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LETTER TO THE EDITOR

Scoring Respiratory Events in Sleep Medicine: Who Is the Driver—Biology or Medical Insurance?

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Accurate scoring of clinically and biologically relevant respiratory events is a core requirement in sleep medicine. On Aug 30, 2013, and not for the first time, the American Academy of Sleep Medicine (AASM) changed its position on the definition of hypopneas as counted in the AHI, allowing the oxygen saturation criterion to change from 3% to 4%, and providing definitions that both do and do not include arousals, to apply to the identically named "AHI." The most recent changes were likely motivated by concerns relating to national Medicare reimbursement requirements for CPAP, but the recurring changes in position taken by the AASM come as a disappointment to many. In fact the July 2014 update to the Online Scoring Manual prefers the 3% arousal criterion but permits the 4%. To the authors, the latest "rules" and permutations seem only a "band-aid" on a chronic problem relating to the AHI as a metric for our field, and go far beyond the issue of how much hypoxia "matters."[1,2]

The implications of choosing one or another definition for AHI are well highlighted in data from the Sleep Heart Health Study,[3] where different scoring strategies were directly compared when calculated from a set of independently marked respiratory events using post hoc associations that range through different degrees of hypoxia and with or without associated arousals. Correlation between the resulting AHIs does not offset the large differences seen in the absolute magnitude of these indices: there is nearly an order of magnitude change in the AHI when moving from the most stringent to the most inclusive rules. As should be immediately obvious, to define "disease" different cut-offs are needed depending on the definition of hypopnea used. This issue has rarely been addressed when changes are made in the AASM's recommendations thereby causing confusion. The AASM could have injected a more useful approach by emphasizing that any new definition of AHI be distinguished from prior definitions (i.e., by changing the name) and be coupled with a new cut-off for the definition of disease. Perhaps because of our lack of guidance, Medicare and many insurers have chosen to use the most restrictive definition of events, along with prior cutoff values, and forced sleep labs to abide by these when seeking reimbursement.

The severity of obstructive sleep apnea was first described in terms of the apnea index, but beginning in the 1990s, steady improvements in methodology and a growing appreciation of the symptoms and long-term outcomes of milder sleep disordered breathing led to inclusion of more subtle events. As it came to be appreciated that thermistors have intrinsic limitations for quantitating reductions in airflow, esophageal manometry was used to characterize the events in the upper airways resistance syndrome.[4] A few years later, the biologically rich information in nasal flow signals measured using a cannula-pressure transducer system became apparent.[5] However, many of the primary research studies on which clinical recommendations are based (e.g., the Wisconsin Cohort and the Sleep Heart Health Study) used earlier event detection techniques. In these studies it was common practice, due to ambiguous flow signals, to add an oxygen desaturation requirement to increase the degree of interscorer reliability. This forced disease defining cut-points to low values (e.g., 5/h) that are quite different when populations are examined using the currently recommended nasal pressure technology to define events.[6]

A variety of rules for defining the AHI have emanated from the AASM and its designated work groups: the "Chicago Criteria" for research studies (counting all events with 3% desaturation or with termination by arousal); the 2003 criteria (only hypopnea events with 4% desaturation); the 2007 revision with two definitions for hypopnea, either a "preferred" based on only 4% desaturation or an "alternate" definition allowing either 3% desaturation or arousal; the 2012 guidelines (only one definition similar to the original Chicago rules); and most recently a return to the "preferred" and "allowable" concept, where a rule counting only events associated with 4% criterion was reintroduced (the latter apparently to preserve compatibility with Federal insurance coverage guidelines). However, throughout all of this, the cut-points of 15/h (or 5/h in the presence of daytime symptoms and signs) have remained inexplicably constant.

While much discussion has centered on the 3% vs. 4% criterion for desaturation, the more critical issue is whether an event with less than 3% desaturation but terminating with a clear arousal should be "counted" in the breathing index that will quantify severity. This issue particularly affects certain clinical populations, including children (who rarely desaturate), some predominantly non-obese individuals with profound sleepiness, pregnant women, and others with "mild" sleep disordered breathing which is nevertheless severely symptomatic and responsive to therapy. Treatment is already being denied by insurers due to absence of 4% criteria regardless of clinical symptoms. Our understanding of sleep homeostasis suggests that arousals logically should contribute to hypersomnolence, and plausibly also contribute to undesirable sleep hemodynamic profiles (e.g., non-dipping of blood pressure[7,8]). There is ample literature supporting the importance of sleep fragmentation (without desaturation), including enhancing amyloidogenesis[9] impairing hippocampal neurogenesis,[10] and dysfunctional arousal circuit function including reduced c-fos activation in noradrenergic, orexinergic, histaminergic, and cholinergic wake-active neurons following experimental fragmentation.[11] While debate continues on what EEG criteria are the best for scoring arousals and not captured by the current AASM rules (e.g. Arousals < 3 sec and Cyclic Alternating Pattern), discarding arousal entirely seems a poor solution to the problem.

Apart from diagnosis of sleep disordered breathing, the choice of metrics for disease severity also impacts evaluation of alternative treatments for mild/moderate disease. Publications with several new therapies for OSA, including Provent,[12] Winx,[13] hypoglossal nerve stimulation,[14] and adaptive ventilation,[15] use 4% desaturation hypopneas as primary endpoints, leaving doubt as to the presence of residual disease. Ignoring all events without desaturation exaggerates the success rate of therapies, by not counting residual non-desaturating events despite persisting sleep fragmentation.

In addition to the above issues, there is the growing use of home-based monitoring of PAP therapy, which usually does not include saturation or EEG, although it may include indirect assessment of arousal with surrogate measures (e.g., movement, assessment of sympathetic activation, detection of breathing patterns suggesting arousal). As the metrics obtained from this source are increasingly used for both diagnoses and to assess quality and compliance with therapy on CPAP, the AASM needs to proactively provide guidance for how to relate flow-only metrics to the lab based AHI to help the field provide for this transition in clinical practices.

What is needed from the AASM is a rational, scientifically defensible but common-sense and consistent stand on defining "significant" sleep disordered breathing that also allows the science to evolve. At present, the scientific evidence does not support a single metric of severity of sleep apnea. The AASM could improve on the present situation by providing at least two different severity metrics with different names (not "alternate" AHIs), so that these could be used for the various clinical and research purposes. Ultimately these may provide a "definitive" answer on who needs treatment for what. Two *distinctly named* metrics, one based on desaturation alone (currently the best choice when evaluating cardiovascular disease) and one also including information from EEG arousals and/or their surrogates on ambulatory non-EEG studies (currently the best choice when evaluating neurological phenomena like sleepiness and memory) would go a long way to clarifying the current confusion. Finally, once making recommendations defined by a thorough review of the literature, the AASM should not bow to political expediency and state there is only one metric, always called the AHI, and that it is permitted to vary depending on whom one is addressing (i.e., Medicare/Medicaid, private insurers, the FDA, or for research studies). In addition to defining several metrics, it is critical that names distinguishing each metric be chosen and that different cut-offs appropriate to each metric be proposed and tested. Scoring more than one "index" may be seen as adding to the burden on sleep centers, but computational and reporting approaches to reduce this burden exist. An example is for technicians to score based on the flow alone, which can then be "linked" electronically to desaturation and arousal after the fact. This approach provides multiple indices and flexibility in reporting without additional work. New epidemiological studies should be required to tabulate hypoxic and fragmenting disease and consequences separately.

In conclusion, we ask our leadership in the AASM to take a firm responsible position that can be defended by logic as well as being "best science and/or evidence based" and we also ask them to then stand by this position when confronted by the forces driving reimbursement.

CITATION

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