ANESTHESIOLOGY

The Evolution, Current Value, and Future of the American Society of Anesthesiologists Physical Status Classification System

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ABSTRACT

The American Society of Anesthesiologists (ASA) Physical Status classification system celebrates its 80th anniversary in 2021. Its simplicity represents its greatest strength as well as a limitation in a world of comprehensive multisystem tools. It was developed for statistical purposes and not as a surgical risk predictor. However, since it correlates well with multiple outcomes, it is widely used—appropriately or not—for risk prediction and many other purposes. It is timely to review the history and development of the system. The authors describe the controversies surrounding the ASA Physical Status classification, including the problems of interrater reliability and its limitations as a risk predictor. Last, the authors reflect on the current status and potential future of the ASA Physical Status system.

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ANESTHESIOLOGY emphasizes quality patient care, safety, and scientific discovery.[1,2] Eighty years ago, leaders of the American Society of Anesthesiologists (ASA; Schaumburg, Illinois) saw the need for a simple tool to collect and tabulate statistical data related to patients' status before anesthesia.[3] This initiative was the framework for the development of the ASA Physical Status classification system.[4]

It was recognized from the time of its introduction that the severity of coexisting diseases and the functional status of the patient are vital parameters to stratify patients before surgery. This system was not designed, developed, or intended to predict perioperative risk.[5,6] Nevertheless, many subsequent publications have shown that the ASA Physical Status classifications are strongly correlated with outcome, either independently or in conjunction with other information.[7–9] When combined with other factors (*e.g.*, age, type and complexity of surgery, frailty, nutritional status, end-organ dysfunction, among others), the ASA Physical Status classification can contribute to the assessment of risk and outcomes, at least with aggregate data.[7–9] However, its utility as a predictor for the individual patient is dubious.

Despite its familiarity, considerable variability exists between anesthesiologists when assigning an ASA Physical Status score to specific patients.[10,11] Misclassification may have several negative consequences, ranging from inappropriate staff assignments to misaligned billing codes, and even skewed measures of outcome.[12–18] One attempt to address this variation was made by the ASA with the addition of case examples, approved first in 2014 and updated in 2020. However, it appears that these examples have only marginally improved reproducibility.[19,20]

Given these issues, we will review the history and evolution of the ASA Physical Status classification system and examine its strengths and limitations, specifically the variability of ASA Physical Status assignments. We will discuss its application to special populations (*e.g.*, pediatrics, obstetrics, trauma surgery, and the potential role of age and frailty), its use as a risk predictor particularly as compared with more comprehensive risk stratification systems, and its use for other administrative purposes (including billing). Finally, we will consider approaches that could impact its future value.

History

In 1940, the ASA established a committee consisting of Meyer Saklad, Ivan Taylor, and Emery Rovenstine (fig. 1) "to study, examine, experiment, and devise a system for the collection and tabulation of statistical data in anesthesia." In the May 1941 issue of ANESTHESIOLOGY,[3] Saklad proposed six designations. Classes 1 to 4 described a patient's preoperative "physical state," whereas classes 5 and 6 were reserved for patients scheduled for emergency surgery. Saklad also provided a series of examples to illustrate the various grades (table 1).

The 1941 publication articulates the authors' vision. Saklad elaborated on the concept of "operative risk," and recognized that its assessment is multifactorial, situational, and complex. Factors such as physical condition, surgical procedure, surgical skill, postoperative care, and the experience of the anesthetist required consideration. As a result,

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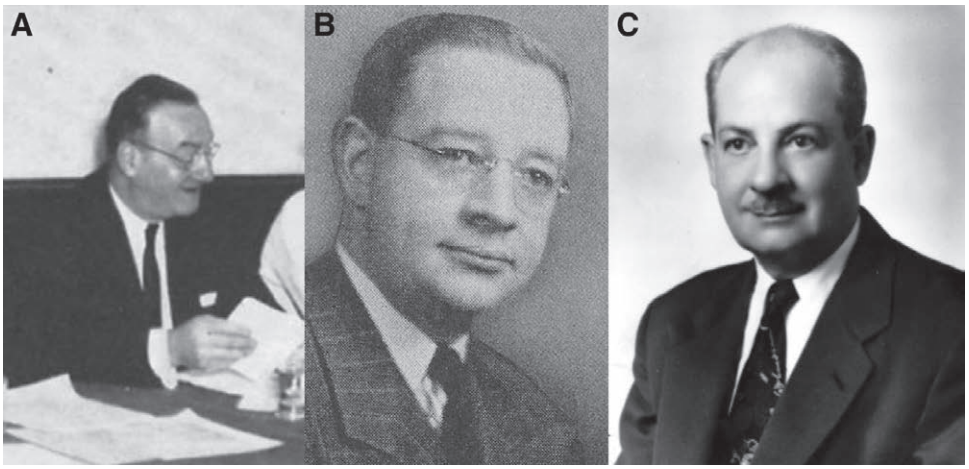


Fig. 1. Pioneers of the American Society of Anesthesiologists Physical Status classification system are (*A*) Meyer Saklad, (*B*) Ivan Taylor, and (*C*) Emery Rovenstine.

operative risk can vary tremendously, even for comparable patients. Given that the goal of the system was to allow the collection of data for statistical analysis, the assignment of a class solely based on the patient's "physical state" required fewer data and was easier to implement. A quote from the manuscript summarizes this thought process:

> The attempt to determine a patient's "Operative Risk" may be of value in prognosis, but such grading of patients is useless from a statistical point of view. It is useless from several standpoints: the excessive number of variables to be considered, the tremendous degree of variation in different clinics and different physicians and the complete lack of agreement as to definition of terms.

Saklad's proposal was apparently adopted by the ASA, although the timeline remains elusive. We assume that the classification system was implemented around April 1945 with publication of a document titled "Codes for the Collection and Tabulation of Data Relating to Anesthesia Inhalation Therapy and Therapeutic & Diagnostic Block" (fig. 2, A and B). A 1978 editorial[21] by Arthur Keats corroborates this concept and reports that the House of Delegates did, sometime before 1945, accept the Saklad plan and also added a seventh category for the "moribund patient not expected to survive with or without surgery." Figure 2C shows a document from the papers of Paul M. Wood, M.D. (Judith A. Robins, Wood Library-Museum of Anesthesiology, Schaumburg, Illinois, January 2021, written communication) in which definitions of physical states 1 through 7 are listed (including a misprint as physical state 6 is listed twice). Unfortunately, the date of this document is unknown. Figure 3 shows a sample paper anesthesia record approved by the ASA in 1950 with the physical status codes in the upper right corner.

In 1961, Dripps *et al.* published "The Role of Anesthesia in Surgical Mortality."[22] Their aim was to define the contribution of anesthesia to perioperative deaths. Among the data collected was the patient's "physical status":

1. A normal healthy patient
2. A patient with a mild systemic disease
3. A patient with a severe systemic disease that limits activity but is not incapacitating
4. A patient with an incapacitating systemic disease that is a constant threat to life
5. A moribund patient not expected to survive 24 h with or without operation

The physical status classification differed slightly from the 1941 system. Specifically, Dripps *et al.* added that "Physical Statuses 1, 2, 3, and 4 correspond to the classification proposed by the American Society of Anesthesiologists. In the event of emergency operation, the only change in classification was to precede the number with the letter E. PS 5 corresponds to the original ASA Classification 7."

Since it appears that members of the society raised questions about the definition and application of Saklad's system, Richard Ament proposed the adoption of the five-category Dripps *et al.* version *via* Resolution No. 6 to the 1962 House of Delegates (fig. 4).[23,24] The resolution was approved, and the new classification system was published in the ASA newsletter and the January–February 1963 issue of Anesthesiology.[25] The ASA used the same wording as in the Dripps *et al.* publication and only added, "In the event of an emergency operation, precede the number with an E."

The Dripps *et al.* version remained unchanged for the next 18 yr. But in 1981, a small modification was made; ASA Phyisical Status 5 was changed to "a moribund patient who is not expected to survive without the operation."[26] However, this change does not appear to have been widely

Table 1. Definitions and Patient Examples of the Six Degrees of Physical State System as Published in 1941

Initial Physical State System	Examples
Class 1 – No organic pathology, or patients in whom the pathologic process is localized and does not cause any systemic disturbance or abnormality.	- Fractures with no shock, blood loss, emboli, signs of systemic injury - Congenital deformities with no systemic disturbance - Infection if localized and no fever - Osseous deformities - Uncomplicated hernia
Class 2 – Moderate, but definite systemic disturbance that is caused by either the condition that is to be treated by the intervention, or which is caused by other existing pathologic processes.	- Mild diabetes - Functional capacity I or II a - Psychotic patients unable to care for themselves - Mild acidosis - Moderate anemia - Septic or acute pharyngitis - Chronic sinusitis with postnasal discharge - Acute sinusitis - Minor or superficial infection that causes systemic reaction - Nontoxic thyroid adenoma causing partial airway obstruction - Mild thyrotoxicosis - Osteomyelitis in early stage - Chronic osteomyelitis - Pulmonary tuberculosis with no functional limitations
Class 3 – Severe systemic disturbance from any cause or causes. It is not possible to state an absolute measure of severity, as it is a matter of clinical judgment.	- Complicated or severe diabetes - Combinations of heart disease and respiratory disease or others that impair normal functions severely - Pulmonary tuberculosis with reduced vital capacity causing tachycardia or dyspnea - Debilitating prolonged illness with weakness of all or several systems - Severe trauma from accident resulting in shock, which may be improved by treatment - Pulmonary abscess
Class 4 – Extreme systemic disorders that have already become an eminent threat to life regardless of the type of treatment. Because of their duration or nature, there has already been damage to the organism that is irreversible. This class is intended to include only patients that are in extremely poor physical state. There may not be much occasion to use this classification, but it should serve a purpose in separating the patient in very poor condition from others.	- Functional capacity III (cardiac decompensation - Severe trauma with irreparable damage - Complete intestinal obstruction of long duration in a patient who is already debilitated - A combination of cardiovascular–renal disease with marked renal impairment - Patients who must have anesthesia to arrest a secondary hemorrhage where the patient is in poor condition associated with marked loss of blood
Emergency surgery – An emergency operation is arbitrarily defined as a surgical procedure which, in the surgeon's opinion, should be performed without delay.	
Class 5 – Emergencies that would otherwise be graded in class 1 or class 2.	
Class 6 – Emergencies that would otherwise be graded as class 3 or class 4	

Adapted from Saklad.[3]

publicized, and multiple sources continued to cite the older definition. This ambiguity was nicely summarized as late as 2011 by Thackray and Gibbs.[26]

In 1983, the ASA added a sixth category (ASA Physical Status 6) to denote a brain-dead patient scheduled for organ retrieval.[27]* Again, this revision was criticized for a lack of clear dissemination. In a 2001 letter (18 yr later), Stone described asking nine consultants and seven junior anesthetists to grade a brain-dead patient undergoing organ harvest. None of the 16 providers assigned the correct class.[27]

On October 15, 2014,[28] the next revision of the ASA Physical Status included the provision of a number of illustrative patient examples for each category, similar to Saklad's original manuscript. The categories (I through VI and E) remained unaltered except for a change to Roman numerals. This was a significant modification to the position taken by the ASA since 1963 when examples or other elaboration on the individual categories were expressly avoided. The change was driven by the growing use of the ASA Physical Status system by nonanesthesiologists and administrative bodies, in many cases for purposes that were far different from the primary intent of the system, but which nevertheless had a major impact on the practice of anesthesiology and general medical care.[29]

In 2019, the ASA House of Delegates added two items to the text surrounding the 2014 version. Specifically, they suggested that "anesthesiology departments may choose to develop institutional examples to supplement the ASA approved examples" and that "the final assignment of Physical Status classification is made on the day of anesthesia care by the anesthesiologist after evaluating the patient."

*It is not clear how the current ASA Physical Status VI category applies to so-called "non-heart beating donors" who were *not* previously declared brain-dead.

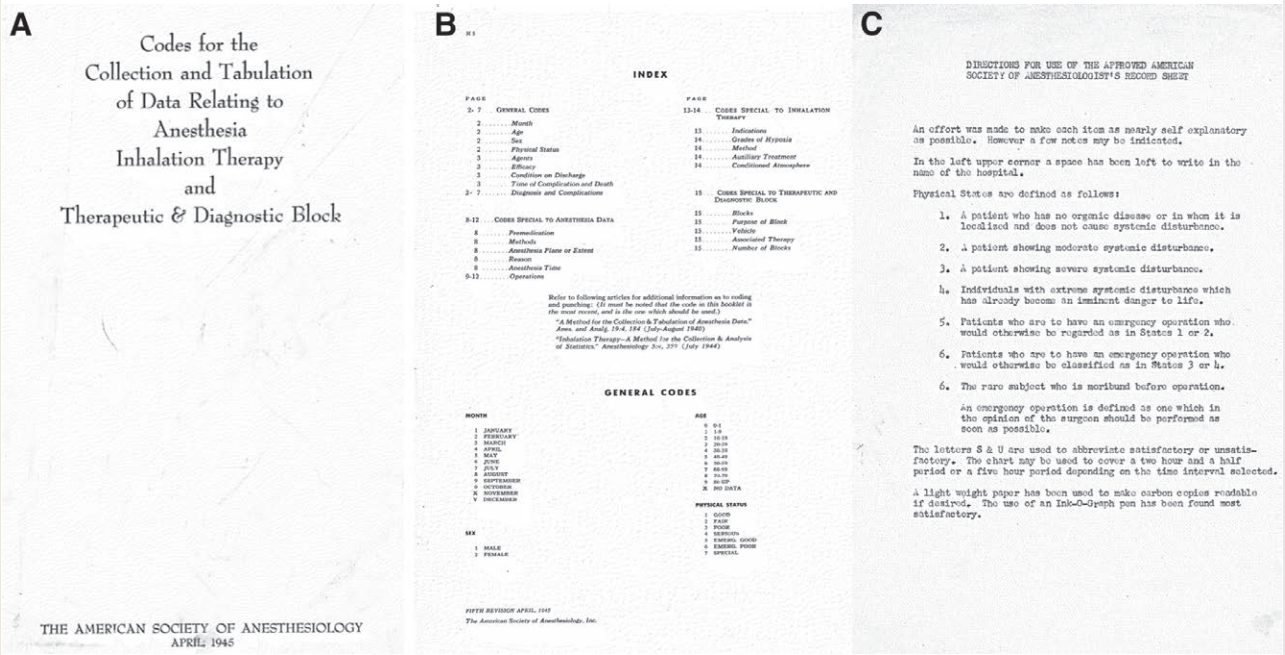


Figure 2. Earliest known publication (*A* and *B*; April 1945) of the proposed American Society of Anesthesiologists Physical Status system, with the version approved by the American Society of Anesthesiologists House of Delegates (*C*; exact date unknown) that included a seventh category for the moribund patient (but mislabeled with two listings of Physical Status 6).

The most recent revision from December 13, 2020, included the addition of pediatric and obstetric patient examples for each category (table 2).[30] Despite the changes aimed at either simplification of the system or improvement of interrater reliability, we find it striking that the current ASA Physical Status system bears such close resemblance to the original version by Saklad and colleagues from 80 yr ago.

Strength of ASA Physical Status

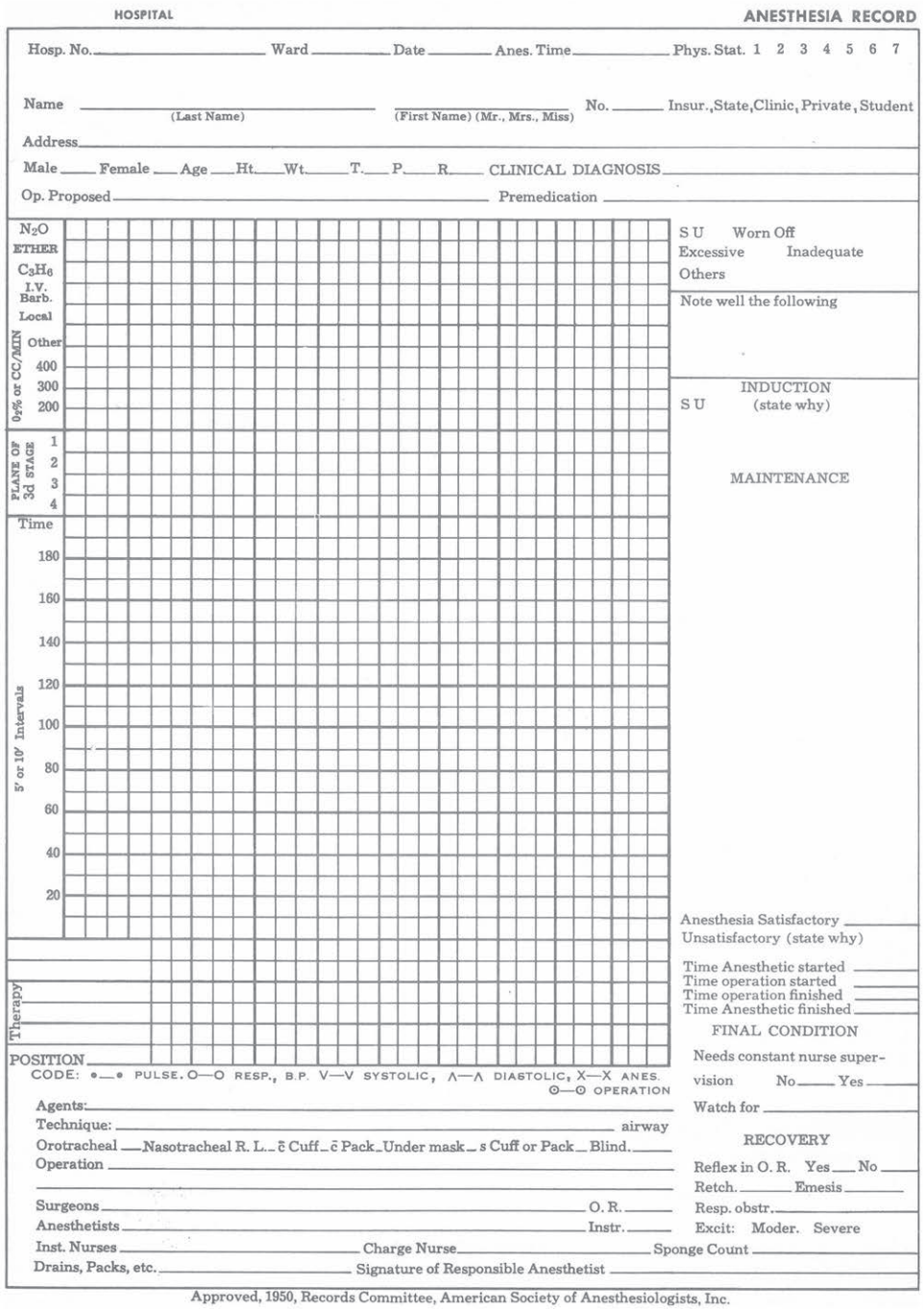
A major strength of the ASA Physical Status system is its simplicity. Saklad and team endeavored to create a tool that would need few variables and no complex computations. This has made it possible for the ASA Physical Status system to be used internationally and across multiple medical specialties. It is freely available and does not require data abstractors or computerized modeling.[30] It is time-tested and obviously durable, as evidenced by iis survival for 8 decades.[3,28] None of the later modifications required any fundamental alteration of its original concepts.

The intended use of the ASA Physical Status system is to allow preoperative health status of surgical patients to be summarized and compared. For example, someone might wish to compare postoperative length of stay at hospital A *versus* hospital B. But someone argues, "We take care of sicker patients at hospital A." Examining the distribution of the assigned ASA Physical Status scores of the patients at the two hospitals helps address this conundrum. As a result, the system has been widely adopted as an administrative tool to compare the performance of hospitals or as a covariate for measuring the outcomes of specific surgical populations.

Also consistent with the originators' goals, the ASA Physical Status system has become a ubiquitous component of clinical investigations.[31] Publications related to anesthesia and surgery almost always contain the ASA Physical Status class distribution of the subjects under investigation. These help define the demographic characteristics of subjects and document similarities (or differences) between groups. It may also be used as a covariable for a wide range of study outcomes. Indeed, the ASA Physical Status classification system has even appeared in the veterinary literature (at least as applied to dogs, cats, pigs, and rabbits).[32]

Limitations of ASA Physical Status

The ASA Physical Status system has also been used for purposes that go far beyond its original intent. For example, it has been used to make triage decisions regarding assignment of inpatient *versus* ambulatory care for individual patients. Some hospitals use it to decide whether or not to transfer patients to other facilities.[33] It may be used to aid in assigning appropriate anesthesia providers to a given case,[29,34,35] and to determine staffing ratios when anesthesiologists cover


HOSPITAL

ANESTHESIA RECORD

Hosp. No. _____ Ward _____ Date _____ Anes. Time _____ Phys. Stat. 1 2 3 4 5 6 7

Name _____ (Last Name) _____ (First Name) (Mr., Mrs., Miss) No. _____ Insur., State, Clinic, Private, Student

Address _____

Male ___ Female ___ Age ___ Ht. ___ Wt. ___ T. ___ P. ___ R. ___ CLINICAL DIAGNOSIS _____

Op. Proposed _____ Premedication _____

N_2O
ETHER
C_3H_6
I.V. Barb.
Local
Other
0₂% or CC/MIN 400 300 200

PLANE OF 3d STAGE 1 2 3 4

Time
5' or 10' Intervals 180 160 140 120 100 80 60 40 20

Therapy

POSITION _____

CODE: •—• PULSE. O—O RESP., B.P. V—V SYSTOLIC, Λ—Λ DIASTOLIC, X—X ANES. ⊙—⊙ OPERATION

Agents: _____

Technique: _____ airway

Orotracheal ___ Nasotracheal R. L. ___ c̄ Cuff ___ c̄ Pack ___ Under mask ___ s Cuff or Pack ___ Blind. ___

Operation _____

Surgeons _____ O. R. ___

Anesthetists _____ Instr. ___

Inst. Nurses _____ Charge Nurse _____ Sponge Count _____

Drains, Packs, etc. _____ Signature of Responsible Anesthetist _____

S U Worn Off
Excessive Inadequate
Others

Note well the following

INDUCTION
S U (state why)

MAINTENANCE

Anesthesia Satisfactory ___
Unsatisfactory (state why)

Time Anesthetic started ___
Time operation started ___
Time operation finished ___
Time Anesthetic finished ___

FINAL CONDITION

Needs constant nurse supervision No ___ Yes ___

Watch for _____

RECOVERY

Reflex in O. R. Yes ___ No ___
Retch. ___ Emesis ___
Resp. obstr. ___
Excit: Moder. Severe

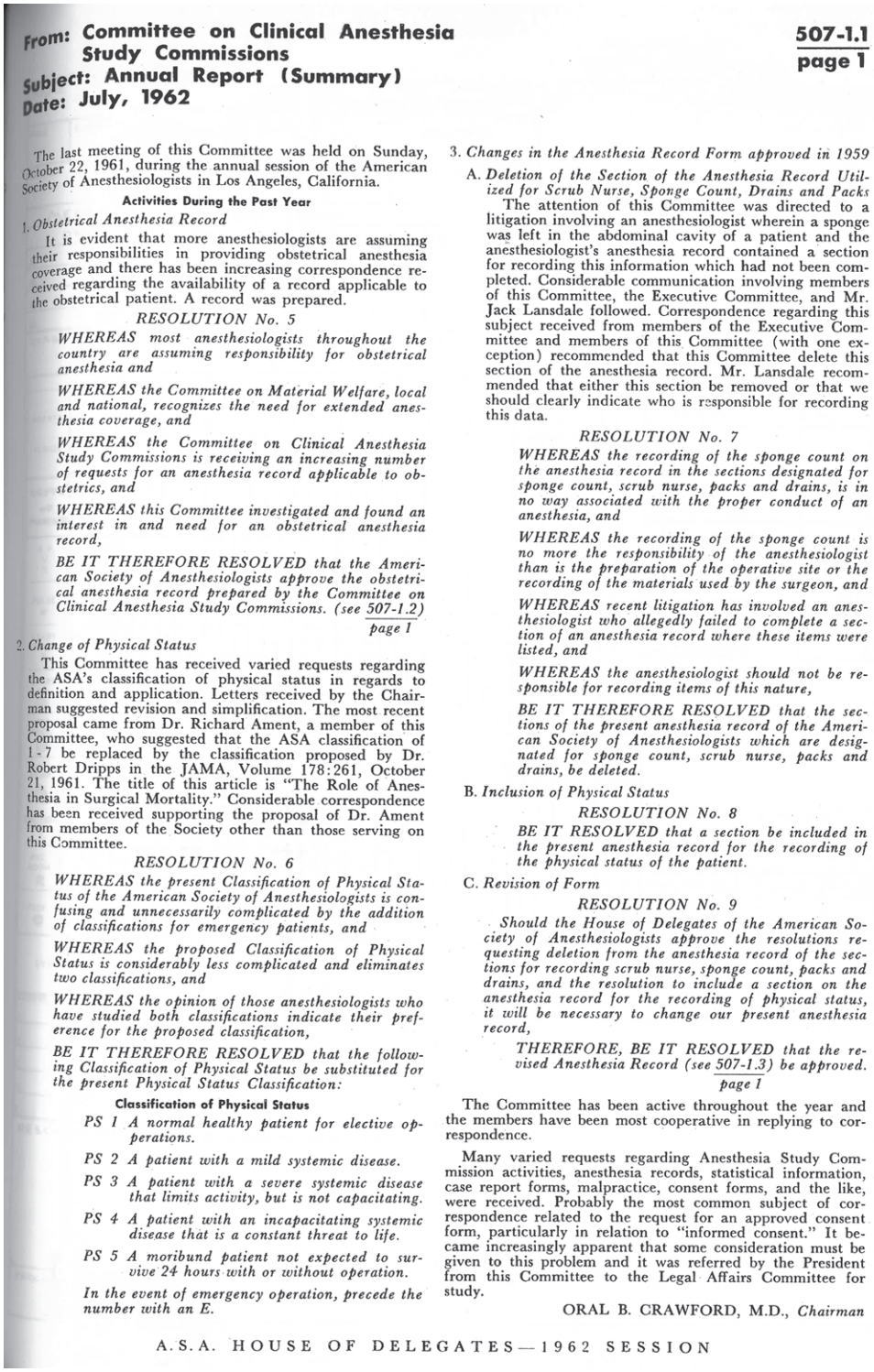
Approved, 1950, Records Committee, American Society of Anesthesiologists, Inc.

Fig. 3. A sample paper anesthesia record approved by the American Society of Anesthesiologists, in 1950 with the Physical Status notation in the right upper corner.

multiple anesthetizing sites.[36] It has been used by nonanesthesiologists to determine whether anesthesia professionals are required for out-of-operating-room procedures with sedation.[37] Finally, ASA Physical Status is used as a billing modifier by many insurers. However, these "unintended" uses may be problematic.

Interrater Reliability/Reproducibility

The first examination of interrater reliability appeared in 1978. Owens *et al.* created a list of 10 hypothetical patients with two of the authors defining a consensus ASA Physical Status designation for each.[38] They then surveyed 235 ASA



From: Committee on Clinical Anesthesia Study Commissions
Subject: Annual Report (Summary)
Date: July, 1962

507-1.1
page 1

The last meeting of this Committee was held on Sunday, October 22, 1961, during the annual session of the American Society of Anesthesiologists in Los Angeles, California.

Activities During the Past Year

1. *Obstetrical Anesthesia Record*

It is evident that more anesthesiologists are assuming their responsibilities in providing obstetrical anesthesia coverage and there has been increasing correspondence received regarding the availability of a record applicable to the obstetrical patient. A record was prepared.

RESOLUTION No. 5

WHEREAS most anesthesiologists throughout the country are assuming responsibility for obstetrical anesthesia and

WHEREAS the Committee on Material Welfare, local and national, recognizes the need for extended anesthesia coverage, and

WHEREAS the Committee on Clinical Anesthesia Study Commissions is receiving an increasing number of requests for an anesthesia record applicable to obstetrics, and

WHEREAS this Committee investigated and found an interest in and need for an obstetrical anesthesia record,

BE IT THEREFORE RESOLVED that the American Society of Anesthesiologists approve the obstetrical anesthesia record prepared by the Committee on Clinical Anesthesia Study Commissions. (see 507-1.2) page 1

2. *Change of Physical Status*

This Committee has received varied requests regarding the ASA's classification of physical status in regards to definition and application. Letters received by the Chairman suggested revision and simplification. The most recent proposal came from Dr. Richard Ament, a member of this Committee, who suggested that the ASA classification of 1-7 be replaced by the classification proposed by Dr. Robert Dripps in the JAMA, Volume 178:261, October 21, 1961. The title of this article is "The Role of Anesthesia in Surgical Mortality." Considerable correspondence has been received supporting the proposal of Dr. Ament from members of the Society other than those serving on this Committee.

RESOLUTION No. 6

WHEREAS the present Classification of Physical Status of the American Society of Anesthesiologists is confusing and unnecessarily complicated by the addition of classifications for emergency patients, and

WHEREAS the proposed Classification of Physical Status is considerably less complicated and eliminates two classifications, and

WHEREAS the opinion of those anesthesiologists who have studied both classifications indicate their preference for the proposed classification,

BE IT THEREFORE RESOLVED that the following Classification of Physical Status be substituted for the present Physical Status Classification:

Classification of Physical Status

PS 1 A normal healthy patient for elective operations.

PS 2 A patient with a mild systemic disease.

PS 3 A patient with a severe systemic disease that limits activity, but is not capacitating.

PS 4 A patient with an incapacitating systemic disease that is a constant threat to life.

PS 5 A moribund patient not expected to survive 24 hours with or without operation.

In the event of emergency operation, precede the number with an E.

3. *Changes in the Anesthesia Record Form approved in 1959*

A. *Deletion of the Section of the Anesthesia Record Utilized for Scrub Nurse, Sponge Count, Drains and Packs*

The attention of this Committee was directed to a litigation involving an anesthesiologist wherein a sponge was left in the abdominal cavity of a patient and the anesthesiologist's anesthesia record contained a section for recording this information which had not been completed. Considerable communication involving members of this Committee, the Executive Committee, and Mr. Jack Lansdale followed. Correspondence regarding this subject received from members of the Executive Committee and members of this Committee (with one exception) recommended that this Committee delete this section of the anesthesia record. Mr. Lansdale recommended that either this section be removed or that we should clearly indicate who is responsible for recording this data.

RESOLUTION No. 7

WHEREAS the recording of the sponge count on the anesthesia record in the sections designated for sponge count, scrub nurse, packs and drains, is in no way associated with the proper conduct of an anesthesia, and

WHEREAS the recording of the sponge count is no more the responsibility of the anesthesiologist than is the preparation of the operative site or the recording of the materials used by the surgeon, and

WHEREAS recent litigation has involved an anesthesiologist who allegedly failed to complete a section of an anesthesia record where these items were listed, and

WHEREAS the anesthesiologist should not be responsible for recording items of this nature,

BE IT THEREFORE RESOLVED that the sections of the present anesthesia record of the American Society of Anesthesiologists which are designated for sponge count, scrub nurse, packs and drains, be deleted.

B. *Inclusion of Physical Status*

RESOLUTION No. 8

BE IT RESOLVED that a section be included in the present anesthesia record for the recording of the physical status of the patient.

C. *Revision of Form*

RESOLUTION No. 9

Should the House of Delegates of the American Society of Anesthesiologists approve the resolutions requesting deletion from the anesthesia record of the sections for recording scrub nurse, sponge count, packs and drains, and the resolution to include a section on the anesthesia record for the recording of physical status, it will be necessary to change our present anesthesia record,

THEREFORE, BE IT RESOLVED that the revised Anesthesia Record (see 507-1.3) be approved. page 1

The Committee has been active throughout the year and the members have been most cooperative in replying to correspondence.

Many varied requests regarding Anesthesia Study Commission activities, anesthesia records, statistical information, case report forms, malpractice, consent forms, and the like, were received. Probably the most common subject of correspondence related to the request for an approved consent form, particularly in relation to "informed consent." It became increasingly apparent that some consideration must be given to this problem and it was referred by the President from this Committee to the Legal Affairs Committee for study.

ORAL B. CRAWFORD, M.D., *Chairman*

A.S.A. HOUSE OF DELEGATES—1962 SESSION

Fig. 4. Resolution No. 6 was approved by the American Society of Anesthesiologists House of Delegates in 1962 that officially adopted the simplified five-category American Society of Anesthesiologists Physical Status system promoted by Dripps *et al.*[22]

members. Just over 60% of respondents agreed with the consensus classifications for six or more of the cases. Four cases were the major sources of disagreement. One healthy patient was "misclassified" (in the opinion of the authors) as ASA Physical Status II based on age alone (75 yr). Another healthy 24-yr-old was "misclassified" as ASA Physical Status II based

Table 2. American Society of Anesthesiologists Physical Status Classification System

ASA Physical Status Classification	Definition	Adult Examples, Including, but Not Limited to, the Following:	Pediatric Examples, Including, but Not Limited to, the Following:	Obstetric Examples, Including, but Not Limited to the Following:
I	A normal healthy patient.	Healthy, nonsmoking, no or minimal alcohol use.	Healthy (no acute or chronic disease), normal body mass index percentile for age.	
II	A patient with mild systemic disease.	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30 < body mass index < 40), well-controlled diabetes mellitus/ hypertension, mild lung disease.	Asymptomatic congenital cardiac disease, well-controlled dysrhythmias, asthma without exacerbation, well-controlled epilepsy, non–insulin-dependent diabetes mellitus, abnormal body mass index percentile for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations.	Normal pregnancy,* well-controlled gestational hypertension, controlled pre-eclampsia without severe features, diet-controlled gestational diabetes mellitus.
III	A patient with severe systemic disease.	Substantive functional limitations; one or more moderate to severe diseases. Poorly controlled diabetes mellitus or hypertension, COPD, morbid obesity (body mass index ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, end-stage renal disease undergoing regularly scheduled dialysis, history (> 3 months) of MI, cerebral vascular accident, transient ischemic attack, or coronary artery disease/ stents.	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin-dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long-term parenteral nutrition. Full-term infants < 6 weeks of age.	Pre-eclampsia with severe features, gestational diabetes mellitus with complications or high insulin requirements, a thrombophilic disease requiring anticoagulation.
IV	A patient with severe systemic disease that is a constant threat to life.	Recent (< 3 months) MI, cerebral vascular accident, transient ischemic attack, or coronary artery disease/ stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, shock, sepsis, DIC, acute respiratory distress syndrome, or end-stage renal disease not undergoing regularly scheduled dialysis.	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic–ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter–defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.	Preeclampsia with severe features complicated by syndrome of hemolysis, elevated liver enzymes, and low platelet count or other adverse event, peripartum cardiomyopathy with ejection fraction < 40, uncorrected/ decompensated heart disease, acquired or congenital.
V	A moribund patient who is not expected to survive without the operation.	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction.	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.	Uterine rupture.
VI	A declared brain-dead patient whose organs are being removed for donor purposes.			

The addition of "E" denotes emergency surgery (an emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part).

* Although pregnancy is not a disease, the parturient's physiologic state is significantly altered from when the woman is not pregnant, hence the assignment of ASA Physical Status II for a woman with uncomplicated pregnancy.

ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease; DIC, disseminated intravascular coagulation; ECMO, extracorporeal membrane oxygenation; MI, myocardial infarction; OSA, obstructive sleep apnea; PCA, patient-controlled analgesia.

on a hemoglobin of 9.5 g/dl (and some respondents even assigned an ASA Physical Status III score). Another patient with a previous, uncomplicated myocardial infarction (7 months earlier) received scores ranging from I to IV. Similar inconsistency was seen for an otherwise healthy 37-yr-old woman, based on her body mass index of 47.5 kg/m^2. The authors note that many anesthesiologists have difficulties in separating "preoperative physical status" from perceived

"anesthetic risk" and concluded that the ASA Physical Status "suffer(s) from a lack of scientific definition."

Multiple other investigators, using similar methods, have found similar results.[39–41] Clinician agreement ranged from 40% to over 90%, but complete agreement was not achieved in any study; in some cases, ASA allocations spanned at least three and occasionally five grades. In perhaps the largest such study, Cuvillon *et al.* extracted the ASA Physical Status scores assigned by attending anesthesiologists in 1,554 cases.[42] The records were presented—along with the original ASA Physical Status assignment—to other experienced anesthesiologists. Each either agreed with the original score or assigned a different one. The lowest and highest discordance rates were found for ASA Physical Status I (24.5%) and IV (83.3%), with a Cohen's kappa coefficient of 0.53, indicating weak to moderate agreement.

Better concordance is seen when direct patient contact by all raters is involved. Sankar *et al.* compared scores assigned by anesthesiologists in the preoperative assessment clinic with scores given to the same patients by different providers on the day of surgery.[43] Sixty-seven percent of patients were assigned the same scores in the clinic and operating room. Nearly 99% of assignment pairs either matched or were within one ASA Physical Status class of each other, producing a kappa score of 0.61. Interrater disagreements were associated with age, selected comorbidities (particularly hypertension and malignancy), and the commonly mistaken belief that the complexity or duration of the surgical procedure influences ASA Physical Status.

Value of Case Examples to Interrater Reliability

Three years after the 2014 ASA Physical Status modification, Hurwitz *et al.* examined the value of the new patient examples.[44] A questionnaire with 10 hypothetical ASA Physical Status I, II, and III patients were sent to 779 anesthesia-trained providers (anesthesiologists, fellow/resident anesthesiologists, certified registered nurse anesthetists, and anesthesia assistants) and to 110 non–anesthesia-trained physicians and nurses who assign ASA Physical Status for sedation purposes. In the first part of the survey, the ASA Physical Status category was decided based on the words of the category alone. In the second part, the same cases were presented in a different order, and with the new ASA-approved examples added. The responses were compared to consensus scores determined by the investigators. Significantly improved agreement (greater than 70% of responders agreed) was found in 9 out of 10 scenarios when examples were provided. However, both overclassification and underclassification occurred despite the examples. One hypothetical patient had several coexisting diseases that may well have med the criteria of the ASA Physical Status III category, and the majority of the responders assigned the patient to that category in the first part of the survey. However, none of those comorbidities were listed in the examples, and therefore both the investigators and the majority of the responders in the second part of the survey scored the same patient as ASA Physical Status II. Clearly, patient examples may have positive and negative consequences.

However, another survey found the opposite result.[10] Eight hypothetical scenarios ranging from ASA Physical Status I to V were presented to providers with differing degrees of experience. Both the ASA Physical Status classes and the examples were provided to the respondents. Interrater reliability remained low despite the examples, with more experienced anesthesiologists "incorrectly" scoring the ASA Physical Status classes more often than residents and recent graduates.

In the largest effort to assess this issue, Fielding-Singh *et al.* examined over 2 million records of patients from the American College of Surgeons (Chicago, Illinois) National Surgical Quality Improvement Program database from 2011 to 2017, with four specific comorbidities.[19] In patients with septic shock and acute renal failure on dialysis (ASA Physical Status IV per definition) the underclassification rates were 24% and 38.7%, respectively, in the 2011 to 2014 cohort. This remained virtually unchanged between 2015 and 2017, after the examples were introduced. In patients with a body mass index from 30 to 39.9 kg/m^2 (ASA Physical Status II) and body mass index over 40 kg/m^2 (ASA Physical Status III), the rates of underclassification were 4.8% and 27.6%, respectively, between 2011 and 2014, with a significant but very small improvement noted after 2014.

Special Populations and Additional Uncertainties

Pediatrics. Before the 2020 amendment,[30] the ASA Physical Status document included the disclaimer, "The examples in the table […] address adult patients and are not necessarily applicable to pediatric or obstetric patients."[28] The only listed pediatric-specific example was a premature infant with postconception age less than 60 weeks (noted as ASA Physical Status III).[28]

Similar to the interrater variability of ASA Physical Status in adults, studies focusing on children show only weak[45,46] to moderate agreement.[47,48] Tollinche *et al.* assessed children with cancerand found kappa scores of only 0.042, which is equivalent to random chance.[46] However,Jacqueline *et al.* reported better results from a postal questionnaire sent to members of the Society for Pediatric Anesthesia (Richmond, Virginia),[48] reporting an overall kappa coefficient of 0.47. This improved to 0.52 when cardiac cases were excluded. Similar to studies of adults, the best agreement was noted at the extremes of the ASA Physical Status categories. In 2019, Leahy *et al.* proposed a Pediatric ASA Physical Status scoring system that was richly populated with clinical examples.[49] Ferrari *et al.*[50] tested the utility of this new proposal by asking teams of three pediatric anesthesiologists to

reclassify 120 pediatric surgical cases based on this proposed system. Reassignment most often resulted in an upgrade to the ASA Physical Status (*e.g.*, 42% of the original ASA Physical Status I group were reclassified ASA Physical Status II), while a quarter of the ASA Physical Status IV children were downgraded to III. As with previous studies, the lowest concordance was noted in ASA Physical Status II and III patients and was best at the extremes.[50]

Based on this and related work, the ASA included pediatric-specific examples in the 2020 amendment of the ASA Physical Status.[30] Whether the new pediatric examples will produce the desired effect remains to be determined.

Obstetrics. The 2020 update of the ASA Physical Status guideline recognizes that normal pregnancy is not a disease, yet it is categorized as ASA Physical Status II due to the significantly different physiologic status of a parturient.[30] However, there is little guidance as to how to adjust for the many complications of pregnancy. This challenge is compounded by the paucity of published papers that address the appropriate stratification of more complicated pregnant patients.[51,52]

Thus, it is not surprising that interrater inconsistency occurs. Nearly 400 members of the Society for Obstetric Anesthesia and Perinatology (Lexington, Kentucky) were asked to assign a ASA Physical Status to "a healthy 24-year-old woman, G_1P_0 [gravida 1, para 0, a woman who is pregnant for the first time and has not yet delivered], in active labor, requesting labor epidural analgesia."[51] Respondents were nearly evenly split (44% ASA Physical Status I *vs.* 55% ASA Physical Status II). Because of this, some obstetric experts sought to introduce a pregnancy specific modifier by adding a "G" to the baseline ASA Physical Status score.[51] Opponents argued that this does not reflect both specific derangements (*e.g.*, placenta previa *vs.* gestational diabetes) and disease severity (*e.g.*, mild *vs.* severe pre-eclampsia) of more complicated pregnancies. Unfortunately, there is no consensus among obstetric anesthesiologists regarding the optimal modification of the traditional ASA Physical Status system as it applies to pregnant patients before surgery.

The new 2020 case examples attempt to capture some of the nuances encountered with more complicated pregnancies. However, as with the new pediatric examples, formal study will be needed to evaluate the impact of these changes.

Emergency Surgery, Trauma, and Critical Illness. The original 1941 physical classification system stated, "An emergency operation is arbitrarily defined as a surgical procedure which, in the surgeon's opinion, should be performed without delay."[3] Since 1963, the addition of "E" to any ASA Physical Status class denotes emergency surgery. ASA now defines an emergency as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part.[53] While deceptively simple, these definitions are, in fact, quite imprecise. The "E" designation does not specify the duration or the severity of the emergency diagnosis; there are obvious differences between a comatose patient with an acute epidural hematoma and a patient with early acute appendicitis. What time increment constitutes a "delay in treatment"—minutes, hours, or days? And how are clinicians to quantify a "*significant* increase in the threat"?

The surgical literature provides one approach. Kluger *et al.* published a proposal for the ideal time to initiate surgery.[54] The authors define bleeding emergencies (predominantly trauma-related) as "immediate surgery" and nontraumatic emergencies (such as perforated viscus, incarcerated hernia) as "surgery within an hour." Both groups would certainly warrant "E" designation within the ASA Physical Status system. In addition, some institutions utilize an "A, B, C" triage system, where a class A emergency would be surgery within an hour, a class B emergency might safely wait 3 or 4 h, and a class C might wait as long as 8 h. However, whether all these categories (other than the most urgent) warrant the "E" designation is debatable and undefined, and how such a classification might be incorporated into the ASA Physical Status is unknown.

There is also ambiguity concerning a patient's preinjury state, their current clinical state, and the assignment of an ASA Physical Status. The current ASA Physical Status system provides no specific guidance as to how the severity of an injury translates to the standard definitions of the preoperative state (*e.g.*, what kind of injury correlates with "severe systemic disease"). But examination of Saklad's notes and examples provides guidance.[3] Saklad described how a previously healthy 20-yr-old patient who sustained both head trauma and significant abdominal hemorrhage is to be designated physical state class 6 (indicating a trauma-triggered transition from the initial physical class 1 state to the emergency category for a class 3 or 4 patient). While not covered in the current ASA examples, this patient would probably be an ASA Physical Status V-E since survival would be unlikely without surgery. But classification of less catastrophic emergencies is more controversial.

Last, the impact of preoperative intensive care unit interventions such as mechanical ventilation, dialysis, extracorporeal membrane oxygenation or left-ventricular assist devices on ASA Physical Status class designation is undefined.[55] Patients receiving such treatments can be of all ages and preintervention conditions, and their physiologic condition can range from near moribund to extremely "stable," even ambulatory. However, there is little guidance on how to integrate advanced life-support devices into an ASA Physical Status assignment.

Age, Chronic Disease, and Frailty. The ASA has consistently refrained from considering age as a part of the physical status system, except for the very young. Chronological age was intentionally omitted since it usually does not correlate with functional status. While older patients

suffer greater perioperative morbidity and mortality,[56–58] a retrospective study in 159 nonagenarians (mean age of 91.8 yr) found that it was not age *per se*, but ASA Physical Status and emergency surgery that were key drivers of their outcomes.[59] In clinical practice, anesthesiologists almost certainly upgrade their ASA Physical Status class assignment based on the extremes of age, possibly independent of "systemic disease" and probably based on the belief that a chronic disorder(s) combined with extreme age warrants such upgrading. While it is likely that this adjustment to the ASA Physical Status score reflects a valid product of clinical intuition and experience, it also reflects the inherent subjectivity of the ASA Physical Status (*e.g.*, what constitutes a "mild" *vs.* "serious" systemic disease) and is unlikely to be resolved by any simple modification to the ASA Physical Status categories.

In recent years, "frailty" has been increasingly recognized as an important comorbidity and factor in surgical outcomes.[60,61] Various scales are available to measure frailty before surgery. They all examine a patient's activities of daily living (such as the need for assistance with bathing, dressing, and so forth), strength, weight loss, cognitive function, among others.[62,63] Frailty is mentioned as a complement to the ASA Physical Status classification system in the ASA's preamble on the current website but is not included in the table of definitions or examples.[30] Thus, there is no formal guidance or current means to integrate frailty into the ASA Physical Status. Nonetheless, it would seem that an objective determination of "frail" could—by itself—constitute at least a "serious systemic disease" (ASA Physical Status III) and in some patients could be a "threat to life" (ASA Physical Status IV). Therefore, we assert that frailty should become a standard part of a comprehensive preoperative evaluation and could well be incorporated into future amendments to the ASA Physical Status system.

ASA Physical Status, Risk, and Outcome. ASA Physical Status is not intended and should not be used as predictor of operative risk, certainly not in individual patients.[5,6,43,64] It has nevertheless evolved into just such a system in both appropriate and inappropriate ways. It is intuitive that a patient's "physical status" will be associated with that person's postoperative outcome as preexisting disease may be the most common cause of death.[65] No one was surprised when Dripps *et al.* reported a strong correlation between ASA Physical Status and postoperative mortality attributable to anesthesia.[22] However, while Dripps *et al.* reported a *statistical* association, the positive predictive value for any individual ASA Physical Status value was very low (*i.e.*, only 3% for ASA Physical Status IV and V combined), meaning that the overwhelming majority of even the sickest patients do not die as a result of their anesthetic care (although all-cause mortality was not reported).

Similar univariate correlations with multiple outcomes have been shown many times. Davenport *et al.* examined the outcomes of a random group of 5,878 patients undergoing noncardiac surgery at a single center.[66] All-cause 30-day mortality, morbidity, costs, and length of stay increased progressively with increasing ASA Physical Status with *P* values of less than 0.0001. Mortality increased from 0 for ASA Physical Status I to 70% for ASA Physical Status V. They also compared the predictive value of ASA Physical Status against a larger series of National Surgical Quality Improvement Program risk factors—and noted an exceptionally high correlation (C-statistic approximately 0.9). Hackett *et al.* examined the records of 2,297,629 noncardiac surgical patients in the National Surgical Quality Improvement Program database[67] where the ASA Physical Status values had been assigned by anesthesia providers. There was a clear and strong relationship between ASA Physical Status and both complications and all-cause deaths (table 3). Koo *et al.* published a meta-analysis of 77 studies containing over 165,000 patients.[68] The results of individual studies were converted into 2 × 2 contingency tables, based on mortality and whether the patient had an ASA Physical Status I or II *versus* ≥ III. Their pooled estimate of sensitivity was 0.74, meaning that if a patient died, they had a 74% chance of having ASA Physical Status III or greater. Specificity was 0.66, meaning that if a patient did not die, they had a 66% chance of having ASA Physical Status I or II. But again, the positive predictive value for an ASA Physical Status III or greater was very low; less than 4% of patients with ASA Physical Status III or greater actually died.

Multiple other studies have shown similar unadjusted and statistically adjusted relationships. These include patients with endometrial cancer,[58] urinary tract cancers,[69] noncardiac thoracic surgery,[70] hip arthroplasty,[9,71] major spine surgery,[72,73] hip fractures,[74] and trauma.[75–77] Such associations are not, however, universal. Thomas *et al.* found that ASA Physical Status was not predictive of postoperative morbidity in patients undergoing surgery for chronic subdural hematomas,[56] but seven of the top eight most common complications were neurologic events that might be unrelated to preoperative "physical status." ASA Physical Status did not predict postoperative prosthetic joint infections,[78] nor

Table 3. Outcome Data for Elective and Emergent Surgeries Involving General Anesthesia (Table Reconstructed from Data in Table 1 of Hackett *et al.*[67])

ASA Physical Status	Total Cases	Complications	Death
I	223,215	2%	0.02%
II	1,053,991	5%	0.14%
III	873,734	14%	1.41%
IV	139,302	37%	11.14%
V	5,796	71%	50.87%

Reconstructed from data in table 1 of Hackett *et al.*[67]
ASA, American Society of Anesthesiologists.

was it associated with mortality in gastric cancer patients.[57] Shahrokni *et al*. found a univariate relation between ASA Physical Status and postoperative intensive care unit admissions, but not with 6-month mortality.[79]

Several of the previously cited studies support the concept that the predictive value of the preoperative physical status can be improved when additional data are used. Perhaps the earliest application of this approach was by Goldman *et al.*, who constructed a multivariate statistical model including the ASA Physical Status classification, along with other cardiac signs and symptoms (*e.g.*, S3 gallop, previous myocardial infarction, among others).[80] ASA Physical Status has also been used as part of the National Surgical Quality Improvement Program Surgical Risk Scale. Davenport *et al*. examined the records of 183,069 patients having general or peripheral vascular surgery.[81] Over 50 preoperative and intraoperative risk factors and laboratory tests were used to construct a predictive model. Twenty factors remained in the final model—with ASA Physical Status having the highest single odds ratio (for ASA Physical Status [IV and V] *vs.* [I and II]).

It is clear that the ASA Physical Status scale is limited in predicting risk as a stand-alone tool and given the issues of interrater reliability and poor positive predictive values, it should never be used as a predictive tool for individual patients (with the possible exception of ASA Physical Status V and V-E). A subjective 5-point scale can never incorporate the myriad of factors that influence outcome in a single individual. As noted above, more elaborate risk prediction models have been developed—but they also require far more information and are more demanding to apply. A qualitative systematic review in 2013 compared the performance of eight leading surgical risk predictors and concluded that the Portsmouth Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity and the Surgical Risk Scale were the most consistently accurate predictive tools for predicting postoperative mortality and morbidity.[82]

ASA Physical Status and Billing. The ASA Physical Status system is used as a billing modifier by some private payors. One additional unit may be added to the charge for an ASA Physical Status III patient, 2 units for an ASA Physical Status IV patient, and 3 units for an ASA Physical Status V patient. No added units are allowed for ASA Physical Status I or II. Other factors related to the ASA Physical Status may also generate additional units, such as the extremes of age or emergency surgery (so-called Qualifying Circumstances codes).[83] While these codes are not recognized by Medicare or Medicaid, the ASA's Commercial Conversion Factor Survey reports that 80% of responding anesthesia group private contracts include reimbursement for ASA Physical Status and Qualifying Circumstances codes. On July 1, 2021, the U.S. Departments of Health and Human Services, Treasury, and Labor (Washington, D.C.), and the Office of Personnel Management (Washington, D.C.) issued their first rule related to the "No Surprises Medical Bill Act" that recognizes anesthesiology's unique payment methodology including the physical status modifier.†

The aforementioned variation in ASA Physical Status assignment amplifies the potential for upcoding or downcoding. Unintentional upcoding may simply occur as a result of the "subjectivity" associated with ASA Physical Status assignments, variation in interpretation of published patient examples, and perhaps the specific experience or practices of providers.

In 2016, Nie *et al.* showed a progressive increase in the fraction of gastrointestinal endoscopy patients coded as ASA Physical Status III or greater (from 11.6% in 2005 to 18.9% in 2013).[84] After adjusting for recorded comorbidities, the probability of medically comparable patients receiving higher ASA Physical Status scores increased almost fivefold, suggesting (to the authors) the likelihood of upcoding. In contrast, Schonberger *et al.*, working with the National Anesthesia Clinical Outcomes Registry, attempted to determine whether there was a discontinuity in the distribution of ASA Physical Status scores assigned to patients below and above age 65 yr.[17] Since patients 65 yr and older are likely to be covered by Medicare, which does not pay for these ASA Physical Status modifiers, this would theoretically remove any incentive to upcode for seniors not covered by Medicare. They were unable to find such a discontinuity, although they acknowledge that they cannot determine whether this was "because of virtue, lack of knowledge, or a combination thereof" or because the incidence of upcoding was too low to detect. Evidence for downcoding, perhaps by nonanesthesia providers seeking to avoid the need for mandated anesthesia services, is even less compelling. In an abstract published in 2015, Romano *et al.* noted that ASA Physical Status scores assigned by nonanesthesiologists for patients requiring sedation were significantly lower than those assigned (retrospectively) to the same patients by anesthesiologists.[85] However, it is impossible know if this represents "intentional" downcoding or is related to other unknowable factors. We have been unable to identify any other published data related to this issue. While it remains possible that upcoding or downcoding occurs, there is absolutely no evidence to support any belief other than that practicing anesthesiologists consistently strive to assign accurate ASA Physical Status classifications.

It should be noted that both upcoding and downcoding involve the use of the ASA Physical Status for the classification of *individual* patients, not large aggregate groups of patients—something that is problematic because of interrater issues. However, with improvement of interrater reliability, potential coding inaccuracies may become less prevalent and hence less of an issue.

The Future: Potential Modifications and Conclusions

ASA Physical Status works extremely well for its intended purpose, which is to allow comparison of large groups of

†Message from the ASA President, Friday, July 9, 2021.

patients.[48,52,86–88] We believe that most ASA members and ASA leadership are comfortable with the current use. Every version of the system has been approved by the ASA's most representative body, the House of Delegates, including in 2020 without dissent. However, on its 80th anniversary, it is timely to ask if the system needs further refinement. To answer that question, we must reflect on the purpose of any such change. Do we simply want better interrater reliability? Do we wish to refine the definitions of ASA Physical Status II, III, and IV patients (which represent the greatest degree of assignment variability) along with additional focus specific to frailty and emergency patients (particularly trauma)?[48,86,87] Do we need more categories? Do we want to improve its use as a risk predictor? Do we want to improve its regulatory applications or its use as a billing modifier? Each goal would require a different approach—and some would mandate major changes to the current structure.

In the opinion of the authors, creating an outcome prediction system for use in an individual preoperative patient would go far beyond a "modification" of ASA Physical Status, and would require a more sophisticated multivariate approach—as has already been done and validated by others. We believe that efforts would be better directed at improving category clarity and interrater consistency—and actively disseminating the most recent version of the ASA Physical Status system to the worldwide anesthesia community. A first step would be to identify those clinical scenarios that seem to result in the most common assignment discrepancies. This was, of course, the origin of the added examples. Further reiterative efforts along these lines, continuing to focus on identified "problems" (*e.g.*, ASA Physical Status III and IV), might yield improvements. However, given the unavoidable fact that different providers will judge the health status of the same patient differently—even if both providers personally perform histories and physical examinations—perfect consistency when binning the enormous spectrum of human disease into a small number of ordinal categories is likely unattainable. Hence, any group striving to improve interrater reliability will need to pre-emptively establish their definition of "sufficiently good reliability."

The end product of such efforts might involve a few more ASA Physical Status categories or further revision of patient examples. In the 21st century, basic technology could readily assist the ASA Physical Status assignment process. A simple option might be to provide the definitions of the current ASA Physical Status categories alongside key "check boxes" on the anesthesia record, or to create "pop-up" screens with both the definitions and examples. There has been one published effort to "predict" ASA Physical Status using a huge number of variables,[89] but this is clearly not feasible for the busy clinician. In a world of anesthesia information management systems, it is possible to imagine automated decision-support algorithms that could be applied using information already contained in the medical record. However, to date, no such effort has been reported. One could envision a semi-manual system (perhaps a smartphone-based application) that asks a provider to answer a series of simple yes/no questions to "recommend" an ASA Physical Status class. Regardless of the approach, it needs to retain the simplicity and ease of use of our current system. Moreover, continued improvements to the current (and future) ASA Physical Status systems also require that the ASA actively disseminate and educate both American and international anesthesia providers regarding precise ASA Physical Status definitions and case examples.

We envision continued utilization of this bedside tool by both anesthesia professionals and others for years to come. Ultimately, its future will be determined by the medical needs of clinicians, the research needs of investigators, the oversight needs of regulators—and most importantly, the goals of the ASA leaders and its membership. In order to stay current and meet these diverse demands, the system warrants periodic re-examination, consistent with its long-standing history. For now, the ASA and its members should be proud of a system that has stood the test of time.

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Competing Interests

Dr. Todd was the Editor-in-Chief of Anesthesiology from 1996 to 2006. Dr. Todd was also the awarded the 2016 Excellence in Research Award by the ASA. Dr. Cole is vice president of the Anesthesia Patient Safety Foundation (Rochester, Minnesota), a foundation of the ASA, and past president of the ASA. Dr. Prielipp is a former member of the Board of Directors of the Anesthesia Patient Safety Foundation. He also serves on the speakers' bureau for Merck Co., Inc. (Kenilworth, New Jersey) and as an opinion leader for 3M (Minneapolis, Minnesota). The other authors declare no competing interests.

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References

1. Gaba DM: Anaesthesiology as a model for patient safety in health care. BMJ 2000; 320:785–8
2. Leape LL, Berwick DM, Bates DW: What practices will most improve safety? Evidence-based medicine meets patient safety. JAMA 2002; 288:501–7
3. Saklad M: Grading of patients for surgical procedures. Anesthesiology 1941; 2:281–4
4. Doyle DJ, Goyal A, Bansal P, Garmon EH: American Society of Anesthesiologists Classification (ASA Class). StatPearls, 2020
5. Owens WD: American Society of Anesthesiologists Physical Status classification system in not a risk classification system. Anesthesiology 2001; 94:378
6. Schwam SJ, Gold MI: ASA PS classification is not risk classification. Anesthesiology 1982; 57:68
7. Kraev AI, McGinn J, Etkin Y, Turner JW, Landis GS: Improving the power of the American Society of Anesthesiology classification system to risk stratify vascular surgery patients based on National Surgical Quality Improvement Project-defined functional status. Ann Vasc Surg 2018; 52:153–7
8. Markovic DZ, Jevtovic-Stoimenov T, Stojanovic M, Vukovic AZ, Dinic V, Markovic-Zivkovic BZ, Jankovic RJ: Cardiac biomarkers improve prediction performance of the combination of American Society of Anesthesiologists physical status classification and Americal College of Surgeons National Surgical Quality Improvement Program calculator for postoperative mortality in elderly patients: A pilot study. Aging Clin Exp Res 2019; 31:1207–17
9. Peters RM, van Steenbergen LN, Stewart RE, Stevens M, Rijk PC, Bulstra SK, Zijlstra WP: Patient characteristics influence revision rate of total hip arthroplasty: American Society of Anesthesiologists score and body mass index were the strongest predictors for short-term revision after primary total hip arthroplasty. J Arthroplasty 2020; 35:188–192.e2
10. De Cassai A, Boscolo A, Tonetti T, Ban I, Ori C: Assignment of ASA-Physical Status relates to anesthesiologists' experience: A survey-based national-study. Korean J Anesthesiol 2019; 72:53–9
11. Knuf KM, Manohar CM, Cummings AK: Addressing inter-rater variability in the ASA-PS classification system. Mil Med 2020; 185:e545–9
12. Doleman B, Blackwell J, Karangizi A, Butt W, Bhalla A, Lund JN, Williams JP: Anaesthetists stress is induced by patient ASA grade and may impair non-technical skills during intubation. Acta Anaesthesiol Scand 2016; 60:910–6
13. Helkin A, Jain SV, Gruessner A, Fleming M, Kohman L, Costanza M, Cooney RN: Impact of ASA score misclassification on NSQIP predicted mortality: A retrospective analysis. Perioper Med (Lond) 2017; 6:23
14. Marian AA, Bayman EO, Gillett A, Hadder B, Todd MM: The influence of the type and design of the anesthesia record on ASA Physical Status scores in surgical patients: Paper records vs. electronic anesthesia records. BMC Med Inform Decis Mak 2016; 16:29
15. Nie X, Mattke S, Liu H: American Society of Anesthesiologist classification-Higher incentives for higher scores-Reply. JAMA Intern Med 2016; 176:1578–9
16. Salemi C, Anderson D, Flores D: American Society of Anesthesiology scoring discrepancies affecting the National Nosocomial Infection Surveillance System: Surgical-site-infection risk index rates. Infect Control Hosp Epidemiol 1997; 18:246–7
17. Schonberger RB, Dutton RP, Dai F: Is there evidence for systematic upcoding of ASA Physical Status coincident with payer incentives? A regression discontinuity analysis of the National Anesthesia Clinical Outcomes Registry. Anesth Analg 2016; 122:243–50
18. Vogt AW, Henson LC: Unindicated preoperative testing: ASA Physical Status and financial implications. J Clin Anesth 1997; 9:437–41
19. Fielding-Singh V, Willingham MD, Grogan T, Neelankavil JP: Impact of the addition of examples to the American Society of Anesthesiologists Physical Status classification system. Anesth Analg 2020; 130:e54–7
20. Godinho P, Gonçalves L, Muendane P, Dos Anjos Dixe M, Valente E: ASA classification - What is the real impact of the introduction of the new clinical examples? J Perioper Pract 2019; 29:203–9
21. Keats AS: The ASA classification of physical status–A recapitulation. Anesthesiology 1978; 49:233–6
22. Dripps RD, Lamont A, Eckenhoff JE: The role of anesthesia in surgical mortality. JAMA 1961; 178:261–6
23. Proceedings of the ASA 1962 House of Delegates (July 1962), Handbook for Delegates, Committee on Clinical Anesthesia Study Commissions, Annual Report (Summary). 507-1.1, page 1
24. Ament R: Origin of the ASA classification. Anesthesiology 1979; 51:179
25. American Society of Anesthesiologists: New classification of physical status. Anesthesiology 1963; 24:111
26. Thackray NM, Gibbs NM: American Society of Anesthesiologists P5: "With or without" definition? Anesthesiology 2011; 114:467–8
27. Stone J: ASA classification of patient for organ donation. Anaesthesia 2001; 56:586
28. American Society of Anesthesiologists: ASA Physical Status classification system. Approved October 15, 2014. Last amended October 23, 2019. Available at: http://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system. Accessed August 13, 2020.

29. Abouleish AE, Leib ML, Cohen NH: ASA provides examples to each ASA Physical Status class. ASA Newsletter 2015; 79:38–49
30. American Society of Anesthesiologists: ASA Physical Status classification system. Approved October 15, 2014. Last amended December 13, 2020. Available at: http://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system. Accessed February 5, 2021.
31. Kopp VJ: Use of the American Society of Anesthesiologists Physical Status classification system in research. Anesth Analg 2013; 117:752
32. Portier K, Ida KK: The ASA Physical Status classification: What is the evidence for recommending its use in veterinary anesthesia?-A systematic review. Front Vet Sci 2018; 5:204
33. Huntington CR, Cox TC, Blair LJ, Prasad T, Lincourt AE, Matthews BD, Heniford BT, Augenstein VA: Acuity, outcomes, and trends in the transfer of surgical patients: A national study. Surg Endosc 2016; 30:1301–9
34. Okocha O, Gerlach RM, Sweitzer B: Preoperative evaluation for ambulatory anesthesia: What, when, and how? Anesthesiol Clin 2019; 37:195–213
35. Enneking FK, Radhakrishnan NS, Berg K, Patel S, Wishin JM, Vasilopoulos T: Patient-centered anesthesia triage system predicts ASA Physical Status. Anesth Analg 2017; 124:1957–62
36. Luedi MM, Kauf P, Mulks L, Wieferich K, Schiffer R, Doll D: Implications of patient age and ASA Physical Status for operating room management decisions. Anesth Analg 2016; 122:1169–77
37. Practice guidelines for moderate procedural sedation and analgesia 2018: A report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. Anesthesiology 2018; 128:437–79
38. Owens WD, Felts JA, Spitznagel EL Jr: ASA Physical Status classifications: A study of consistency of ratings. Anesthesiology 1978; 49:239–43
39. Ranta S, Hynynen M, Tammisto T: A survey of the ASA Physical Status classification: Significant variation in allocation among Finnish anaesthesiologists. Acta Anaesthesiol Scand 1997; 41:629–32
40. Mak PH, Campbell RC, Irwin MG; American Society of Anesthesiologists: The ASA Physical Status classification: Inter-observer consistency. Anaesth Intensive Care 2002; 30:633–40
41. Riley R, Holman C, Fletcher D: Inter-rater reliability of the ASA Physical Status classification in a sample of anaesthetists in Western Australia. Anaesth Intensive Care 2014; 42:614–8
42. Cuvillon P, Nouvellon E, Marret E, Albaladejo P, Fortier LP, Fabbro-Perray P, Malinovsky JM, Ripart J: American Society of Anesthesiologists' Physical Status system: A multicentre Francophone study to analyse reasons for classification disagreement. Eur J Anaesthesiol 2011; 28:742–7
43. Sankar A, Johnson SR, Beattie WS, Tait G, Wijeysundera DN: Reliability of the American Society of Anesthesiologists Physical Status scale in clinical practice. Br J Anaesth 2014; 113:424–32
44. Hurwitz EE, Simon M, Vinta SR, Zehm CF, Shabot SM, Minhajuddin A, Abouleish AE: Adding examples to the ASA-Physical Status classification improves correct assignment to patients. Anesthesiology 2017; 126:614–22
45. Aplin S, Baines D, DE Lima J: Use of the ASA Physical Status grading system in pediatric practice. Paediatr Anaesth 2007; 17:216–22
46. Tollinche LE, Yang G, Tan KS, Borchardt R: Interrater variability in ASA Physical Status assignment: An analysis in the pediatric cancer setting. J Anesth 2018; 32:211–8
47. Burgoyne LL, Smeltzer MP, Pereiras LA, Norris AL, De Armendi AJ: How well do pediatric anesthesiologists agree when assigning ASA Physical Status classifications to their patients? Paediatr Anaesth 2007; 17: 956–62
48. Jacqueline R, Malviya S, Burke C, Reynolds P: An assessment of interrater reliability of the ASA Physical Status classification in pediatric surgical patients. Paediatr Anaesth 2006; 16:928–31
49. Leahy I, Berry JG, Johnson CJ, Crofton C, Staffa SJ, Ferrari L: Does the current American Society of Anesthesiologists Physical Status classification represent the chronic disease burden in children undergoing general anesthesia? Anesth Analg 2019; 129:1175–80
50. Ferrari LR, Leahy I, Staffa SJ, Johnson C, Crofton C, Methot C, Berry JG: One size does not fit all: A perspective on the American Society of Anesthesiologists Physical Status classification for pediatric patients. Anesth Analg 2020; 130:1685–92
51. Barbeito A, Muir HA, Gan TJ, Reynolds JD, Spahn T, White WD, Panni MK, Schultz JR: Use of a modifier reduces inconsistency in the American Society of Anesthesiologists Physical Status classification in parturients. Anesth Analg 2006; 102:1231–3
52. ul Hasan MR: The significance of the American Society of Anesthesiologists Physical Status classification in obstetrics and gynaecology. Obstetr Gynaecol Reprod Med 2008; 18:110–11
53. Schuster KM, Davis KA, Rosenbaum SH: Emergency and urgent surgery. Anesthesiol Clin 2009; 27:787–804
54. Kluger Y, Ben-Ishay O, Sartelli M, Ansaloni L, Abbas AE, Agresta F, Biffl WL, Baiocchi L, Bala M, Catena F, Coimbra R, Cui Y, Di Saverio S, Das K, El Zalabany

T, Fraga GP, Gomes CA, Gonsaga RA, Kenig J, Leppäniemi A, Marwah S, Junior GA, Sakakushev B, Siribumrungwong B, Sato N, Tranà C, Vettoretto N, Moore EE: World Society of Emergency Surgery study group initiative on Timing of Acute Care Surgery classification (TACS). World J Emerg Surg 2013; 8:17

55. Ortoleva JP, Reich JA, Dalia AA: Extracorporeal membrane oxygenation patients presenting for surgery should be considered ASA status 5. J Cardiothorac Vasc Anesth 2020; 34:2546–7
56. Thomas PAW, Mitchell PS, Marshman LAG: Early postoperative morbidity after chronic subdural hematoma: Predictive usefulness of the Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity, American College of Surgeons National Surgical Quality Improvement Program, and American Society of Anesthesiologists grade in a prospective cohort. World Neurosurg 2019; 124:e489–97
57. Rosa F, Tortorelli AP, Quero G, Galiandro F, Fiorillo C, Sollazzi L, Alfieri S: The impact of preoperative ASA-Physical Status on postoperative complications and long-term survival outcomes in gastric cancer patients. Eur Rev Med Pharmacol Sci 2019; 23:7383–90
58. Kolehmainen AM, Pasanen A, Tuomi T, Koivisto-Korander R, Butzow R, Loukovaara M: American Society of Anesthesiologists Physical Status score as a predictor of long-term outcome in women with endometrial cancer. Int J Gynecol Cancer 2019; 29:879–85
59. Fariña-Castro R, Roque-Castellano C, Artiles-Armas M, Marchena-Gómez J: Emergency surgery and American Society of Anesthesiologists Physical Status score are the most influential risk factors of death in nonagenarian surgical patients. Geriatr Gerontol Int 2019; 19:293–8
60. Choi JY, Kim KI, Choi Y, Ahn SH, Kang E, Oh HK, Kim DW, Kim EK, Yoon YS, Kang SB, Kim HH, Han HS, Kim CH: Comparison of multidimensional frailty score, grip strength, and gait speed in older surgical patients. J Cachexia Sarcopenia Muscle 2020; 11:432–40
61. Shinall MC, Jr., Arya S, Youk A, Varley P, Shah R, Massarweh NN, Shireman PK, Johanning JM, Brown AJ, Christie NA, Crist L, Curtin CM, Drolet BC, Dhupar R, Griffin J, Ibinson JW, Johnson JT, Kinney S, LaGrange C, Langerman A, Loyd GE, Mady LJ, Mott MP, Patri M, Siebler JC, Stimson CJ, Thorell WE, Vincent SA, Hall DE: Association of preoperative patient frailty and operative stress with postoperative mortality. JAMA Surg 2019; 155:e194620
62. Hall DE, Arya S, Schmid KK, Carlson MA, Lavedan P, Bailey TL, Purviance G, Bockman T, Lynch TG, Johanning JM: Association of a frailty screening initiative with postoperative survival at 30, 180, and 365 days. JAMA Surg 2017; 152:233–40
63. Sillner AY, McConeghy RO, Madrigal C, Culley DJ, Arora RC, Rudolph JL: The association of a frailty index and incident delirium in older hospitalized patients: An observational cohort study. Clin Interv Aging 2020; 15:2053–61
64. Fitz-Henry J: The ASA classification and peri-operative risk. Ann R Coll Surg Engl 2011; 93:185–7
65. Beecher HK, Todd DP: A study of the deaths associated with anesthesia and surgery: Based on a study of 599, 548 anesthesias in ten institutions 1948-1952, inclusive. Ann Surg 1954; 140:2–35
66. Davenport DL, Bowe EA, Henderson WG, Khuri SF, Mentzer RM Jr: National Surgical Quality Improvement Program (NSQIP) risk factors can be used to validate American Society of Anesthesiologists Physical Status classification (ASA PS) levels. Ann Surg 2006; 243:636–41; discussion 641–4
67. Hackett NJ, De Oliveira GS, Jain UK, Kim JY: ASA class is a reliable independent predictor of medical complications and mortality following surgery. Int J Surg 2015; 18:184–90
68. Koo CY, Hyder JA, Wanderer JP, Eikermann M, Ramachandran SK: A meta-analysis of the predictive accuracy of postoperative mortality using the American Society of Anesthesiologists' Physical Status classification system. World J Surg 2015; 39:88–103
69. Boorjian SA, Kim SP, Tollefson MK, Carrasco A, Cheville JC, Thompson RH, Thapa P, Frank I: Comparative performance of comorbidity indices for estimating perioperative and 5-year all cause mortality following radical cystectomy for bladder cancer. J Urol 2013; 190:55–60
70. Prause G, Offner A, Ratzenhofer-Komenda B, Vicenzi M, Smolle J, Smolle-Jüttner F: Comparison of two preoperative indices to predict perioperative mortality in non-cardiac thoracic surgery. Eur J Cardiothorac Surg 1997; 11:670–5
71. Teni FS, Burström K, Berg J, Leidl R, Rolfson O: Predictive ability of the American Society of Anaesthesiologists Physical Status classification system on health-related quality of life of patients after total hip replacement: Comparisons across eight EQ-5D-3L value sets. BMC Musculoskelet Disord 2020; 21:441
72. Somani S, Capua JD, Kim JS, Phan K, Lee NJ, Kothari P, Kim JH, Dowdell J, Cho SK: ASA classification as a risk stratification tool in adult spinal deformity surgery: A study of 5805 patients. Global Spine J 2017; 7:719–26
73. Bronheim RS, Caridi JM, Steinberger J, Hunter S, Neifert SN, Deutsch BC, DeMaria S Jr, Hermann L, Gal JS: American Society of Anesthesiologists' status association with cost and length of stay in lumbar laminectomy and fusion: Results from an institutional database. Spine (Phila Pa 1976) 2020; 45:333–8

74. Quach LH, Jayamaha S, Whitehouse SL, Crawford R, Pulle CR, Bell JJ: Comparison of the Charlson Comorbidity Index with the ASA score for predicting 12-month mortality in acute hip fracture. Injury 2020; 51:1004–10
75. Tran A, Mai T, El-Haddad J, Lampron J, Yelle JD, Pagliarello G, Matar M: Preinjury ASA score as an independent predictor of readmission after major traumatic injury. Trauma Surg Acute Care Open 2017; 2:e000128
76. Skaga NO, Eken T, Søvik S, Jones JM, Steen PA: Preinjury ASA Physical Status classification is an independent predictor of mortality after trauma. J Trauma 2007; 63:972–8
77. Lupei MI, Chipman JG, Beilman GJ, Oancea SC, Konia MR: The association between ASA status and other risk stratification models on postoperative intensive care unit outcomes. Anesth Analg 2014; 118:989–94
78. Schiffner E, Latz D, Karbowski A, Grassmann JP, Thelen S, Gehrmann S, Windolf J, Schneppendahl J, Jungbluth P: Possible risk factors for acute and chronic deep periprosthetic joint infections in primary total knee arthroplasty. Do BMI, smoking, urinary tract infections, gender, and ASA classification have an impact? J Orthop 2020; 19:111–3
79. Shahrokni A, Vishnevsky BM, Jang B, Sarraf S, Alexander K, Kim SJ, Downey R, Afonso A, Korc-Grodzicki B: Geriatric assessment, not ASA Physical Status, is associated with 6-month postoperative survival in patients with cancer aged ≥75 Years. J Natl Compr Canc Netw 2019; 17:687–94
80. Goldman L, Caldera DL, Nussbaum SR, Southwick FS, Krogstad D, Murray B, Burke DS, O'Malley TA, Goroll AH, Caplan CH, Nolan J, Carabello B, Slater EE: Multifactorial index of cardiac risk in noncardiac surgical procedures. N Engl J Med 1977; 297:845–50
81. Davenport DL, Ferraris VA, Hosokawa P, Henderson WG, Khuri SF, Mentzer RM Jr: Multivariable predictors of postoperative cardiac adverse events after general and vascular surgery: Results from the patient safety in surgery study. J Am Coll Surg 2007; 204:1199–210
82. Moonesinghe SR, Mythen MG, Das P, Rowan KM, Grocott MP: Risk stratification tools for predicting morbidity and mortality in adult patients undergoing major surgery: Qualitative systematic review. Anesthesiology 2013; 119:959–81
83. American Society of Anesthesiologists: Anesthesia payment basics series: #4 Physical Status. September 2019. Available at: https://www.asahq.org/quality-and-practice-management/managing-your-practice/timely-topics-in-payment-and-practice-management/anesthesia-payment-basics-series-4-physical-status. Accessed October 13, 2020.
84. Nie X, Mattke S, Predmore Z, Liu H: Upcoding and anesthesia risk in outpatient gastrointestinal endoscopy procedures. JAMA Intern Med 2016; 176: 855–6
85. Romano DN, Serafin J, Worah SH, Twersky RS: Quality Control Review of the ASA Physical Status (ASA-PS) Classification of Patients Undergoing Moderate Sedation by Non-Anesthesiologists, Abstract # A2103, ASA Annual Meeting 2015
86. Kuza CM, Matsushima K, Mack WJ, Pham C, Hourany T, Lee J, Tran TD, Dudaryk R, Mulder MB, Escanelle MA, Ogunnaike B, Ahmed MI, Luo X, Eastman A, Imran JB, Melikman E, Minhajuddin A, Feeler A, Urman RD, Salim A, Spencer D, Gabriel V, Ramakrishnan D, Nahmias JT: The role of the American Society of Anesthesiologists Physical Status classification in predicting trauma mortality and outcomes. Am J Surg 2019; 218:1143–51
87. Kuza CM, Hatzakis G, Nahmias JT: The Assignment of American Society of Anesthesiologists Physical Status classification for adult polytrauma patients: Results from a survey and future considerations. Anesth Analg 2017; 125:1960–6
88. Daabiss M: American Society of Anaesthesiologists Physical Status classification. Indian J Anaesth 2011; 55:111–5
89. Mudumbai SC, Pershing S, Bowe T, Kamal RN, Sears ED, Finlay AK, Eisenberg D, Hawn MT, Weng Y, Trickey AW, Mariano ER, Harris AHS: Development and validation of a predictive model for American Society of Anesthesiologists Physical Status. BMC Health Serv Res 2019; 19:859