Catalogue of knowledge and skills for sleep medicine

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Keywords
curriculum, educational programme, medical education, sleep medicine, training

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Accepted in revised form 29 July 2013; received 15 July 2012

DOI: 10.1111/jsr.12095

SUMMMARY
Sleep medicine is evolving globally into a medical subspeciality in its own right, and in parallel, behavioural sleep medicine and sleep technology are expanding rapidly. Educational programmes are being implemented at different levels in many European countries. However, these programmes would benefit from a common, interdisciplinary curriculum. This 'catalogue of knowledge and skills' for sleep medicine is proposed, therefore, as a template for developing more standardized curricula across Europe. The Board and The Sleep Medicine Committee of the European Sleep Research Society (ESRS) have compiled the catalogue based on textbooks, standard of practice publications, systematic reviews and professional experience, validated subsequently by an online survey completed by 110 delegates specialized in sleep medicine from different European countries. The catalogue comprises 10 chapters covering physiology, pathology, diagnostic and treatment procedures to societal and organizational aspects of sleep medicine. Required levels of knowledge and skills are defined, as is a proposed workload of 60 points according to the European Credit Transfer System (ECTS). The catalogue is intended to be a basis for sleep medicine education, for sleep medicine courses and for sleep medicine examinations, serving not only physicians with a medical speciality degree, but also PhD and MSc health professionals such as clinical psychologists and scientists, technologists and nurses, all of whom may be involved professionally in sleep medicine. In the future, the catalogue will be revised in accordance with advances in the field of sleep medicine.

INTRODUCTION

In recent years, sleep medicine has emerged as a new discipline in health care. In analogy with other specialities, the practice of sleep medicine is based on the acquisition of particular professional competences. Importantly, the clinical management of sleep disorders currently pertains to the practice of many physicians and non-medical health-care professionals, with variations of the term, such as behavioural sleep medicine, reflecting a multi-disciplinary approach to the diagnosis and treatment of individual patients. Sleep medicine, therefore, is open to professionals with different professional backgrounds. In parallel, scientific knowledge in this field has grown substantially in several areas, including neuroscience, physiology, pharmacology, psychology and epidemiology, as well as in respiratory and cardiovascular medicine. It is clear, therefore, that caring for patients with sleep disorders requires a high level of multi-disciplinary proficiency that can only be obtained reliably following proper education and practical training.

The ESRS catalogue of knowledge and skills for sleep medicine, hereafter called 'the catalogue', is intended to be a basis and a guide for professional curricula in clinical sleep medicine. By describing a comprehensive set of topics and learning objectives, the catalogue delineates the areas of knowledge and competence expected across aetiologically diverse sleep disorders. The catalogue inevitably has to be descriptive and advisory, reflecting primarily the content and competencies of these fields of expertise. The catalogue should not be used to circumvent the legal framework for practitioners in the different countries, and national regulations regarding professional titles and roles must be respected at all times.

The catalogue expands further on the guidelines published previously by the ESRS regarding the accreditation of sleep medicine centres (Pevernagie *et al.*, 2006) and certification of sleep specialists (Pevernagie *et al.*, 2009).

The publication on certification specifies qualification procedures pertaining to three professional categories: physicians with a medical specialist degree, non-medical sleep professionals with a university doctorate or Master's degree (psychologists, higher education scientists with additional health-care education) and nurses and technologists (people with medico-technical education intended to serve in health care). Moreover, criteria were listed for performing supervised clinical work, acquiring professional skills and theoretical knowledge, and for obtaining a specific professional title in sleep medicine (Pevernagie *et al.*, 2009). The current paper offers a contemporary reference point for university curricula and awards, particularly in Europe. This had been introduced recently for other fields besides sleep medicine, and is called the 'Bologna process'. In 1999 the goals for European higher education institutions were defined in Bologna. The goals were enhance mobility, recognition and comparability of education modules and of final degrees in European countries (European Commission Education and Training, 2013).

The catalogue will therefore be of importance to teachers and students who are focusing on a career in professional sleep medicine. The first section of this paper describes the goals of the catalogue in greater detail. Subsequent sections deal with the content and layout of the document, and with the methodology of the accreditation system. Finally, the learning objectives are listed.

GOALS OF THE CATALOGUE

A prime objective of the catalogue is to match the content of the proposed sleep medicine curriculum with the European Credit Transfer and Accumulation System (ECTS) (European Commission, 2011). ECTS makes teaching and learning more transparent and facilitates mutual recognition of studies, whether formal, non-formal or informal. The system is used across Europe to foster student mobility by credit transfer. Credit accumulation ensures that learning paths towards an academic qualification can be constructed by different institutions in different European countries. It also strengthens curriculum design and quality assurance. Institutions that apply ECTS publish their course catalogues, including detailed descriptions of study programmes, units of learning, university regulations and student services. Course descriptions contain learning outcomes and workload, expressed in terms of credits. In most cases, student workload ranges from 1500 to 1800 h for an academic year, and one credit corresponds to 25–30 h of work. Therefore, an academic year comprises on average 60 ECTS credits (corresponding to 45 weeks of 40 working hours or a total workload of 1800 h). The ECTS comprises the full workload of the student, including components such as teaching classes, private study and literature review. The workload may considerably exceed the number of hours spent in direct classroom and/or practical sessions. Indeed, not uncommonly, approximately 25–33% of hours may be spent in traditional face-to-face teaching. It is also important to note, therefore, that teaching and practical sessions may increasingly comprise new teaching modalities such as E-learning, seminars, bedside teaching and training on the job. Flexibility is important in modern adult learning environments.

The catalogue is intended to be a reference for institutions or organizations that implement sleep medicine curricula based on the ECTS approach. Its content covers all relevant aspects of sleep medicine exhaustively, so the catalogue may be used as a checklist of suitable topics. The catalogue may also guide the format of teaching, e.g. lectures and distance learning, but this is not intended as prescriptive. The catalogue may also help with quality assurance of teaching courses and university programmes, and serve to delineate learning material for examinations.

The catalogue itself will be made available in the public domain, but aimed particularly towards organizations, including universities and National Sleep Societies (NSS), which set up teaching courses and training programmes. If these parties wish to solicit endorsement by the ESRS, then the

catalogue will be used as a framework for assessment of their programmes. Based on existing endorsement rules, the ESRS will implement an administrative procedure to evaluate externally the content and quality of the submitted course programme. This procedure may comprise submitted materials such as questionnaires, course outlines and samples of teaching material and statements from external examiners. Eventually, a statement with the decision of the ESRS, including the recommended number of ECTS credit points, will be made available to the inquiring party.

Future educational programmes and board examinations organized directly by the ESRS will also be based on the catalogue.

CONTENT AND LAYOUT OF THE CATALOGUE

The catalogue is itemized in a table with headings and topics. This paper includes a table with an overview of broad content (areas A–J), with numbered topic lists provided in Table 1 and a summary of ECTS credit points allocated to these areas in Table 2. A comprehensive description of learning outcomes is available as an Addendum table. This material, in particular, shows that the content is organized at three levels: chapters, sections or subchapters and topics, with a further subdivision being listed in parentheses after the title of the topic. The topics correspond to units of knowledge and skills, and together they constitute the set of learning objectives.

As can be seen, the catalogue lists 10 chapters (Table 1): (A) Physiological basis of sleep, (B) Assessment of sleep disorders and diagnostic procedures, (C) Insomnia, (D) Sleep-related breathing disorders, (E) Hypersomnias of central origin, (F) Circadian rhythm sleep disorders, (G) Parasomnias, (H) Sleep-related movement disorders, (I) Miscellaneous sleep-related conditions and disorders and (J) Societal, economic, organizational and research in sleep medicine.

Each chapter receives ECTS credit points split into theoretical knowledge ('Credits T') and practical skills acquired primarily by supervised training ('Credits P') (Table 2). In accordance with the European guidelines on Certification of Professionals in Sleep Medicine (Pevernagie *et al*., 2009), the education and training amounts in total to 1 year of workload, corresponding to 60 ECTS credit points. Accordingly, three-quarters of the available learning time is allocated to practical training, with one-quarter reserved for more academic learning.

For sections in each chapter, additional features are stipulated: 'importance', 'level of knowledge' and 'level of skills'. The latter two characteristics are based on the Swiss catalogue of learning objectives for undergraduate medical training (Bloch and Bürgi, 2002). This choice was based on a consensus of the working group.

The range of values for each of the qualifications is as follows. 'Importance': 0, not applicable (NA) or irrelevant; 1, low; 2, high; 'Level of knowledge': 0, NA or not relevant; 1, recognize; 2, cope with.

Level 1, *be able to recognize or relate to a given situation*:

In *Clinical scenarios*, the practitioner does not have to be able to deal with this clinical situation, but is supposed to have heard of it. This means that, when confronted with it in the literature or in correspondence, she/he can relate to the scenario and knows how to acquire more information.

In *Further knowledge*, this level indicates an overview. The practitioner must be able to roughly define the concept and to recognize it as a relevant clinical item or health matter. He/she knows the epidemiology and how to acquire more information.

In *Pharmacotherapy* this means an overview level on a class of drugs.

Level 2, *be able to cope with a given situation in practice*:

In *Clinical scenarios*, the practitioner must be able to cope with this clinical situation in practice. This means that she/he must be able to consider possible diagnoses and treatment options, from knowledge of presentations and complaints and of diagnostic and therapeutic possibilities. It includes knowledge of the relevant pathology, histology and epidemiology, as well as of the pathophysiology (including psychiatric outcomes and psychological formulations where relevant).

In *Further knowledge*, the person should demonstrate an appropriate level of professional insight. It includes an ability not only to describe the situation and its epidemiology, but to interpret findings and develop a plan of intervention or prevention if relevant.

In *Pharmacotherapy*, for example, this implies knowledge of the mechanism of action, kinetics (if relevant), indication, dosage, side effects and interactions of the drug.

'Level of skills': 0, NA or not relevant; 1; 2; 3; 4.

Level 1, *theory only*:

The practitioner must at least have the theoretical knowledge (principle, indication, contraindication, burden, performance, complications) of the skill.

Level 2, *seen or have had demonstrated*:

The practitioner has at least the theoretical knowledge regarding the skill and has had observed the performance of the skill in question (live, by simulator, video or other media).

Level 3, *apply/perform*:

The practitioner has the theoretical knowledge regarding the skill; as well, he/she has performed the skill in question

Table 1 Overview of topics in sleep medicine

	Physicians with medical speciality degree					*Psychologists and scientists with PhD/Master's qualifications*					*Technologists and nurses*				
	Importance	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*
A. Physiological basis of sleep				3	0				2	0				2	0
1. The neurophysiology and neurobiology of sleep	2	1	1			2	1	1			2	1	1		
2. Regulation of sleep and wakefulness	2	1	1			2	1	1			2	1	1		
3. Adaptation of bodily functions to sleep	1	1	1			1	1	1			1	1	1		
4. Theories on the functions of sleep	1	1	1			1	1	1			1	1	1		
5. Effects of acute and chronic sleep deprivation	2	2	1			2	2	1			1	1	1		
6. Sleep and dreaming	1	1	1			1	1	1			1	1	1		
7. Sleep in all stages of human development	1	1	1			1	1	1			1	1	1		
8. Gender differences in sleep	1	1	1			1	1	1			1	1	1		
B. Assessment of sleep disorders and diagnostic procedures				3.5	10				3.5	10				6.5	25
1. Classification of sleep disorders	2	2	1			2	2	1			1	1	1		
2. The clinical interview	2	2	4			2	2	4			1	1	2		

Table 1 *Continued*

	Physicians with medical speciality degree					*Psychologists and scientists with PhD/Master's qualifications*					*Technologists and nurses*				
	Importance	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*
and clinical examination															
3. Measuring–monitoring sleep and wakefulness	2	2	4			2	2	4			2	2	4		
4. Other tests and examinations	2	2	4			2	2	4			1	1	2		
5. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	4			2	2	4		
C. Insomnia				1	10				3	10				0.5	2
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	4			2	1	2		
4. Special populations and comorbidities	2	2	4			2	2	4			1	1	2		
5.1. Treatment: practicalskills for applying CBT-i	2	1	2			2	2	4			1	1	2		
5.2. Treatment: tailoring CBT-i to specific needs	2	1	2			2	2	4			1	1	2		
5.3. Treatment: pharmacological treatment	2	2	4			2	1	2			1	1	4		
6. Miscellaneous topics (suitable for workshops)	2	2	2			2	2	4			2	2	2		
D. Sleep-related breathing disorders				2	10				1	10				2	8
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			2	1	1		

Table 1 *Continued*

	Physicians with medical speciality degree					*Psychologists and scientists with PhD/Master's qualifications*					*Technologists and nurses*				
	Importance	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*
2. Pathophysiology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	2			2	2	2		
4. Comorbidities	2	2	4			2	2	2			1	1	2		
5. Treatment	2	2	4			2	2	2			2	2	4		
6. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	2			2	2	4		
E. Hypersomnias of central origin				1	3				1	3				0.5	3.5
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	2			2	2	2		
4. Comorbidities	2	2	4			2	2	2			1	1	2		
5. Treatment	2	2	4			2	2	2			1	1	2		
6. Miscellaneous topics (suitable forworkshops)	2	2	4			2	2	2			2	2	4		
F. Circadian rhythm sleep disorders				1	3				1	3				0.5	1.5
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	2			2	2	2		
4. Comorbidities	2	2	4			2	2	2			1	1	2		
5. Health risks (may overlapwith J1.)	2	2	4			2	2	2			1	1	2		
6. Treatment	2	2	4			2	2	2			1	1	2		
7. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	2			2	2	4		

Table 1 *Continued*

	Physicians with medical speciality degree					*Psychologists and scientists with PhD/Master's qualifications*					*Technologists and nurses*				
	Importance	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*
G. Parasomnias				1	3				1	3				0.5	1.5
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology and psychopathology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	2			2	2	2		
4. Comorbidities	2	2	4			2	2	2			1	1	2		
5. Treatment	2	2	4			2	2	2			1	1	2		
6. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	2			2	2	4		
H. Sleep-related movement disorders				1	3				1	3				1	2.5
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology	2	2	1			2	2	1			1	1	1		
3. Clinical picture and diagnosis	2	2	4			2	2	2			2	2	2		
4. Comorbidities	2	2	4			2	2	2			1	1	2		
5. Treatment	2	2	4			2	2	2			1	1	2		
6. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	2			2	2	4		
I. Miscellaneous sleep-related conditions and disorders				0.5	3				0.5	3				0.5	0.5
1. Nosological classification, definitions, epidem	2	2	1			2	2	1			1	1	1		
2. Pathophysiology and psychopathology	2	2	1			2	2	1			1	1	1		
3. Treatment	2	2	4			2	2	2			1	1	1		
4. Miscellaneous topics (suitable for workshops)	2	2	4			2	2	2			2	2	4		

Table 1 *Continued*

	Physicians with medical speciality degree					*Psychologists and scientists with PhD/Master's qualifications*					*Technologists and nurses*				
	Importance	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*	*Importance*	*Level of knowledge*	*Level of skills*	*Credits T*	*Credits P*
J. Societal, economical, organizational and research aspects				1	0				1	0				1	1
1. Demographic and socioeconomic aspects of	2	2	1			2	2	1			1	1	1		
2. Forensic aspects of sleep	2	2	1			2	2	1			1	1	1		
3. Organization of a sleepmedicine centre	2	2	4			2	2	2			2	2	4		
4. Training and consultancy	2	2	4			2	2	4			2	2	4		
5. Research design and quantitative methods	1	1	2			1	1	2			1	1	2		

Table 2 European Credit Transfer System (ECTS) credit points in different professional groups

	MD		*PhD/Master's*		*Tech/nurse*	
Chapter	*Credits T*	*Credits P*	*Credits T*	*Credits P*	*Credits T*	*Credits P*
A	3	0	2	0	2	0
B	3.5		3.5		6.5	
C	1		3		0.5	
D	2	45	1	45	2	45
E	1		1		0.5	
F	1		1		0.5	
G	1		1		0.5	
H	1		1		1	
I	0.5		0.5		0.5	
J	1	0	1	0	1	1
Total	15	45	15	45	15	45

This table shows the allocation of ECTS credit points to the different chapters in the catalogue. Credits T means credit points for theoretical education. Theoretical education amounts to one-quarter of the total package. Credits P means credit points obtained during supervised practical training. This part amounts to three-quarters of the total package.

under supervision at least several times (live or simulated).

Level 4, *routine*:

The practitioner has the theoretical knowledge regarding the skill and has experience in using and performing the skill.

If a section implies only theoretical knowledge, the default level of skills is 1.

The numerals in the columns of Tables 1 and 2 reflect ratings of the importance of a topic, the level of knowledge and level of skills to be reached, as well as the allocation of credits T and credits P, as assigned by consensus of the members of the ESRS sleep medicine committee.

In analogy with the European guidelines for certification of professionals in sleep medicine (Pevernagie *et al.*, 2009), the catalogue is differentiated over three professional groups: (1) registered physicians or medical practitioners who have a speciality qualification in addition to a basic medical education (this group is summarized under MD in Table 2); (2) registered psychologists (mostly clinical or health psychologists) and non-medical sleep professionals with a PhD or Master's degree allowing them to provide service in health care (summarized as PhD/Master's in Table 2); and (3) technologists, people with medico-technical education which allows them to provide health care to a limited degree and nurses (Tech/nurse in Table 2). Typically, technologists are involved in sleep scoring, in direct care with the patients when performing diagnostic tests and initiating treatment according to physicians' prescription and advice. These are the three main groups involved in sleep medicine care.

The catalogue is based on the current knowledge on sleep medicine and the current international classification of sleep disorders. If this knowledge, and the classification of sleep disorders, is updated then the catalogue will be updated accordingly by the ESRS.

SURVEY ON THE VALIDITY OF THE CATALOGUE

During summer 2011 an evaluation of the items in the catalogue was conducted to check for completeness and acceptability within the sleep medicine community in Europe, this being the professional target group for the catalogue. An interactive web-based evaluation was used to facilitate scoring of all items, to permit the addition of comments on items, and to recommend additions or deletions. Scoring was performed according to the Delphi assessment method (Milholland *et al.*, 1973). An introduction preceding the questionnaire explained the purpose of the catalogue, and explained the purpose of the evaluation as being to validate the items proposed for inclusion in the catalogue. Catalogue items had to be rated as being very important (5), important (4), average (3), slightly important (2) or not important (1).

The web-based evaluation was sent by e-mail to 206 experts who had been nominated by sleep medicine committee members either directly or through the ESRS Association of National Sleep Societies (ANSS). Experts in 31 European countries were contacted. The 206 sleep experts comprised 183 medical specialists from various disciplines, 20 psychologists and three technicians/nurses. Completing the web-based evaluation took 30–60 min. Of the 128 sleep experts who agreed to complete the online survey, 110 valid surveys from 25 countries were collected and analysed. Additionally, the catalogue was presented to ANSS members and to the European Society of Sleep Technologists during the 2012 ESRS congress in Paris, who approved the conclusions of the survey. This adds to the validity of the process.

Scoring per item was typically 'important (4)', with the 'classification of sleep disorders' receiving the highest single score (4.58), whereas the lowest single item score was given to 'nosological classification, definitions, epidemiology of miscellaneous sleep-related conditions and disorders (3.54). Hence, all items were rated from average to very important. Regarding the chapters, 'Assessment of sleep disorders and diagnostic procedures' and 'Sleep-related breathing disorders' received the highest values.

DISCUSSION

Founded on the conventional ECTS system this catalogue, published by the ESRS, is the first European document to describe comprehensively learning outcomes in clinical sleep medicine. The catalogue is intended to offer a blueprint for the various professional curricula associated with this area of expertise, and so to foster the education and training of the interdisciplinary group of practitioners who provide services across the wide spectrum of clinical sleep disorders. The practical training part amounts to three-quarters of the total package and aims at preparing clinicians and trainees for appropriate clinical decision-making. The catalogue, however, is not prescriptive about how such teaching and training is delivered; rather, innovation and flexibility seems warranted to meet growing demand. The mastering of interviewing the patient correctly, recognizing symptoms, deciding on the use of appropriate questionnaires, scales and inventories and working in a multi-disciplinary setting is paramount in clinical sleep medicine. Furthermore, appropriate skills must be acquired regarding administration of diagnostic tests and therapeutic interventions. Finally, the basics of research methodology are pertinent to the practice of the sleep professional, and are listed among other salient learning objectives.

This integrated approach is at variance with the objectives of more traditional curricula, which integrate certain aspects of sleep pathology into organ speciality-orientated educational programmes. Although introduction to a limited array of sleep disorders may be part of specific professional education, e.g. in a medical speciality training, the state-of-the-science practice of multi-disciplinary sleep medicine requires additional tuition. Given the wide range of disorders where sleep changes can be involved as a primary or secondary cause, an appropriate training in sleep medicine requires the acquisition of knowledge and practical skills covering a broad spectrum of diseases. Moreover, and even more importantly, clinical practice in sleep medicine is a multi-disciplinary field, in which different professionals interact to tailor diagnosis and treatment to the individual patient's needs.

Based on the catalogue, curricula may be constructed at different levels, including academic Master's degrees, post-graduate diplomas, speciality training and clinical fellowships. The ESRS intends to elaborate a modular educational programme to promote international teaching in clinical sleep medicine. Moreover, criteria will have to be defined for the accreditation of training centres in clinical sleep medicine, where the practical teaching of sleep professionals will be implemented. Besides ESRS actions, this catalogue is in the public domain and is likely to be utilized by a range of interested parties, including universities, professional groups and National Sleep Societies. If endorsement by the ESRS is solicited for any given course, adherence to the catalogue will serve as a basis for assessment of the teaching programme.

It should be noted that the HERMES (Sleep Harmonized Education in Respiratory Medicine for European Specialists) project on respiratory sleep medicine within the European Respiratory Society (ERS) is, in parallel, aiming to structure and harmonize European sleep education, but more limited to one important segment of sleep medicine—sleep breathing disorders or respiratory sleep medicine (De Backer *et al*., 2011a,b). It has defined in detail the respiratory sleep medicine syllabus consisting of eight modules and also incorporating some other aspects of sleep medicine in brief, such as insomnia, restless legs syndrome and narcolepsy, etc. (De Backer *et al*., 2011b).

This evident overlap of these activities is a good illustration of a growing demand for (a) standardization of education in sleep medicine (and in respiratory sleep medicine as one important element), (b) the establishment of clinical training facilities, (c) standardization of operational procedures in sleep medicine centres or specialized respiratory sleep laboratories and (d) collaboration among different European societies interested in viewing sleep medicine as an inter-disciplinary area of medicine. In line with this demand, a common task force between the ERS and the ESRS has been established recently.

The American Academy of Sleep Medicine as well as the Australasian Sleep Society have developed teaching materials for their members to prepare for the formal certification procedures that are operational in the respective countries. Their programme can be found on the corresponding websites.

In summary, the catalogue delineates a competence area for clinical sleep medicine. The detailed description of the learning objectives provides the template for developing professional curricula in this speciality field.

ACKNOWLEDGEMENTS

The authors thank the European Sleep Research Society for funding meetings of the Sleep Medicine Committee and the Assembly of National Sleep Societies (ANSS, representing the associated members of 28 European Sleep Societies within the ESRS) for funding additional meetings. The authors thank all participants of the survey for completing the online questionnaires. The authors thank M. Tassielli and the staff from Congrex (Basel) for secretarial support regarding the web-based survey.

CONFLICT OF INTEREST

No conflicts of interest declared.

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ADDENDUM

A. Physiological basis of sleep

1. The neurophysiology and neurobiology of sleep
   - Macro- and microarchitecture of sleep
   - Neuroanatomy of sleep
   - Neurochemistry of sleep
   - Sleep–wake functions and consciousness
   - Effects of pharmacological agents on sleep and wakefulness
2. Regulation of sleep and wakefulness
   - Definitions of sleep, sleep transition, wakefulness, sleepiness and tiredness
   - The two-process model
   - Sleep homeostasis
   - Sleep duration, 'core' sleep and 'optional' sleep
   - Chronobiology: the circadian clock and its influence on sleep and circadian rhythms
   - Variation of tiredness (fatigue), sleepiness and cognitive performance during the day
   - Genetics of sleep regulation
   - Chronotypes and sleep
   - Hormone secretion
   - Thermoregulation
3. Adaptation of bodily functions to sleep
   - Mental and cognitive activities
   - Motor control of skeletal muscles
   - Sensation
   - Activity of the autonomic nervous system
   - Heart and circulatory functions
   - Respiratory functions
   - Metabolic activity
4. Theories on the functions of sleep
   - Evolutionary (including phylogeny of sleep)
   - Cerebral restitution
   - Body restitution (including integrity of immune system, recovery and resilience)
   - Theories on the functions of non-rapid eye movement (NREM) and REM sleep
   - Sleep, learning and memory
   - Mental health
5. Effects of acute and chronic sleep deprivation on
   - Emotional state
   - Mood
   - Cognitive function
   - Physical health
   - Immune function
   - Other
6. Sleep and dreaming
   - Mental processes during NREM and REM sleep, at sleep onset and upon awakening
   - What is a dream? Neuropsychology and neuroimaging of dreaming
   - Dreaming and brain/medical disorders
   - Dreaming and psychopathological conditions
7. Ageing and sleep: sleep in all stages of human development
   - Perinatal sleep
   - Sleep in infancy
   - Sleep in childhood
   - Adolescence and sleep
   - Adult sleep
   - Sleep in later life
8. Gender differences in sleep
   - Sleep and the menstrual cycle
   - Sleep and pregnancy
   - Sleep and the menopause/andropause

B. Assessment of sleep disorders and diagnostic procedures

1. Classification of sleep disorders
   - ICSD-2
   - Other classification systems
2. The clinical interview and clinical examination
   - Medical history
   - Sleep history

- Interviewing partner and relatives
- Semi-structured interview techniques
- General medical examination [including height, weight, body mass index (BMI), collar size, hip/waist ratio, blood pressure measurements]
- Examination of the upper airway (nasal patency, Friedman–Mallampati scores)
- Neurological examination
- Psychological/psychiatric evaluation
- Differential diagnosis and working hypothesis

3. Measuring and monitoring sleep and wakefulness

- General principles (establishing a differential diagnosis, baseline, quantifying treatment progress, appraising outcome)
- Sleep questionnaires
- Questionnaires on mental wellbeing, daytime function, etc.
- Sleep diary
- Measurement of core and surface body temperature
- Actigraphy (including equipment, handling, interpretation, reporting, advantages and limitations)
- Pulse oximetry (including equipment, handling, interpretation, reporting, advantages and limitations)
- Cardiorespiratory polygraphy (including equipment, handling, interpretation, advantages and limitations)
- Polysomnography, hook-up, montage and technical aspects (including calibration, recording, sampling, filtering and displaying)
- Polysomnography, obligatory and optional sensors
- Polysomnography, video recording and telemetry
- Polysomnography, sleep scoring and reporting [2012 American Association of Sleep Medicine (AASM) scoring guidelines]
- Polysomnography, event scoring, artefact rejection, and reporting (2012 AASM scoring guidelines)
- Polysomnography, miscellaneous [split night recording, full montage, effect of drugs and pathological conditions on electroencephalogram (EEG)]
- Basic and advanced computer-assisted polysomnography (PSG) signal analysis
- Tests of sleep propensity and alertness: multiple sleep latency test (MSLT), maintenance of wakefulness test (MWT) and other tests (e.g. Osler test)

4. Other tests and examinations

- Cognitive evaluation
- Psychometric evaluation
- Neuropsychological tests [including assessment of vigilance, e.g. psychomotor vigilance task (PVT)]
- Technologies relevant to the cognitive neuroscience of sleep [event-related potentials (ERPs), magnetoencephalogram (MEG), functional magnetic resonance imaging (fMRI)]
- Pulmonary function tests
- Analysis of blood and other bodily fluids (e.g. assessment of ferritin, hypocretin, melatonin, etc.)
- Various imaging techniques

5. Miscellaneous topics (suitable for workshops)

- The clinical interview and further diagnostic management
- Assessing motivational state
- Setting up diagnostic tests
- Scoring, interpretation and reporting of diagnostic tests (see remark attached to this cell)
- Putting all data together to formulate a diagnosis

6. Practical training in patient care (fellowship in a sleep medicine training centre)

- $\pm$300 work-hours or 10 ECTS credit points

C. Insomnia

1. Nosological classification, definitions, epidemiology

- Standardized criteria for defining insomnia (ICSD-2)
- Adjustment insomnia (acute insomnia)
- Psychophysiological insomnia
- Paradoxical insomnia
- Idiopathic insomnia
- Insomnia due to mental disorder
- Inadequate sleep hygiene
- Behavioural insomnia of childhood
- Insomnia due to drug or substance (including alcohol and hypnotics dependence)
- Insomnia due to medical condition
- Insomnia not due to substance or known physiological condition, unspecified
- Physiological (organic) insomnia, unspecified
- Definition of insomnia in other classification systems (ICS-10, DSM-IV, DSM-5)

2. Pathophysiology

- Predispositional factors
- Precipitating factors
- Perpetuating factors
- Arousal/hyperarousal models
- Cognitive–behavioural models
- Primary versus secondary versus comorbid insomnia

3. Clinical picture and diagnosis

- Day- and night-time symptoms of insomnia
- Clinical evaluation including psychiatric assessment
- Questionnaires to assess insomnia complaints
- Sleep logs and actigraphy
- Sleep laboratory diagnostics in insomnia (PSG, …)
- Other diagnostic tests in insomnia

4. Special populations and comorbidities (this is in part redundant with 1)

   - Mental health ('comorbid' psychiatric disorders often implicated in differential diagnosis of sleep disorders, e.g. anxiety and depression, bipolar disorder, …)
   - Insomnia in older adults
   - Insomnia in children
   - Trauma and chronic stress (insomnia and life events, post-traumatic stress disorder, burnout, …)
   - Insomnia and depression
   - Insomnia and personality disorders
   - Insomnia and addiction
   - Insomnia in physically disabled and neurological disorders
   - Insomnia in brain injury
   - Insomnia in medical conditions with bodily discomfort (e.g. pain)

5.1. Treatment: practical skills for applying cognitive–behavioural therapy (CBT) to insomnia

   - Sleep information and education
   - Sleep hygiene practice
   - Relaxation and biofeedback methods
   - Establishing routines
   - Sleep stimulus control
   - Sleep restriction
   - Cognitive restructuring
   - Thought management methods
   - Paradoxical intention
   - Mindfulness meditation
   - Other novel strategies

5.2. Treatment: tailoring CBT for insomnia to clinical and service need

   - Improving adherence to home practice
   - Working with individuals
   - Working with groups
   - Working with other professionals and services
   - Directed self-help approaches
   - Other cognitive and behavioural treatments (mindfulness, biofeedback, multi-component CBT-i)
   - Behavioural treatment of childhood insomnia; working with parents

5.3. Treatment: pharmacological treatment

   - Overview of hypnotic and other sleep-inducing drugs
   - Indications, choice of drug(s), dose adjustment, (long-term) follow-up
   - Combined treatment (pharmacotherapy and CBT-i)
   - Evidence base for CBT-i and pharmacotherapy
   - Novel pharmacological approaches behind firm evidence

6. Miscellaneous topics (suitable for workshops)

   - CBT-i (behavioural components, cognitive components, package, adherence)
   - Drug treatment (What works and what not? Efficacy, efficiency and safety. Combining with CBT-i)
   - Diagnostic approaches to insomniac patients
   - Case records

7. Practical training in patient care (fellowship in a sleep medicine training centre)

   - See Appendix 1 of Certification guidelines: For MDs ±400 work-hours or 13 ECTS credit points

D. Sleep-related breathing disorders

1. Nosological classification, definitions, epidemiology

   - [Simple] snoring
   - Obstructive sleep apnea and upper airway resistance syndrome (adult and paediatric)
   - Central sleep apnea syndrome and Cheyne–Stokes respiration (primary central sleep apnea, central sleep apnea due to Cheyne–Stokes breathing pattern, high-altitude periodic breathing, medical condition not Cheyne–Stokes, drug or substance, primary sleep apnea of infancy)
   - Sleep-related hypoventilation and hypoxaemic syndromes (obesity–hypoventilation syndrome and others)
   - Other sleep-related breathing disorders

2. Pathophysiology

   - Control of breathing
   - Obstructive sleep–sleep-disordered breathing
   - Central sleep apnea
   - Cheyne–Stokes respiration in cardiac failure
   - Hypoventilation during sleep

3. Clinical picture and diagnosis

   - Obstructive sleep-disordered breathing
   - Central sleep apnea (including eucapnic and hypercapnic CSA, Cheyne–Stokes respiration and 'complex sleep apnea')
   - Hypoventilation during sleep
   - Differential diagnosis
   - Sleep-disordered breathing in children
   - Diagnostic value of polygraphy and polysomnography
   - Special conditions (stroke, hypothyroidism, acromegaly, etc.)

4. Comorbidities

   - Hypertension
   - Cardiac failure
   - Stroke and other brain disorders
   - Respiratory comorbidities [asthma, chronic obstructive pulmonary disease (COPD), other lung diseases, chest wall and neuromuscular diseases]
   - Metabolic syndrome
   - Proinflammatory conditions

5. Treatment
   - Conservative measures (including weight reduction and positional therapy)
   - Pharmacological treatment
   - Nasal continuous positive airway pressure (CPAP)
   - Modifiable PAP (bilevel PAP, auto-CPAP, etc.)
   - Behavioural sleep medicine (BSM) approaches to improving adherence to treatment
   - Surgical procedures
   - Dental appliances
6. Miscellaneous topics (suitable for workshops)
   - PSG examples
   - Nuts and bolts of PAP treatment set-up (choice of interfaces and pressure generators, titration algorithms, trouble-shooting)
   - PAP follow-up: monitoring and improving adherence/compliance
   - Behavioural methods to improve patient and service outcomes
   - Case records
7. Practical training in patient care (fellowship in a sleep medicine training centre)
   - ±400 work-hours or 13 ECTS credit points

E. Hypersomnias of central origin

1. Nosological classification, definitions, epidemiology
   - Narcolepsy with cataplexy
   - Narcolepsy without cataplexy
   - Narcolepsy due to medical condition
   - Narcolepsy unspecified
   - Recurrent hypersomnia/Kleine–Levin syndrome
   - Recurrent hypersomnia/menstrual-related hypersomnia
   - Idiopathic hypersomnia with long sleep time
   - Idiopathic hypersomnia without long sleep time
   - Behaviourally induced insufficient sleep syndrome
   - Hypersomnia due to medical condition
   - Hypersomnia due to drug or substance (alcohol)
   - Hypersomnia not due to substance or known physiological condition
   - Physiological hypersomnia, unspecified
2. Pathophysiology
   - Normal regulation of sleep and wakefulness, the 'sleep switch'
   - Hypothalamic regulation of sleep, especially the role of the hypocretin (orexin) system
   - Neurophysiology, neurochemistry, neurogenetics and neuroimmunology of narcolepsy
3. Clinical picture and diagnosis
   - Spectrum and differential diagnosis of tiredness (fatigue), sleepiness and cognitive dysfunction
   - Spectrum of narcolepsy (not only classical tetrad, but also fragmented sleep, obesity, psychiatric comorbidity, etc.)
   - The role of the MSLT and other techniques in assessing EDS
   - Behaviourally induced insufficient sleep syndrome as an important, role of actigraphy to determine habitual sleep duration
   - The use of hypocretin measurements

   The non-diagnostic value of human leucocyte antigen (HLA) typing for narcolepsy
4. Comorbidities
   - Comorbidity in narcolepsy, especially overweight/obesity
   - Mood and anxiety disorders as comorbidity in hypersomnias
5. Treatment
   - General aspects: information, acceptance, social guidance
   - Behavioural managements: sleep–wake timing, sleep extension if necessary, planned naps
   - Pharmacological treatment for EDS
   - Pharmacological treatment for cataplexy, hallucinations and sleep paralysis
   - Pharmacological treatment for fragmented night-time sleep
6. Miscellaneous topics (suitable for workshops)
   - PSG, MSLT and MWT examples
   - Video session
   - Case records, especially regarding diagnosis and treatment of primary hypersomnias
7. Practical training in patient care (fellowship in a sleep medicine training centre)
   - ±100 work-hours or three ECTS credit points

F. Circadian rhythm sleep disorders

1. Nosological classification, definitions, epidemiology
   - Delayed sleep phase type
   - Advanced sleep phase type
   - Irregular sleep–wake type
   - Non-entrained type (free-running)
   - Jet lag type
   - Shift work type
   - Due to medical condition
   - Other circadian rhythm sleep disorder
   - Due to drug or substance (including alcohol)

2. Pathophysiology
   - Neuroendocrine pathways and disturbances
   - Blindness
   - Genetics: clock gene polymorphisms
   - Adaptations to shifted work schedules
   - Chronobiotic effect of drugs
3. Clinical picture and diagnosis
   - Assessment of circadian phase
4. Comorbidities
   - Psychological and psychiatric issues
5. Health risks (may overlap with J1)
   - Shift work and other conditions
6. Treatment
   - Behavioural approaches
   - Melatonin
   - Light therapy
   - Other (e.g. stimulants)
7. Miscellaneous topics (suitable for workshops)
   - PSG and actigraphy examples
   - Case records
8. Practical training in patient care (fellowship in a sleep medicine training centre)
   - ±100 work-hours or three ECTS credit points

G. Parasomnias

1. Nosological classification, definitions, epidemiology
2. Pathophysiology and psychopathology
   - State dissociation/activation of central patterns; neurophysiology, genetics, neuroimaging of parasomnias
   - REM sleep behaviour disorder (RBD) and neurodegenerative disease
3. Clinical picture and diagnosis
   - Differentiation between parasomnias and epileptic seizures
4. Comorbidities
   - Parasomnias and brain disorders, psychiatric disorders
5. Treatment
   - Conservative measures
   - Pharmacological treatment
   - CBT
6. Miscellaneous topics (suitable for workshops)
   - PSG examples
   - Video polysomnography
   - Differentiation between epileptic and non-epileptic motor activity during sleep
   - Case records
   - Video session
7. Practical training in patient care (fellowship in a sleep medicine training centre)
   - ±100 work-hours or three ECTS credit points

H. Sleep-related movement disorders

1. Nosological classification, definitions, epidemiology
   - Restless legs syndrome
   - Periodic limb movement disorder
   - Sleep-related leg cramps
   - Sleep-related bruxism and other disorders with orofacial activity
   - Hypnic myoclonus
   - Sleep-related rhythmic movement disorder
   - Propiospinal myoclonus and fragmentary myoclonus
   - Sleep disturbances in Parkinson's disease
   - Sleep disturbances in other movement disorders
   - Sleep-related movement disorder, unspecified
   - Sleep-related movement disorder due to drug or substance
   - Sleep-related movement disorder due to medical condition
2. Pathophysiology
   - Neurobiological basis of the control of motor function during sleep
   - Neurophysiology, neuroimaging, genetics of sleep-related movement disorders
   - Neurobiology of RLS/PLMS (should include metabolic factors and basic neurobiology)
3. Clinical picture and diagnosis
   - A clinical approach to the patient with sleep-related movement disorders
   - Laboratory evaluation of motor disturbances during sleep
   - Immobilization tests and actimetry in the assessment of sleep-related movement disorders
   - Differential diagnosis in sleep-related movement disorders
4. Comorbidities
   - Sleep-related movement disorders and brain disorders, psychiatric, medical disorders
5. Treatment
   - Conservative measures
   - Pharmacological treatment

6. Miscellaneous topics (suitable for workshops)
    - PSG and actigraphy examples
    - Introduction to video polysomnography
    - Case records
    - Video session
7. Practical training in patient care (fellowship in a sleep medicine teaching centre)
    - ±100 work-hours or three ECTS credit points

I. Miscellaneous sleep-related conditions and disorders

1. Nosological classification, definitions, epidemiology
    - Isolated symptoms, apparently normal variants and unresolved issues
        - Long sleeper
        - Short sleeper
        - Snoring
        - Sleep talking
        - Sleep starts (hypnic jerks)
        - Benign sleep myoclonus of infancy
        - Hypnagogic foot tremor and alternating leg muscle activation during sleep
        - Propriospinal myoclonus at sleep onset
        - Excessive fragmentary myoclonus
    - Other sleep disorders
        - Other physiological (organic) sleep disorder
        - Other sleep disorder not due to substance or known physiological condition
        - Environmental sleep disorder
    - Sleep disorders associated with conditions classifiable elsewhere (ICSD-2, Appendix A)
        - Fatal familial insomnia
        - Agrypnia excitata
        - Fibromyalgia
        - Sleep-related epilepsy
        - Sleep-related headaches
        - Sleep-related gastro-oesophageal reflux disease
        - Sleep-related coronary artery ischaemia
        - Sleep-related abnormal swallowing, choking and laryngospasm
    - Sleep disorders associated with conditions classifiable elsewhere (not mentioned in ICSD-2, Appendix A)
        - Sleep in Parkinson's and other neurodegenerative diseases (including dementia)
        - Sleep in disorders associated with chronic pain (e.g. cancer, fibromyalgia)
        - Sleep in disorders associated with chronic fatigue [e.g. chronic fatigue syndrome (CFS), fibromyalgia]
        - Sleep and learning disability
        - Sleep and brain injury
    - Other psychiatric and behavioural disorders frequently encountered in the differential diagnosis of sleep disorders (mentioned in ICSD-2, Appendix B)
        - Mood disorders
        - Anxiety disorders
        - Somatoform disorders
        - Schizophrenia and other psychotic disorders
        - Disorders usually first diagnosed in infancy, childhood or adolescence
        - Personality disorders
2. Pathophysiology and psychopathology
    - Sleep habits; behaviourally induced insufficient or excessive sleep
    - Sleep and social life (relation with family and bedpartner, relation with co-workers, co-sleeping, pets)
    - Relationship between sleep, analgesia and fatigue
    - Personal remedies for managing sleep [traditional remedies, over-the-counter (OTC) remedies, napping]
    - Sleep and substance abuse (alcohol, caffeine, nicotine, recreational drugs, withdrawal and relapse)
3. Treatment
    - Cognitive–behavioural approaches
    - Pharmacological treatment
4. Miscellaneous topics (suitable for workshops)
    - PSG examples
    - Examples of other sleep tests
    - Case records
5. Practical training in patient care (fellowship in a sleep medicine training centre)
    - ±90 work-hours or three ECTS credit points

J. Societal, economic, organizational and research aspects of sleep medicine

1. Demographic and socioeconomic aspects of sleep disorders
    - Sleep and sleep disorders in the public opinion and lay press
    - Prevalence of sleep disorders
    - Shift work (the sleep deprivation and circadian misalignment has a substantial impact on a person's health as well as on society/industry)
    - Absenteeism (due to illness)
    - Traffic and occupational hazards
    - Driver's licence
    - Socioeconomic cost
    - Impact of sleep disorders on public health and quality of life

- Cost-effectiveness and cost–benefits of treating sleep disorders

2. Forensic aspects of sleep
    - Sleep and the law
    - Driving and falling asleep
    - Sleepiness and work-related accidents
    - Sleep and crimes of sexual nature
    - Sleep and murder
    - Clinical assessment and differential diagnosis
    - Expert testimony
3. Organization of a sleep medicine centre
    - Human resources, organization chart
    - Professional certification requirements (certified sleep specialists)
    - Facilities, sleep laboratory
    - Quality assurance (including PSG scoring QA: intra- and interscorer reproducibility)
    - Business case
4. Training and consultancy
    - Training practitioners
    - Supervising practitioners
    - Professional intervision
    - Giving advice on service development
5. Research design and quantitative methods (optional)
    - The research process
    - Hypothesis-driven foundations of quantitative measurements (the process of measuring, psychometric theory, reliability, validity)
    - Introduction to quantitative assessment of sleep
    - Foundations of qualitative research
    - Self-report methods
    - Observation
    - Foundations of design
    - Sampling and ethics
    - Evaluating research
    - Analysis interpretation and dissemination