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Measurement of Quality to Improve Care in Sleep Medicine

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The Board of Directors of the American Academy of Sleep Medicine (AASM) commissioned a Task Force to develop quality measures as part of its strategic plan to promote high quality patient-centered care. Among many potential dimensions of quality, the AASM requested Workgroups to develop outcome and process measures to aid in evaluating the quality of care of five common sleep disorders: restless legs syndrome, insomnia, narcolepsy, obstructive sleep apnea in adults, and obstructive sleep apnea in children. This paper describes the rationale, background, general methods development, and considerations in implementation for these sleep disorder quality measures.

The Workgroup papers are published in this issue under the following titles: Quality Measures for the Care of Adult Patients with Restless Legs Syndrome, Quality Measures for the Care of Patients with Insomnia, Quality Measures for the Care of Patients with Narcolepsy, Quality Measures for the Care of Adult Patients with Obstructive Sleep Apnea, and Quality Measures for the Care of Pediatric Patients with Obstructive Sleep Apnea.

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High quality health care is safe, timely, effective, efficient, equitable, and designed to maximize the patient's interests (patient centered).[1] Although there has always been an imperative to deliver high quality care,[2–4] recent assessment has shown that overuse, misuse, and underuse of healthcare services are common. These shortcomings in healthcare lead to excessive costs and in many cases lost opportunity for improving the health of our fellow citizens.[1,5] The pursuit of improving healthcare is best aligned with three simultaneous achievements, known as "The Triple Aim": improving the quality of care, improving the health of populations, and reducing per capita costs of healthcare.

High quality sleep medicine care has always been a focus of the American Academy of Sleep Medicine (AASM). The mission of the AASM is to improve "sleep health and promote high quality patient-centered care through advocacy, education, strategic research, and practice standards."[6] Pursuant to this mission, the AASM was among the first professional societies to produce evidence-based practice standards (Practice Parameters, Best Practice Guidelines, and Clinical Practice Guidelines) that explicitly describe best practices for sleep medicine.[7] In light of growing demands to deliver and demonstrate high value care and the goals of the Patient Protection and Affordable Care Act, the AASM has developed measures for five common sleep disorders to evaluate the quality of care in sleep medicine.[8–12] This document explains the process used to develop these quality measures and factors related to their appropriate application and implementation. It will also describe the values and tradeoffs considered in developing these measures including anticipated challenges to their utilization in the healthcare setting.

The accompanying **Appendix** should guide clinicians on how to implement these sleep quality measures in their practices. The **Appendix** outlines what the clinician needs to do at the initial evaluation, when follow-ups should be done, and what the clinician should complete at these follow-up visits.

WHY MEASURE QUALITY OF CARE?

The two primary purposes of measuring quality are (1) to serve as essential management tools for improvement, and (2) to evaluate the value of healthcare (see endnote).[13,14] Healthcare professionals are well-acquainted with using measurements to assist in patient management. The success of treatment for hypertension, hyperlipidemia, diabetes, and obesity are judged in large part on the basis of measures such as blood pressure, lipid level, hemoglobin glycosylation (hemoglobin A1c), and body mass index. Experienced healthcare providers treat patients for these conditions with serial measurements to track the response to therapy. Similarly, the development of measures is an essential first step towards managing quality improvement efforts. Measures of healthcare quality help providers identify opportunities for improvement, evaluate the effectiveness of interventions to improve quality, and prioritize areas for improvement.

Other stakeholders, including patients, third-party payers, employers, and society at large, are increasingly concerned with the value of healthcare, which can be represented as a ratio of quality to patient costs (see equation 1).[15,16] Ultimately, quality is represented as various outcomes of interest, including meeting certain goals, avoiding harm, and experiencing healthcare with dignity. Costs are often distributed between

patient and third parties initially, but ultimately become reflected in costs directly born by the patient.

$$Value\ of\ Healthcare = \frac{Quality\ of\ Care}{Costs} \quad (1)$$

One way to improve value is to reduce stakeholder cost. Physicians and other healthcare professionals have experienced increasing pressure to reduce cost. In sleep medicine, this has been particularly evident as systems and incentives promote expanded use of home sleep apnea testing (HSAT), reduced reimbursement for technical and cognitive services, and restricted patient access to sleep specialists. However, exclusive focus on cost reduction to the exclusion of quality of care in sleep medicine is myopic and may decrease quality of care. There is growing evidence of the influence of healthy sleep in adequate quantity on other medical conditions and overall improvement in quality of life. The best applications of the rapid advances in sleep medicine may alleviate suffering, improve productivity, and save costs over time. Beyond these considerations, growing evidence suggests that improving quality substantially reduces the cost of healthcare delivery.[17] Therefore, it is necessary to continue to focus on the numerator of the value equation with at least as much intensity as the denominator. We must measure quality to move sleep healthcare forward.

HOW SHOULD WE MEASURE THE QUALITY OF CARE FOR PATIENTS WITH SLEEP DISORDERS?

Quality of care is typically measured across three dimensions: structure, process, and outcome. Each has distinct advantages and disadvantages.[18,19]

Structure Measures

Structure measures evaluate the setting in which care is delivered. Such measures include practice volume, affiliation with professional educational institutions, accreditation status, use of information technology, qualifications and ratios of personnel involved in care delivery, or characteristics of management structures. Such measures are easily obtained, often by survey or observation, and are efficient to monitor. Many AASM accreditation standards address structure, but were not specifically addressed by the quality measures Task Force.

Process Measures

Processes represent the steps taken by healthcare providers and systems in the course of care provided to an individual patient. Process measures highlight variations in care delivery within a system and, in comparison to outcome measures (see next section), are less sensitive to the demographics, socioeconomics, and disease burden differences in the served patient populations. Relevant clinical outcomes are often measurable only years after treatment, while process measures are generally real-time, and more immediately responsive to improvement efforts. For this reason, they are the most common types of measures initially used in benchmarking. The best process measures reflect certain characteristics: (a) they measure an agreed upon process of care, (b) the process elements of care being measured have strong linkage to desired outcomes, (c) execution of the process elements of care are modifiable by the organization measuring them, and (d) measurement is minimally resource intensive.[19]

Outcome Measures

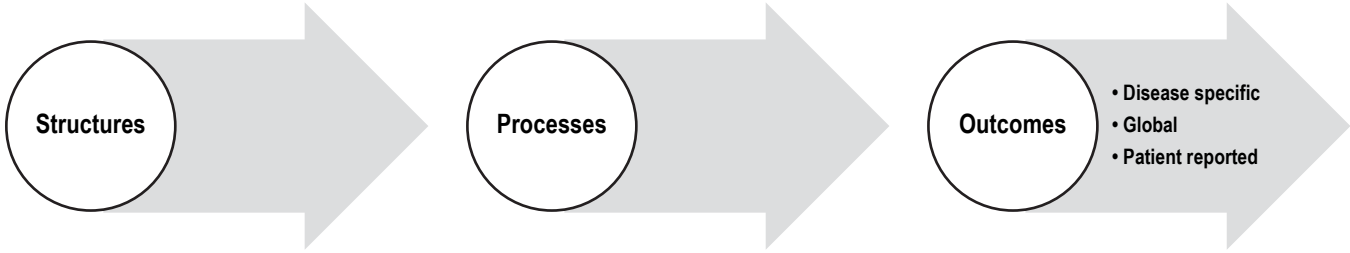
Outcome measures refer to "a health state of a patient resulting from health care," and are therefore patient-centric.[20] For example, completion of the Epworth Sleepiness Scale (ESS) at a follow up visit could be a process measure (a dichotomous nominal measure), while the ESS numeric score (0–24, a continuous ordinal measure) is an outcome measure. Outcome measures span a broad range of potential measures, such as mortality, stroke rate, sleepiness measures, quality of life measures, and patient-solicited information such as satisfaction and global scale measures of improvement.[16,21–23] The advantage of outcome measures is that they often represent the overall goals of healthcare, and the systematic measurement of outcomes often leads to awareness of gaps in processes to achieve those goals.

While, ideally, outcome measures measure what actually matters most—the health of the patient or population—many challenges arise from efforts to obtain and use outcome measures for improvement and benchmarking. First, many healthcare outcomes are the product of not only processes of care within the control of a healthcare system, but also of socioeconomic, hereditary, cultural, and other influences beyond the control of a healthcare facility. As a result, although outcome measures are readily adopted for internal benchmarking, such as tracking a given outcome in a specific system or context over time, controversy often ensues when utilized for external benchmarking comparisons or accountability. Comparisons between contexts require risk adjustment to control for such factors. Ideally, the risk adjustment will be based upon the patient's situation prior to receiving a particular health care service. Usually such risk adjustment is complex, inadequate, or at least controversial, leading to excessive expenditure of resources to optimize risk adjustment or to argue against external benchmarking rather than focusing on actual quality improvement. To minimize complexities, risk-adjustment has tended to focus on measurement of outcomes of very specific diseases or procedures that have well defined risk factors.

In addition, many meaningful healthcare outcomes lag the process of care by years or decades, making it necessary for the temporality of the outcome measure to be precise and often protracted. In many circumstances, the period necessary to relate outcome to process increases complexity due to the difficulties and expense of locating patients, who may migrate during the relevant period. For these reasons, the best outcome measures for quality improvement are those most closely tied in causality and temporality to processes of care within control of the healthcare system. The relationship between structure, process, and outcome measures is depicted in **Figure 1**.

Realizing some of the inherent limitations of the structural, process, and disorder-specific outcome measures, a next step in maturation of quality measurement is to focus on patient-reported outcomes (PRO), with assessment of patients' preferences, symptoms, and functional and emotional status across episodes of care, along with other risk-adjusted health outcomes. Development of appropriate PROs, particularly those applicable to sleep medicine, is in early stages.

Figure 1—Construct of quality assessment model.



Healthcare begins with structures (physical structures, leadership, organizations, policies, governance, etc.) that support the delivery of services. The actual delivery from the system to the patient or population takes place as a series of processes to produce outcomes. Key structural elements that increase the likelihood for good outcomes are often codified in accreditation standards. Among many candidate processes, some have stronger links to desired outcomes and are amenable to measurement to determine the extent to which the delivery processes conform to best practices. Outcomes are assessed as changes in the patient or population attributable to the processes of care (disease specific or global) or as health-state specific (patient-reported outcomes).

Table 1—Process for development of quality measures for sleep disorders.

Steps	Considerations
1. Conduct literature review	Summarize the evidence regarding structure and processes of care associated with improved outcomes.
2. Select specific outcome and process measures to consider	Selection criteria: outcomes should be ones that can be influenced by processes of care using current science; processes should be those that under most circumstances lead to improved outcomes and are supported by acceptable levels of evidence.
3. Draw driver diagram and determine strength of linkage between outcomes and process measures	Determine the strength of the evidence that a specific process would improve the outcomes; the feasibility of the data collection.
4. Write the design specifications for the measures	For each measure, define who, what, where, when, and how. Who will collect the measure? What will they measure? Where will they measure it? When in the course will they measure it? How will they measure it?
5. Evaluate the validity and reliability of the data	Validity: do providers believe that the measure evaluates an important aspect of quality of care? Stakeholder groups will provide feedback of interest here.

QUALITY MEASURES FOR THE TREATMENT OF SLEEP DISORDERS

The AASM chartered five Workgroups in June of 2013 to develop quality measures for assessment and management of the following sleep disorders:

- Restless Legs Syndrome
- Insomnia
- Narcolepsy
- Adult Patients with Obstructive Sleep Apnea
- Pediatric Patients with Obstructive Sleep Apnea

Formation and Charge of the Workgroups

Workgroup members were sleep specialists solicited via AASM member sections and completed detailed conflict-of-interest statements. Conflicts of interest, if present, were managed according to the conflict of interest policies of the AASM, and the AASM Board of Direcotors approved Task Force membership. The Workgroups were charged to develop both process and outcome measures that, if implemented, would lead to improvements in quality of care and allow for comparisons between care contexts. Their charge was to develop 2–10 process measures, and 1–3 outcome measures following the process outlined below and shown in **Table 1**.[24]

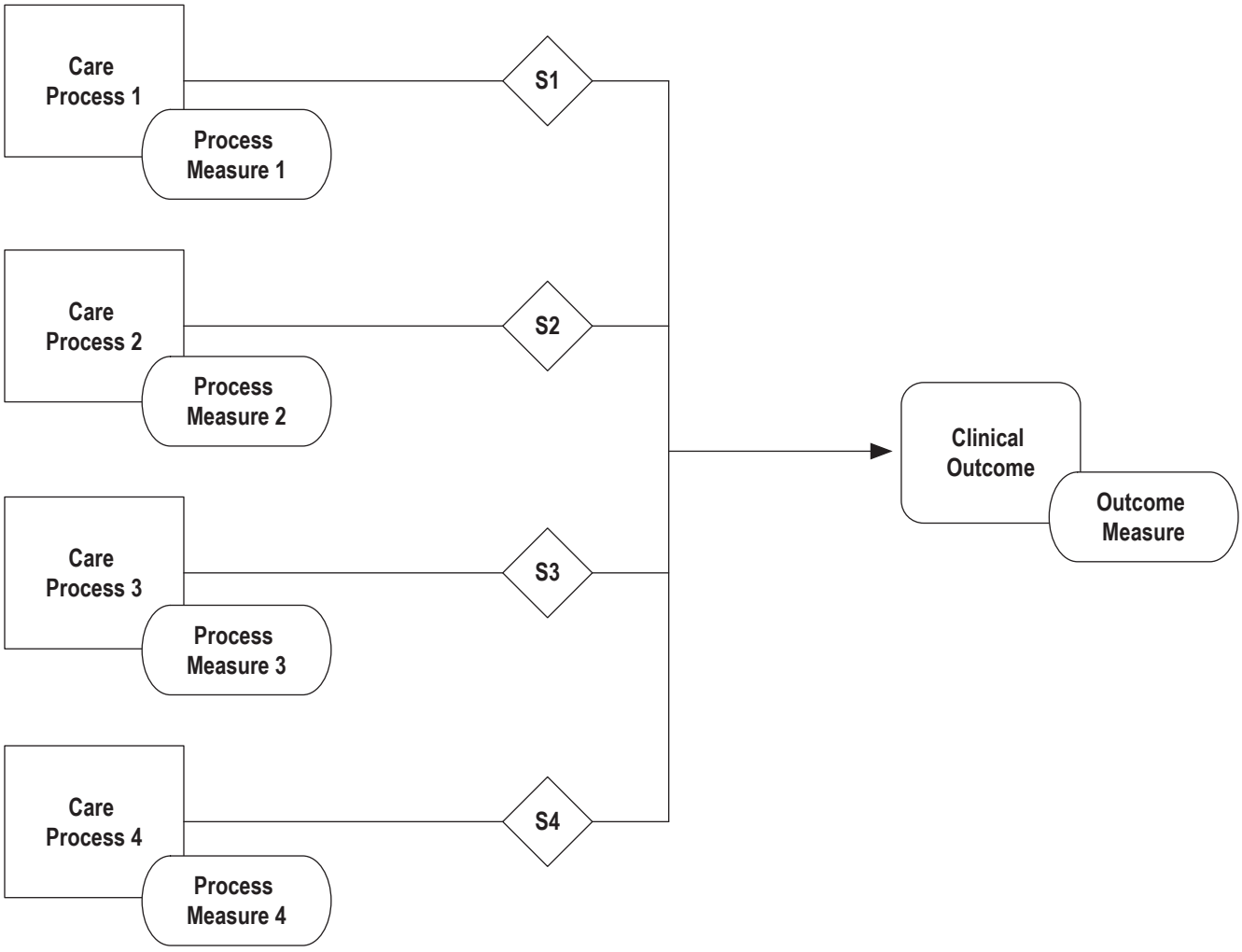
The process was convened with a face-to-face meeting at the 2013 Association of Professional Sleep Society Sleep meeting in Baltimore, MD. Subsequently, a webinar was conducted to acquaint Task Force members with basic issues related to quality measures and to clarify the charge of the Quality Measures Task Force.

Development of Candidate Measures

For each Workgroup, a literature review was performed to identify published evidence regarding the measurement of quality, care processes, or validated outcome tools. Focus was also placed on literature that would support or measure the strength of linkage between certain care processes and desired outcomes.

A comprehensive search was conducted to identify any publications that addressed any of the four sleep disorders in conjunction with quality care. The following disorder search terms, and associated MeSH terms, were used: restless legs syndrome, Willis-Ekbom, sleep apnea, narcolepsy, and sleep initiation and maintenance disorders. The disorder search terms were used in conjunction with quality terms such as quality indicators, quality measure, quality assurance, outcome measurement/assessment, process measurement/assessment, validation, performance assessment and best practices.

Figure 2—Driver diagram for the development of quality measures.



In this example, key care processes are identified (Care Process 1–4) that contribute to the desired clinical outcome (Clinical Outcome). In addition to developing measures to determine the performance of key clinical processes (Process Measures 1–4) and a measure of Clinical Outcome (Outcome Measure), a process was used to determine the strength of association between each process (S1–S4) and the clinical outcome.

For each disorder, an additional search was conducted to identify clinical practice guidelines, measures, systematic reviews, meta-analyses, and consensus recommendations published by the AASM or other specialty societies in the National Guidelines Clearinghouse, the National Quality Measures Clearinghouse, PubMed, EMBASE, PsycInfo, and the Cochrane Library. Workgroup members also performed "pearling," where references from full articles found through the literature search were examined to identify any additional relevant evidence.

All searches were limited to articles published between 2002 and 2013 and in the English language. Publication types such as news, letters, editorials, and case reports were excluded.

Two Workgroup members reviewed the titles and abstracts of all articles. A third Workgroup member resolved any disagreements. Full articles of publications thought to be relevant were obtained and reviewed in full to identify and provide support for the drafted quality measures.

In general, with the exception of adult OSA, little or no antecedent literature directly addressed measurement of quality in the management of sleep patients. However, published evidence did exist on best practices for care processes relevant to all of the disorders. The Workgroups worked to identify candidate processes linked to outcomes of importance and then schematized the relationship between candidate processes and outcomes of importance in driver diagrams. An example is shown in **Figure 2**.

Sleep disorder specific examples are provided in the accompanying articles.[8–12] Workgroups next graded the available evidence for the strength of association between the proposed process and the desired outcome (S in **Figure 2**). The grading scheme utilized is shown in **Table 2**. Additionally, Workgroups used literature, when available, to develop an estimate of how the measure might address any current gaps in quality of care. Adult OSA Workgroup members evaluated current literature to assure that gaps in preexisting OSA measures were addressed.

Initial Selection of Measures

After each Workgroup developed a list of possibly relevant processes and outcomes amenable to measure, face-to-face

Table 2—Strength of association between process measure and desired outcome.

Strength	Characteristic
Level 1: Strong Evidence	• AASM Practice Parameter paper recommendations—STANDARD level of recommendation • Recommendation statements from other clinical guidelines developed using an evidence-based approach and without serious biases—Strong(est) level of recommendation
Level 2: Moderate Evidence	• AASM Practice Parameter paper recommendations—GUIDELINE level of recommendation • AASM Best Practice Guide or Clinical Guideline recommendations—STANDARD or GUIDELINE level of recommendation • Recommendation statements from other clinical guidelines developed using an evidence-based approach and without serious biases—Moderately strong level of recommendation
Level 3: Supporting Evidence	• AASM Practice Parameter paper recommendations—OPTION level of recommendation • AASM Best Practice Guide or Clinical Guideline recommendations—OPTION or CONSENSUS level of recommendation • Recommendation statements from other clinical guidelines developed using an evidence-based approach and without serious biases—Lower levels of recommendation • Conclusions from other systematic reviews and meta-analyses • Randomized controlled trials with at least moderate effect size* and no serious bias/quality issues
Level 4: Workgroup Consensus	• Randomized controlled trials with low effect size** • Observational studies • Expert consensus of the Workgroup

*To calculate effect size (Cohen's *d*): http://www.uccs.edu/~lbecker/, moderate effect size = Cohen's $d \geq 0.5$.
**To calculate effect size (Cohen's *d*): http://www.uccs.edu/~lbecker/, low effect size = Cohen's $d < 0.5$.

meetings were held in November 2013 at the AASM national office in Darien, IL, during which each Workgroup presented their candidate measures to the other Workgroups. After presentation and discussion for any required clarification, a multivoting method was used to rank candidate measures. This method optimized the importance of the measure to improve the quality of management of the sleep disorder against pragmatic issues related to the potential measurement. Through iterative refinement, each Workgroup concluded the meeting by selecting specific key processes and outcomes to be developed further.

Development of the Selected Measures

Workgroups next drafted the technical definitions of numerators and denominators (if any) for measures utilizing a measure specification template (**Table 3**). Important outputs of this activity included clear statements of numerators and denominators of the proposed measures, including any exclusions to the numerators or denominators. Workgroups also provided rationales for the selection of the particular measure, along with estimates of the strength of evidence supporting their choices. For each measure, known gaps in the present state of care that might be assessed by measurement were illuminated. The choice of measure was made keeping in mind that the ability to perform measurement should not be limited by the setting or environment in which care was delivered. Administrative or billing data make automation possible across multiple platforms. Where possible, Workgroups strove to identify patients in the numerator and denominator using descriptors characterized by Current Procedural Terminology (CPT) codes that would typically be recorded on claims or billing forms.

Workgroups next engaged in a Plan, Do, Study, Act (PDSA) process to refine the measures for use.[25] Developed measures were first piloted in Task Force members' individual sleep medicine practice locations. As this was part of a quality improvement activity rather than research, patient-specific data were not retained, and no data from the reviews were to be published, patient consent and institutional review board approval were not required. Through this iterative process of assessment and improvement, the Workgroup members developed a working draft of their measures.

Expression of Performance on Quality Measures

The AASM has chosen to display performance as the proportion of patients meeting the quality criteria (equation 2).

$$Performance = \frac{\#\ of\ patients\ meeting\ numerator\ criteria}{(\#\ of\ patients\ meeting\ denominator\ criteria - \#\ of\ patients\ with\ valid\ exclusions)} \quad (2)$$

Generally, in order to track performance over time, it is useful to display performance measures graphed as a function of time, a display called a run chart (**Figure 3**).

Stakeholder and AASM Board of Directors Review

The AASM requested review and feedback regarding the measures from a variety of stakeholders who might either use or be impacted by the measures. This included sleep specialists, primary care providers, other medical specialists, professional organizations, and patient advocacy groups. Workgroups used stakeholder feedback to further revise the measures. The AASM Board of Directors subsequently reviewed and approved the quality measures for sleep disorders contained in the accompanying articles. In addition, a summary of these first measures is provided in the **Appendix**.

NEXT STEPS AND LIMITATIONS

The AASM recommends the use of these measures as part of a quality improvement program that will enhance the ability to improve the quality of care for patients with sleep disorders. With additional refinement and validation, these measures may

Table 3—Quality measure template.

Measure Name

Measure Description
- Describes what is being measured
- Type of measure (process or outcome)

Measure Components
- Numerator statement: description of what is in the numerator of the measure, using plain language
- Denominator statement: description of what is in the denominator of the measure, using plain language
- Exceptions: description of patient populations that should NOT be counted in the general population with the disorder of interest
- Exception Justifications: clarify rationale for why certain patient populations were excluded from either the numerator or denominator (if there were exclusions listed)
- Supporting Evidence/Rationale: lists supporting evidence from literature for the measure along with evidence grade (Table 2)

Measure Importance
- Relationship to Desired Outcome: description of how the measure influences desired outcomes
- Opportunity for Improvement: describe any documented gaps in care, unexplained variations in care, and cost of care that this measure might address.

Harmonization with Existing Measures (if any)

Technical Specifications
- Description with sufficient clarity that audit systems or personnel could reproducibly perform the measure. For the patient populations/diagnoses which meet the numerator and denominator criteria listed for this measure, attempts were made to list all the CPT codes which would be recorded on claims or billing forms.

be helpful for external benchmarking. This first exercise in development of measures for quality care in sleep medicine is a beginning, but almost certainly not an end in the effort to measure and improve the quality of sleep medicine. With the exception of management of adult OSA, little prior experience existed upon which to draw in sleep medicine quality measures development. Absent are mature literature and long experience in quality improvement in sleep medicine, this effort is a first and early step, with many opportunities for improvement in the future.

First, most of the measures developed are process measures. Nearly a century ago Codman urged us to focus on the "end results" of care, so in some ways many of our new proposed measures may seem far afield from both our roots and more recent trends that are beginning to focus on patient reported outcomes.[26] However, process measures are often the first focus for healthcare quality improvement efforts for important reasons.[19] Measurement and improvement in care processes that are tightly linked to relevant outcomes obviates the need for risk adjustment and focuses on improvement of "what we do" in healthcare. Improvement activities associated with measurement of care processes tends to reduce variation in care delivered and improve the reliability with which key processes of care are rendered. Nonetheless, potential problems with a primary focus on process measures include (a) the measurement of the many processes required to influence outcomes may utilize and compete with resources that would otherwise be directed to activities that have more meaning to the healthcare system, (b) selected processes measured may not be tightly linked or sufficiently influential to important outcomes, and (c) outcomes linked to the chosen processes of care may not be maximally important to patients.

Like limitations of process measures, potential limitations of outcome measures also exist: (a) the measurement of outcomes may utilize and compete with resources that would otherwise be directed to activities that have more meaning to the healthcare system, (b) selected outcomes may only measure a limited facet of desirable outcomes of importance to the patient, and (c) comparisons of outcomes between healthcare contexts are usually not adequately controlled for risk factors and confounders.[18] Furthermore, the outcome measures chosen may require additional measurement tools not currently in routine use in many practices. The Workgroups have chosen the final outcomes primarily for two reasons: (a) they are important objectives in the care of patients with these disorders, and (b) these outcomes of care should be a focus in routine practice and, in the context of clinical quality improvement activities, would lead to important changes in the effectiveness of care rendered.

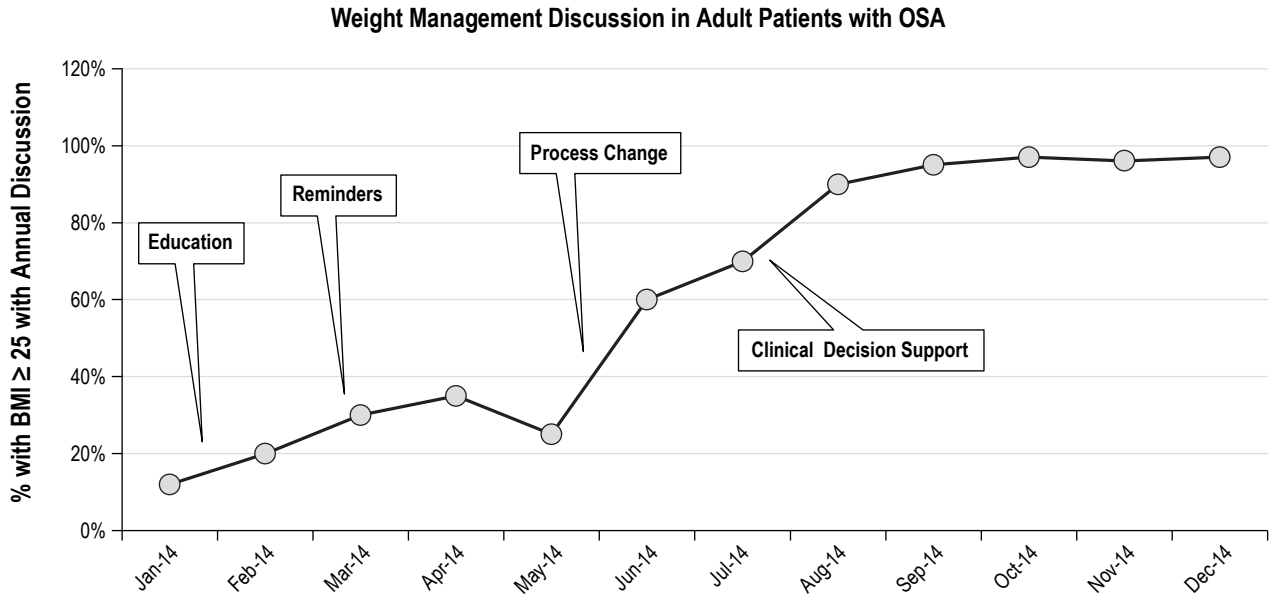
The reasons various processes and outcomes were selected for the care of patients with specific sleep disorders are described in each of the accompanying papers, along with estimates regarding the strength of evidence underlying the recommended measures. In many cases, evidence is not plentiful. This underscores opportunities for clinical research to reveal best practices in sleep medicine.

Regarding the proliferation of quality measures, the last decade clearly has seen a significant increase in the quantity and comprehensiveness of process and outcome measures used for quality improvement. For example, in 2005 there was one CMS inpatient quality reporting system which required reporting of 10 measures (mostly process measures); in 2014 there are ten CMS quality systems with over 350 measures. Additional to these are many other CMS pay-for-reporting and meaningful use incentive programs, and yet other measure programs linked either to various accreditations (such as the Joint Commission ORYX reporting system), to certifications (e.g., National Database of Nursing Quality Indicators for Magnet Hospital status, Get with the Guidelines measures from the American Heart Association for heart failure), or various state-mandated quality measurement systems.[13] Many healthcare systems are already straining under quality reporting requirements. Although this proliferation may provoke the question of why the AASM would want to offer yet other measures, recent history and legislation shows that the future of healthcare will demand improved and quantified value. The AASM believes that measures developed for the care of patients with sleep disorders are most aptly conceived by those most knowledgeable in sleep medicine.

One important issue with quality measures relates to evaluation of measure validity. The AASM's stakeholder review appeared to support at least face validity. Although minimal construct validity was tested by panel-member field pilots, a need remains for more extensive field testing and formal evaluation.

It is additionally acknowledged that, like most of the measures listed above, chart abstraction of clinical data seems necessary, given the state of most electronic medical records

Figure 3—Run chart.



The run chart displays the proportion of overweight or obese patients with OSA who have a discussion regarding weight management documented in the record within the past year of care. It is often helpful to select a statistical sample of all patients seen in a given unit of time for review, in this case one month. A run chart provides visual evidence regarding the effect of various improvement interventions (displayed in the call-outs).

(EMRs). This requirement stems from the fact that many of the processes of care are either not documented by discrete data fields in our EMRs or are not represented by CPT codes.[27]

To move toward improvement, the AASM recommends the following:

1. Professionals or healthcare systems that provide care to patients with OSA, insomnia, narcolepsy, or restless legs syndrome should commit to a systematic program to evaluate and improve the quality of care rendered to patients with one or more of these sleep disorders. A broad range of healthcare providers may utilize these measures, not only those who practice in sleep centers or sleep specialists. Patients who receive care for OSA, for example, should not experience one standard of care in one setting and a different one in another. Care providers should adopt one or more measure sets to begin assessment of the quality of care they render. Which set(s) to select might be influenced by factors such as perceived quality gaps, practice-specific prevalence of the disorder, perceived impact on payment or referral advantage, resources available to commit to improvement activities, or healthcare burden of disease. These and other factors relevant to measure selection might vary between contexts and over time. Use of a formal prioritization matrix might prove helpful in the decision process.[28] Sleep centers accredited by the AASM might consider such measures and related improvement activities as appropriate targets for quality improvement programs.
2. Data should be kept in a confidential database (compliant with the Health Insurance Portability and Accountability Act of 1996-HIPAA) and be used as part of meaningful quality improvement activity.[29] Data could be stored in HIPAA compliant registries shared across care contexts for further manipulation, risk adjustment, and benchmarking. Such data often reveal potential areas for enhanced improvement focus and a commitment to best practices.[30] The AASM would anticipate that such data registries might be a part of integrated sleep care management systems.[31]
3. The AASM anticipates that accreditation requirements will continue to develop increased emphasis on quality improvement and hope that these measures will serve well for this purpose.

Measurement of quality is a first and important step towards fulfilling one of the most important missions of the AASM, to improve sleep health and promote high quality patient-centered care. These quality measures apply to the ambulatory care model of today, but will almost certainly need evolution to apply to new models of care that will replace our current ones. The AASM regards this first step with pride and humility, recognizing there is much work yet to do to harmonize clinical work, quality measurement, and improve the value of rendered care.

ENDNOTE

The National Quality Forum suggests that quality measurement may (1) inform consumers of healthcare, (2) influence payment and payment programs, (3) drive improvement via external comparison or accreditation/regulatory standards, or (4) help with internal quality improvement. The authors feel these all are subsumed into the two listed purposes of quality measurement.

REFERENCES

1. Institute of Medicine (U.S.). Committee on Quality of Health Care in America. Crossing the quality chasm: a new health system for the 21st century. Washington, DC: National Academy Press, 2001.
2. Hippocrates. The Hippocratic Oath. Available from: http://classics.mit.edu/Hippocrates/hippooath.html.
3. Lynn J, Baily MA, Bottrell M, et al. The ethics of using quality improvement methods in health care. Ann Intern Med 2007;146:666–73.
4. Taylor HA, Pronovost PJ, Sugarman J. Ethics, oversight and quality improvement initiatives. Qual Saf Health Care 2010;19:271–4.
5. McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. N Engl J Med 2003;348:2635–45.
6. About the American Academy of Sleep Medicine. 2014 [cited 2014 18 May]; Available from: http://www.aasmnet.org/aboutaasm.aspx
7. Aurora RN, Morgenthaler TI. On the goodness of recommendations: the changing face of practice parameters. Sleep 2010;33:1273–6.
8. Trotti LM, Goldstein CA, Harrod CG, et al. Quality measures for the care of adult patients with restless legs syndrome. J Clin Sleep Med 2015;11:293–310.
9. Edinger JD, Buysse DJ, Deriy L, et al. Quality measures for the care of patients with insomnia. J Clin Sleep Med 2015;11:311–34.
10. Krahn LE, Hershner S, Loeding LD, et al. Quality measures for the care of patients with narcolepsy. J Clin Sleep Med 2015;11:335–55.
11. Aurora RN, Collop NA, Jacobowitz O, Thomas SM, Quan SF, Aronksy AJ. Quality measures for the care of adult patients with obstructive sleep apnea. J Clin Sleep Med 2015;11:357–83.
12. Kothare SV, Rosen CL, Lloyd RM, et al. Quality measures for the care of pediatric patients with obstructive sleep apnea. J Clin Sleep Med 2015;11:385–404.
13. Panzer RJ, Gitomer RS, Greene WH, Webster PR, Landry KR, Riccobono CA. Increasing demands for quality measurement. JAMA 2013;310:1971–80.
14. Foundation NQ. 2012 NQF Report to Congress: Changing Healthcare by the Numbers. 2012 [cited 2014 18 May]; Available from: http://www.qualityforum.org/Publications/2012/03/2012_NQF_Report_to_Congress.aspx.
15. Smoldt RK, Cortese DA. Pay-for-performance or pay for value? Mayo Clin Proc 2007;82:210–3.
16. Porter ME. Value-based health care delivery. Ann Surg 2008;248:503–9.
17. Porter ME. What is value in health care? N Engl J Med 2010;363:2477–81.
18. Lilford R, Mohammed MA, Spiegelhalter D, Thomson R. Use and misuse of process and outcome data in managing performance of acute medical care: avoiding institutional stigma. Lancet 2004;363:1147–54.
19. Lilford RJ, Brown CA, Nicholl J. Use of process measures to monitor the quality of clinical practice. BMJ 2007;335:648–50.
20. Tutorials on Quality Measures. National Quality Measures Clearinghouse 2014 [cited 2014 20 May]; Available from: http://www.qualitymeasures.ahrq.gov/tutorial/index.aspx
21. Krumholz HM. Real-world imperative of outcomes research. JAMA 2011;306:754–5.
22. Krumholz HM. Outcomes research: myths and realities. Circ Cardiovasc Qual Outcomes 2009;2:1–3.
23. Clancy CM, Eisenberg JM. Outcomes research: measuring the end results of health care. Science 1998;282:245–6.
24. Pronovost PJ, Berenholtz SM, Ngo K, et al. Developing and pilot testing quality indicators in the intensive care unit. J Crit Care 2003;18:145–55.
25. Joint Commission on Accreditation of Healthcare Organizations. An Introduction to quality improvement in health care: the transition from QA to CQI. Oakbrook Terrace, IL: Joint Commission on Accreditation of Healthcare Organizations, 1991.
26. Neuhauser D. Ernest Amory Codman MD. Qual Saf Health Care 2002;11:104–5.
27. Pakhomov S, Bjornsen S, Hanson P, Smith S. Quality performance measurement using the text of electronic medical records. Med Decis Making 2008;28:462–70.
28. Breyfogle FW. Implementing six sigma: smarter solutions using statistical methods. 2nd ed. Hoboken, NJ: Wiley, 2003.
29. Carey RG, Lloyd RC. Measuring quality improvement in healthcare: a guide to statistical process control applications. New York: Quality Resources, 1995.
30. Pascale RT, Sternin J, Sternin M. The power of positive deviance: how unlikely innovators solve the world's toughest problems. Boston, MA: Harvard Business Press, 2010.
31. Morgenthaler TI, Badr MS. Ensuring patient access to sleep specialty care in the evolving U.S. healthcare system: introducing the Welltrinsic Sleep Network. J Clin Sleep Med 2014;10:463–4.

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APPENDIX

Clinician's Guide for Implementing Sleep Quality Measures

The clinician is responsible for documenting all steps of care in the patient's chart.

Sleep Disorder	Measure	To Perform during Initial Evaluation	To Perform during Follow-Up Visits	Follow-Up Interval Range
Restless Legs Syndrome	**RLS-O1:** Improve accuracy of RLS diagnosis			
	RLS-P1: Use of accepted diagnostic criteria	Use currently accepted RLS diagnostic criteria (ICSD-3, IRLSSG, DSM) to determine diagnosis		
	RLS-P2: Assessment of iron stores	Measure iron stores, at a minimum including serum ferritin		
	RLS-O2: Decrease RLS severity	Assess symptom severity (using self-report, IRLS score, other validated scale of RLS severity, or assessment of sleep quality, daytime tiredness or sleepiness, daytime function, and mood)	• Assess symptom severity (using self-report, IRLS score, other validated scale of RLS severity, or assessment of sleep quality, daytime tiredness or sleepiness, daytime function, and mood) • Document any change in symptom severity from baseline (i.e. improvement, decline, no change)	Within 12 months of being prescribed a new medication for RLS
	RLS-P3: Assessment of symptom severity	Assess symptom severity (using self-report, IRLS score, other validated scale of RLS severity, or assessment of sleep quality, daytime tiredness or sleepiness, daytime function, and mood)	Assess symptom severity (using self-report, IRLS score, other validated scale of RLS severity, or assessment of sleep quality, daytime tiredness or sleepiness, daytime function, and mood)	Every visit in the reporting period in which RLS is addressed
	RLS-P4: Delivery of evidence-based treatment	Prescribe evidence-based treatment once RLS diagnosis is made		
	RLS-O3: Minimize treatment complications			
	RLS-P5: Counseling about medication side effects		Counsel patient regarding side effects	Every visit in the reporting period in which a new RLS medication is initiated
	RLS-P6: Assessment for impulse control disorders		Assess (by history or validated scale) for impulse control disorders for those on a dopamine agonist or levodopa	Every visit in the reporting period in which RLS is addressed after either dopamine agonist or levodopa treatment has been initiated
	RLS-P7: Assessment for augmentation		Assess for augmentation for those on a dopamine agonist or levodopa	Every visit in the reporting period in which RLS is addressed after either dopamine agonist or levodopa treatment has been initiated

The bold terms in the measure column refer to the sleep disorder and whether it is an outcome (O) or process (P) measure (i.e. "RLS-P1" = Restless Legs Syndrome – Process Measure #1).

Sleep Disorder	Measure	To Perform during Initial Evaluation	To Perform during Follow-Up Visits	Follow-Up Interval Range
Insomnia	**I-O1:** Improve sleep satisfaction or quality (SSQ)	Assess sleep quality (using self-reported or global SSQ, subjective sleep latency, sleep diary, or a validated questionnaire like ISI, PSQI, CSHQ, SSR)	• Assess sleep quality after treatment initiation (using self-reported or global SSQ, subjective sleep latency, sleep diary, or a validated questionnaire like ISI, PSQI, CSHQ, SSR) • Document any change in sleep quality from baseline (i.e. improvement, decline, no change)	Every visit in the reporting period in which insomnia is addressed after insomnia treatment has been initiated
	I-P1: Assessment of sleep quality	Assess sleep quality (using self-reported or global SSQ, subjective sleep latency, sleep diary, or a validated questionnaire like ISI, PSQI, CSHQ, SSR)	Assess sleep quality (using self-reported or global SSQ, subjective sleep latency, sleep diary, or a validated questionnaire like ISI, PSQI, CSHQ, SSR)	Every visit in the reporting period in which insomnia is addressed
	I-P2: Delivery of evidence-based treatment	Prescribe at least one evidence-based treatment		Every time treatment is prescribed during the reporting period
	I-O2: Improve daytime functioning	Assess daytime functioning (using self or caregiver report of clinical items, clinician rating of clinical items, administration of a validated questionnaire)	• Assess daytime functioning after treatment initiation (using self or caregiver report of clinical items, clinician rating of clinical items, administration of a validated questionnaire) • Document any change in daytime functioning from baseline (i.e. improvement, decline, no change)	Every visit in the reporting period in which insomnia is addressed after insomnia treatment has been initiated
	I-P3: Assessment of daytime functioning	Assess daytime functioning (using self or caregiver report of clinical items, clinician rating of clinical items, administration of a validated questionnaire)	Assess daytime functioning (using self or caregiver report of clinical items, clinician rating of clinical items, administration of a validated questionnaire)	Every visit in the reporting period in which insomnia is addressed
	I-P4: Assessment of side effects of treatments		Assess for treatment-related side effects	Every visit in the reporting period in which insomnia is addressed after insomnia treatment has been initiated

The bold terms in the measure column refer to the sleep disorder and whether it is an outcome (O) or process (P) measure (i.e. "I-P1" = Insomnia – Process Measure #1).

Sleep Disorder	Measure	To Perform during Initial Evaluation	To Perform during Follow-Up Visits	Follow-Up Interval Range
Narcolepsy	**N-O1:** Reduce excessive daytime sleepiness	Assess subjective sleepiness (including, but not limited to, using ESS, SSS, KSS, Cleveland Adolescent Sleepiness Questionnaire, or a VAS)	• Assess subjective sleepiness after treatment initiation (including, but not limited to, using ESS, SSS, KSS, Cleveland Adolescent Sleepiness Questionnaire, or a VAS) • Document any change in subjective sleepiness from baseline (i.e. improvement, decline, no change)	Every visit in the reporting period in which narcolepsy is addressed after narcolepsy treatment has been initiated
	N-P1: Assessment of sleepiness	Assess subjective sleepiness (including, but not limited to, using ESS, SSS, KSS, Cleveland Adolescent Sleepiness Questionnaire, or a VAS)	Assess subjective sleepiness (including, but not limited to, using ESS, SSS, KSS, Cleveland Adolescent Sleepiness Questionnaire, or a VAS)	Every visit in the reporting period in which narcolepsy is addressed
	N-P2: Treatment initiation following initial diagnosis		Advise patients to pursue pharmacologic and/or behavioral treatment for narcolepsy symptoms	Within 1 month of diagnosis by MSLT or by CSF hypocretin
	N-O2: Improve accuracy of diagnosis			
	N-P3: Comprehensive sleep history and physical exam	Complete a comprehensive sleep history and physical exam.		
	N-P4: Objective sleep assessment	Complete a PSG and MSLT according to protocols in the AASM practice parameters.		
	N-O3: Reduce adverse events			
	N-P5: Treatment follow-up		Reassess narcolepsy symptoms and functionality via direct interview, phone, or by other HIPAA-compliant electronic means	At least once annually after narcolepsy treatment initiation
	N-P6: Documented medication counseling		Counsel patient regarding side effects of medications or interactions with other medications	Before or at every visit in the reporting period in which a new narcolepsy medication is prescribed

The bold terms in the measure column refer to the sleep disorder and whether it is an outcome (O) or process (P) measure (i.e. "N-P1" = Narcolepsy – Process Measure #1).

Sleep Disorder	Measure	To Perform during Initial Evaluation	To Perform during Follow-Up Visits	Follow-Up Interval Range
Adult OSA	**AdOSA-O1:** Improve disease detection and categorization			
	AdOSA-P1: Baseline assessment of OSA symptoms	Assess OSA symptoms including, but not limited to, the presence of snoring and daytime sleepiness		
	AdOSA-P2: Severity assessment at initial diagnosis		Document or measure AHI, RDI, or REI	Within 2 months of initial evaluation for suspected OSA
	AdOSA-O2: Improve quality of life	Assess quality of life (using, but not limited to any of the following: SF36, Medical outcomes study SF-12, Nottingham health profile, EuroQol EQ-5D, FOSQ, SAQLI)	• Assess quality of life after treatment initiation (using, but not limited to any of the following: SF36, Medical outcomes study SF-12, Nottingham health profile, EuroQol EQ-5D, FOSQ, SAQLI) • Document any change in quality of life from baseline (i.e. improvement, decline, no change)	At least once annually after OSA treatment initiation
	AdOSA-P3: Evidence based therapy prescribed		Prescribe an evidence-based therapy	After initial diagnosis
	AdOSA-P4: Assessment of adherence to OSAS Therapy		Assess OSA therapy adherence using PAP download or subjective adherence report for non-PAP therapies	At least annually after OSA treatment initiation
	AdOSA-P5: Assessment of sleepiness		Assess sleepiness	At least annually after OSA treatment initiation
	AdOSA-P6: Assessment of motor vehicle crashes or near-miss crashes	Question patient about motor vehicle crashes (or near-miss crashes) associated with drowsiness/excessive sleepiness		
	AdOSA-O3: Reduce cardiovascular risk			
	AdOSA-P7: Assessment of weight	Measure patient's weight	Measure patient's weight	Every visit in the reporting period
	AdOSA-P8: Weight management discussion	If patient is overweight or obese, discuss weight status or refer to specialist for weight management	If patient is overweight or obese, discuss weight status or refer to specialist for weight management	At least once annually every reporting period
	AdOSA-P9: Assessment of blood pressure	Measure patient's blood pressure	Measure patient's blood pressure	Every visit in the reporting period
	AdOSA-P10: Elevated blood pressure discussion	If patient has elevated blood pressure, discuss elevated blood pressure or note discussion with another healthcare provider	If patient has elevated blood pressure, discuss elevated blood pressure or note discussion with another healthcare provider	Every visit in the reporting period where patient has elevated blood pressure

The bold terms in the measure column refer to the sleep disorder and whether it is an outcome (O) or process (P) measure (i.e. "AdOSA-P1" = Adult OSA – Process Measure #1).

Sleep Disorder	Measure	To Perform during Initial Evaluation	To Perform during Follow-Up Visits	Follow-Up Interval Range
Pediatric OSA	**POSA-O1:** Improve detection of childhood OSA			
	POSA-P1: Assessment of OSA symptoms and risk factors	Assess for at least one OSA symptom or risk factor		Once within reporting period
	POSA-P2: Initiation of an Evidence-Based (EB) Action Plan		Offer an evidence-based action plan	Once within 12 months of initial evaluation
	POSA-P3: Objective assessment of OSA signs and symptoms in children with complex medical conditions	Order an objective assessment (PSG or specialist referral)		Once within reporting period
	POSA-O2: Reduce signs or symptoms of OSA	Assess abnormal nighttime symptoms or daytime functioning symptoms	• Assess abnormal nighttime symptoms or daytime functioning symptoms • Document any change in abnormal nighttime symptoms or daytime functioning symptoms from baseline (i.e. improvement, decline, no change)	Once within 12 months after initiating an OSA management plan
	POSA-P4: Reassessment of OSA signs and symptoms		Reassess for OSA signs and symptoms	Once within 12 months after initiating an OSA management plan
	POSA-P5: Objective assessment of PAP therapy adherence		Objectively assess PAP adherence (i.e. PAP download)	Once within 3 months of starting OSA therapy

The bold terms in the measure column refer to the sleep disorder and whether it is an outcome (O) or process (P) measure (i.e. "POSA-P1" = Pediatric OSA – Process Measure #1).