revision, the previous main Chapters A–H were transferred to the new curriculum with updates considering the growth in knowledge, and importantly, the new Chapters I–N were introduced. The previous Chapter J has now become Chapter O. The ECTS points were redistributed to reflect this expansion. The group discussed the potential need to run a new Delphi round for identifying important and less important keywords and topics to be covered in the revision. Several discussions took place among the authors of this paper, the ESRS examination committee, and the editors of the ESRS textbook on sleep medicine. Feedback was collected from authors of questions for the ESRS somnologist examinations, from participants of the examinations, and from the ESRS sleep medicine textbook chapter authors. Finally, it was agreed that this feedback was sufficient for the revision of the catalogue and a new Delphi round was not needed.

### 3 | RESULTS

The results of the revision of the catalogue on knowledge are two-fold; they provide a new table of contents (Table 1) for the new textbook on sleep medicine, and a new table with ECTS points (Table 2), which defines the time and effort to be spent with each chapter. The new table of contents mirrors the table of content for the new ESRS textbook on sleep medicine. The comment next to each chapter

headline explains whether the chapter has been renamed and restructured ("changes") or has been updated to current knowledge ("update") or has been added and newly written ("new").

## 4 | DISCUSSION

The initial catalogue of knowledge and skill was compiled and consolidated using a Delphi round among 110 sleep experts worldwide. The update used the experience from using the curriculum in several implementations and from several examinations in sleep medicine. As the field of sleep medicine expands and returns to the initial main fields in medicine, new chapters have been added to reflect the demand of physicians who want to stay in their field and need to understand the relevance of sleep medicine in their specific clinical environment. With this, the updated catalogue of knowledge and skills reflects the increase in demands for medical knowledge about sleep medicine and sleep research. Feedback from ESRS somnologist examinations and from the ESRS textbook on sleep medicine chapter authors was used to update the catalogue. A new Delphi was considered, but was not found necessary for this revision.

### CONFLICTS OF INTEREST

TPe received grants from Cidelec, Löwenstein Medical, Novartis. Received consulting fees and speaker fees from Bayer Healthcare, Cerebra, Jazz Pharmaceutical, Löwenstein Medical, Neuwirth Medical, National Sleep Foundation and owns shares of Advanced Sleep Research, Nukute, The Siestagroup.

DP, CB, PP, TPau, WTMcN, ZD: these authors declared no conflict of interest.

LG reports grant support from Resmed, Itamar, and Desitin, speaker fees from Resmed, Philips, Itamar, Fisher & Paykel, and Astra Zeneca. LG is co-owner of a patent related to sleep apnoea treatment.

AR, FC, MPO, LN, TPai, TPO, DR, MZ, EH, EA, LP: these authors declared no conflict of interest.

### DATA AVAILABILITY STATEMENT

This paper does contain tables with knowledge but no additional data which need to be disclosed.

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## REFERENCES

- American Academy of Sleep Medicine (AASM). (2014). *ICSD-3 – International Classification of Sleep Disorders. 3rd edn Diagnostic and coding manual*. AASM.
- Bassetti, C. L., Dogas, Z., & Peigneux, P. (Eds). (2014). *ESRS European sleep medicine textbook*. ESRS Regensburg. ISBN 9781119038931
- Bassetti, C. L., McNicholas, W. T., Paunio, T., & Peigneux, P. (Eds). *Sleep medicine textbook*. 2nd edn. European Sleep Research Society. Forthcoming.
- Berry, R. B., Brooks, R., Gamaldo, C., Harding, S.M., Lloyd, R.M., Quan, S.F., Troester, M.T., & Vaughn, B.V., for the American Academy of Sleep Medicine. (2020). *The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications, Version 2.6*. American Academy of Sleep Medicine.

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