

A different approach to medical risk assessment

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It has been widely accepted that dentists can no longer be 'expected to only fill a tooth, extract a tooth, or replace a tooth' (1). The maintenance of dental health is an integral component of the overall health of patients, which has clearly been publicized in numerous studies and reiterated in the Surgeon General's Report on Oral Health (2). Studies have shown that approximately 30% of the population will present to the dental office with at least one medical condition (3, 4). It has also been demonstrated that as patients become older, the likelihood of polypharmacology increases (5). Therefore, one of the critical issues facing dentists in practice today is how to manage a more medically complex patient population safely. Medical risk assessment has become an essential part of clinical practice, and needs to be recognized as such.

The intent of this article is to review the appropriateness of the commonly used American Society of Anesthesiologists' (ASA) Physical Status Classification, and to propose an alternative classification system for medical risk assessment. This new method of medical risk assessment is based on medical complexity, anticipated complications, and dental modifications.

The ASA Physical Status Classification

The ASA Physical Status Classification was devised in 1941 by a committee of the American Society of Anesthetists (a forerunner of the American Society of Anesthesiologists). The original intent of the ASA classification was to compile statistical data in anesthesia that could be used to audit procedures and assign 'operative risk' (6). By the authors' own accord, the

term 'operative risk' was deemed unacceptable due to what they described as 'differing factors and circumstances' that prevail at any given moment. The term 'operative risk' was therefore changed to 'physical state' as a potential statistical tool for assessing 'result, the operative procedure, and the pre-operative condition'. The authors further stated that 'no attempt should be made to prognosticate the effect of a surgical procedure upon a patient of a given Physical State' (6).

The original ASA classification was revised in 1961, in which five categories were preceded by an 'e' to describe an emergent situation (7, 8). It was revised to its present form in 1983 with a sixth category being added (9) (see Table 1). The new classification emphasized that mortality was equated with the pre-anesthetic condition of the patient. This change was based on records showing no deaths among 16 000 'physically fit' patients. Dripps et al. (8) also showed that as the physical status of the patients deteriorated, the rate of anesthesia-related deaths increased. Additional studies established the link between physical status and peri-operative mortality (10–12).

The ASA classification has become the most widely used operative assessment method for pre-anesthetic patients (13, 14). Unfortunately, there remain inherent limitations to the ASA classification as a peri-operative risk predictor.

Despite its widespread acceptance and use, significant misunderstanding and discrepancy have always existed when attempts are made to calibrate practitioners. Owens et al. (15) conducted a study in which 343 anesthesiologists were asked to classify 10 hypothetical patients. Of the 10 cases, the mean number of cases classified identically was 5.9. The authors concluded that the variation among responses was likely due to

Table 1. American Society of Anesthesiologists' (ASA) Physical Status Classification (7, 8)

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 who is not expected to survive without the operation
6.	A declared brain-dead patient whose organs are being removed for donor purposes

In the event of an emergency, precede the number with an 'e'.

'pre-determined opinions, often scientifically unfounded, that may provide impetus for a given rating'. A further study by Haynes and Lawler (16) surveyed 113 anesthesiologists' classification of another 10 hypothetical patients. This study further demonstrated that the ASA classification was inconsistent and lacked 'scientific precision'. Two other more recent analyses have shown inconsistencies among anesthesiologists (17, 18). In both studies, it was indicated that significant variations existed between respondents, leading to the conclusion that there is a need for a more precise and useful predictor for peri-operative risk.

Discrepancies also exist when dentists assign ASA classifications to potential patients. de Jong et al. (19) sampled 50 dentists to test the standardization of the ASA classification between practitioners and a computer model. The authors noted significant discrepancies, but concluded that risk assessment could be optimized by verbal verification of the health questionnaire by the dentist. It is of interest that the layout and choice of questions played a large role in the accuracy and clinical relevance of the medical history information.

In 1979, McCarthy and Malamed (20) proposed a revised ASA Physical Status Classification for the risk assessment of dental patients (see Table 2). The intent of the system was to categorize dental patients into the established ASA classification that would correspond to dental modifications. McCarthy and Malamed devote considerable attention to stress reduction in the system proposed, although the classic ASA classification did not include fear and anxiety as modifying factors.

Table 2. Physical evaluation system proposed by McCarthy and Malamed (20)

Physical status	Therapy modifications
ASA 1	None (stress reduction as indicated)
ASA 2	Possible stress reduction and other modifications as needed
ASA 3	Possible strict modifications; stress reduction and medical consultation are priorities
ASA 4	Minimal emergency care in office; hospitalize for stressful elective treatment; medical consultation urged*
ASA 5	Treatment in the hospital is limited to life support only; for example, airway and hemorrhage management

*Minimal emergency care for the Class 4 patient in the office requires strict attention to pain or anxiety. The practitioner's judgment might favor pharmacological treatment only (antibiotic or analgesic) whereas significant operative intervention is performed in the hospital.

Limitations of the ASA classification

If significant variation exists when using the ASA classification, how can the general dentist who is performing out-patient dentistry on medically complex patients correctly assess clinical risk? Despite the inconsistency of the ASA classification, it remains universally accepted and is considered a useful guideline (13). However, the general practitioner must understand the limitations of the ASA classification and how further risk assessment is required prior to performing dentistry on a medically complex patient.

The ASA classification does not account for variables such as age, obesity, type or duration of surgery, type of anesthesia, or the experience and skill of the healthcare provider (6, 11-14, 21-23). Further, the ASA classification refers to only 'disease' states, and does not differentiate between acute and chronic conditions (22).

Need for a new system

Advancements in medicine and out-patient therapeutics have allowed patients with chronic disease to live longer and live more active lives. The life expectancy

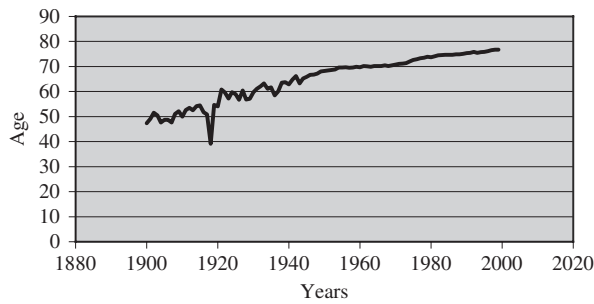


Fig. 1. Life expectancy from 1990 to 1999 (the chart represents life expectancy from birth of all races and both sexes (24)).

from birth in 1999 was 73.9 and 79.4 years in males and females, respectively, and it is anticipated to increase even further (24) (see Fig. 1). Dentistry has also benefited from technology, with advancements in both materials and methods resulting in increased tooth retention. According to Marcus et al. (25), patients aged 50–59 years had an average of 17.25 remaining teeth, whereas individuals 75 years or older had an average of seven remaining teeth. The National Oral Health Surveillance System indicated that in 1999, 24.4% of all individuals aged 65 years or older in the United States were completely edentulous (26). Thus, more than 75% of older Americans still retained some of their permanent dentition. These statistics suggest that patients not only live longer, but live longer with a partially intact dentition.

As Americans live longer, the number of medically complex patients treated by dentists is increasing. Consequently, dentists will be faced with treating more patients with chronic conditions and associated polypharmacopeia. As discussed above, the ASA Physical Status Classification lacks precision and specificity. If dental procedures on medically complex patients are to be performed, the dentist must be able to make an appropriate assessment, which is based on clinically relevant operative risk information and treatment modifications. Accordingly, a more dentist-directed classification system needs to be developed, which can account for the medical complexity of the patient, anticipated potential complications associated with dental care, and the most appropriate setting for the provision of care.

Medical history

Regardless of which operative risk assessment criteria are used, oral healthcare providers need to review the

medical history of their patients. Most practitioners rely on pre-printed health questionnaires to gain initial information about their patients. The health questionnaire needs to be validated by direct interviews with patients to eliminate both false negatives and false positives (27).

The goal of the medical history is to collect information that can be used to treat the dental patient safely. Provided all pertinent information is disclosed and interpreted, the delivery of dental care to medically complex patients has proven to be remarkably safe (28).

Drinnan (29) reviewed the subject of practitioners treating patients without a thorough knowledge of known medical history, with a focus toward increasing medical liability in the US. The author describes several cases in which patients received large monetary awards after suffering medical problems because of dental treatment. He states, ‘In each case the dentist had been unaware of any risk factor and had provided treatment without any special precautions.’

Many studies have examined the reasons as to why patients withhold medical information from dentists. McDaniel et al. (30) surveyed 107 dental patients to ascertain the accuracy of information collected on a health questionnaire. The results of this study demonstrate that adults are reluctant to divulge certain information on dental health history forms. The most frequent reason given by respondents for not revealing medical information was privacy (62%) and unimportant information (17%). A study by Fenlon and McCartan (4) found two reasons for the omission of information from the health questionnaire: (1) forgetfulness and (2) not understanding the interest a dentist could have in ‘non-dental’ medications or conditions.

A thorough medical history is the most important step toward risk assessment and dental therapy modifications. Once the practitioner has collected the appropriate data, informed judgments about the risk of the dental procedure can be made (13). However, because patients must be active participants in dental treatment, it is the responsibility of the oral healthcare provider to educate the patient on the need for full disclosure of medical information. As stated previously, the goal of the medical history is to identify diseases or conditions in order to treat dental patients safely. Furthermore, a thorough medical history can ensure the safety of the dental team and prevent cross-infection (30).

A new assessment tool

A different approach to risk assessment screening was successfully designed and implemented in an out-patient clinic setting, specifically addressing the needs of medically complex patients, by one of the authors (MG). The concept behind this new medical complexity classification (MCC) was based on medical stability, anticipated dental complications, timing of dental modifications, and treatment setting.

The first step in determining the operative risk is to use the information gathered in the medical history to assess the medical stability of the patient (see Table 3). Once medical stability is established, possible complications for dental treatment can be determined. Complications are designated as either minor (easily managed chair-side by the dentist, not life-threatening) or major (not easily managed chair-side, potentially life-threatening).

Determining medical stability and potential adverse events results in an understanding of the need for the institution of modifications required to provide dental care safely. The type of modification (e.g. the need for antibiotic prophylaxis, the need to address a patient's hemostatic status, or the need to address actions and interactions of medications) is individually based according to the patient's underlying medical problem.

Table 3. Medical complexity (MC) status

MC-0	No significant medical problems
MC-1A	Controlled and stable condition/disease No anticipated complications
MC-1B	Controlled and stable condition/disease Anticipated/possible <i>minor</i> complications
MC-1C	Controlled and stable condition/disease Anticipated/possible <i>major</i> complications
MC-2A	Poorly controlled and/or unstable condition/disease No anticipated complications
MC-2B	Poorly controlled and/or unstable condition/disease Anticipated/possible <i>minor</i> complications
MC-2C	Poorly controlled and/or unstable condition/disease Anticipated/possible <i>major</i> complications
MC-3	Cardiac or other conditions needing continuous monitoring

Table 4. Dental modification (DM) status (circle all that apply)

DM-0	No modifications needed
DM-1	Modifications needed <i>before</i> initiating some dental procedures
DM-2	Modifications needed <i>during</i> some dental procedures
DM-3	Modifications needed <i>after</i> finishing some dental procedures

Implementation of these modifications can be assigned in a temporal relationship to the provision of dental care (see Table 4). The timing of modifications for the dental procedure could either be before, during, and/or after dental treatment. In certain cases, it may be necessary to institute modification during all three stages, i.e. before, during, and after dental treatment.

Once medical status and timing of modifications have been determined, the clinical judgment of the individual practitioner should be used to determine if the patient is suitable for dental care. Like the ASA Physical Status Classification, the MCC should be used as an instrument to determine if the dentist is sufficiently qualified to handle adverse events that could arise during dental treatment. The setting in which dental patients are treated can be a major factor in minimizing the risk potential of dental care. Accordingly, patients are assigned to different dental settings such as out-patient care, hospital-based dental care, treatment in a short-procedure unit, or treatment in an operating room. The assignment of a patient to a particular setting should be based upon three criteria:

- training and experience of the provider;
- medical complexity of the patient;
- dental modification needs of the patient.

This MCC should be considered a guideline. Guidelines can generate clinically relevant information for practitioners, but only when used correctly. Similar to the ASA Physical Status Classification, the MCC proposed in this manuscript should be used in conjunction with proper training and good clinical judgment.

Summary

The ASA Physical Status Classification can be a useful guideline for establishing the pre-operative fitness of

a patient. However, when assessing the peri-operative risk associated with routine dental procedures, the ASA classification lends little help. A more relevant approach to risk assessment has been proposed in this article. Using this assessment classification, practitioners will more directly be able to relate the medical status of patients to the need of dental modifications necessary to provide safe and appropriate care. However, as with all guidelines, the clinical judgment of the practitioner should determine the overall acceptability and appropriateness of any medical assessment classification.

Seven case presentations representing different classes of medical complexity (MC), according to the proposed MCC, are given below.

Case presentations and MCC

Patient 1

A 36-year-old Caucasian female was scheduled for root canal therapy on tooth #30 following a carious exposure. Her medical history included mitral valve prolapse (MVP) without regurgitation, verified by an echocardiogram 5 years ago. The remainder of the medical history was non-contributory. She took no medications and had no drug allergies. Intra- and extra-oral examinations were within normal limits and her vital signs were normal.

MC-1A: The presence of MVP without regurgitation represents a stable medical condition, which is generally not associated with complications caused by dental-care procedures.

DM-0: No modification is needed to treat this patient.

Patient 2

A 42-year-old Caucasian male was scheduled for apicoectomy on tooth #10. The patient interview revealed a history of asthma brought on by seasonal allergies and exercise. When questioned more thoroughly, the patient stated he had asthma attacks approximately three times per year, but had never been hospitalized due to asthma. He took no medications on a routine basis, but carried an albuterol inhaler if the need arose. He had no drug allergies. Clinical examination was within normal limits. His vital signs revealed a blood pressure (BP) of 135/85 mmHg and a pulse rate of 100 bpm.

MC-1B: Asthma is a medical condition that has wide inter-patient variability. It is important to assess the individual stability of every patient. In this example, the patient had exacerbations of the disorder infrequently and could identify the stimuli for his attacks. The status of this patient should be viewed as controlled, with a possible minor complication (i.e. a mild attack of asthma). The possible complication of a mild asthma attack should be classified as minor, as it can be easily managed in the dental setting without outside medical assistance.

DM-1, -2, -3: *Before* treatment, it is important to verify the availability of a bronchodilator. *During* treatment, stress management and pain control are helpful in decreasing the likelihood of an asthmatic attack. *After* treatment, if analgesics are needed post operatively, special attention should be given to aspirin or NSAIDs, as a small percentage of asthmatics may exhibit adverse events secondary to these types of medications.

Patient 3

A 22-year-old African-American male presented for emergency endodontic care after traumatic exposure of tooth #9. Five years ago, he was hospitalized for a bilateral inguinal hernia repair, with no residual complications. During his pre-admission testing, a prolapsed mitral valve with regurgitation was noted. He took fexofenadine for chronic rhinitis and reported no allergies to medications. Clinical examination was unremarkable and vital signs were within normal limits.

MC-1C: MVP with regurgitation is a stable medical condition that could have potentially serious medical complications, i.e. bacterial endocarditis, following dental care.

DM-1: Before treatment, antibiotic prophylaxis should be administered. The American Heart Association's (AHA's) recommended regimen is 2.0 g amoxicillin, 1 h prior to dental treatment (31).

Patient 4

A 47-year-old Hispanic male, height 5 ft 8 in, weight 220 lb, was scheduled for endodontic re-treatment of tooth #19. Medical history revealed stage 1 hypertension, diagnosed 2 years ago. The patient denied diabetes, kidney problems, heart problems, or a history of stroke. He admitted to leading a sedentary lifestyle,

and was overweight. The patient's medications included lisinopril 20 mg qd. Unfortunately, he reported missing his dose that morning. His vital signs revealed a BP of 158/95 mmHg and a pulse rate of 90 bpm. Clinical examination was within normal limits.

MC-2A: This patient's BP was not controlled. According to the latest recommendations for BP control, the goal is a BP below 140/90 mmHg, with an optimal BP of 120/80 mmHg (32). Because no target organ disease was present and the BP was below 160/100 mmHg, no complications were anticipated due to the planned endodontic treatment (33).

DM-1, -2: Before: The dentist should take an active role in the monitoring of BP. According to the JNC 7, 'all members of the healthcare team must work together to influence and reinforce instructions to improve patients' lifestyles and BP control' (32). Furthermore, all hypertensive patients, as well as any patient with a BP above 140/90 mmHg, should have their BP measured at all dental visits to verify that no dramatic changes in their control is present. *During:* Efforts to minimize stress should be utilized. The use of epinephrine in local anesthesia cartridges is not contraindicated.

Patient 5

A 55-year-old African-American male, height 6 ft, weight 275 lb, was scheduled for an apicoectomy on tooth #12 following an unsuccessful attempt to remove a separated instrument within a canal. On the health-history questionnaire, the patient indicated that he had type 2 diabetes and took glimepiride 4 mg once daily. When questioned, the patient stated that he measured plasma glucose infrequently and usually exhibited a plasma glucose range of 215–250 mg/dL. The patient reported no hypo- or hyperglycemic events during the past 6 months. He was not allergic to any medications. Clinical examination was within normal limits and his vital signs included a BP of 135/82 mmHg and a pulse rate of 87 bpm. Consultations with the patient's physician indicated that the patient was a poorly controlled type 2 diabetic with a glycosylated hemoglobin A1C (HgA1C) of 12%, but had surprisingly not exhibited clinical signs or complications of hypo- or hyperglycemia.

MC-2B: This patient's diabetic status was poorly controlled. Target plasma glucose is optimally <126 mg/dL and HgA1C is below 6–7%. The

patient's HgA1C indicated poorly controlled diabetes during the past 2–3 months. This level of poor control over a long period may suggest impaired neutrophil function and an increased susceptibility to infections. Acute hypoglycemic episodes are less of a concern for this diabetic patient. Impaired wound healing and increased risk of infection as a result of dental treatment should be considered.

DM-1, -2, -3: Before: Dentists may consider postponing treatment until glycemic control is better established. Further considerations when scheduling this patient include not interfering with eating and medication-dosing schedules sometimes caused by impaired oral intake after the dental procedure, and planning for shorter visits. Antibiotic prophylaxis should be considered. *During:* Care must be taken to maintain a clean surgical field and eliminate sources of infection. *After:* The dentist should not impair the patient's ability to eat or ingest nutrition. Antibiotic coverage should be considered.

Patient 6

A 49-year-old Caucasian female was referred from her general dentist for emergency root canal therapy for tooth #5. The patient's past medical history was remarkable for chemotherapy, which is still ongoing, for the treatment of Hodgkin's disease. Her main complaint was a feeling of fatigue and occasional upper respiratory infections. The patient had no drug allergies, and her vital signs revealed a BP of 125/85 mmHg and a pulse rate of 75 bpm. Consultation with the patient's physician revealed that she was undergoing 3 months of chemotherapy, once every 14 days. Her complete blood cell count was normal, except for a low white blood cell count of 2900 cells/mm³ and a hemoglobin level of 8.6 gm/dL. A differential cell count, measured over a period of 6 weeks, revealed a neutrophil cell count ranging from a low of 900 to 1600 cells/mm³.

MC-2C: This patient manifested as an unstable, poorly controlled immune system due to her chemotherapy. Her neutrophil count, as well as her medical history of recurrent upper respiratory infections, indicated significant susceptibility to infections. Bacteremia due to dental procedures may, in her case, result in a severe systemic effect requiring intravenous therapy. Although her hemoglobin level was low, it will not affect dental care.

DM-1, -2, -3: Preferably, invasive dental procedures should not be performed in a patient during the period of receiving chemotherapy. Instead, analgesics and antibiotics should be used, without causing bacteremia. However, if the only way to get rid of a nidus of infection is to perform root canal therapy, this must be undertaken with great caution. *Before:* Antibiotic prophylaxis should be instituted. *During:* Care should be taken to ensure that instrumentation is not performed beyond the apex of the tooth. *After:* Antibiotic therapy should be continued for an additional 5–7 days in case infectious material was introduced beyond the apex.

Patient 7

A 64-year-old Caucasian male presented for root canal therapy on teeth #23 and #24 following a concussive injury. The patient reported that trauma to the teeth occurred as a result of falling down the stairs during an angina attack. Further investigation revealed that the patient now suffers from 2–3 angina attacks per week (it was previously 2–3 attacks per month). The angina attacks are occurring with increased severity and the patient is now requiring more nitroglycerin. The patient denied a history of myocardial infarction. He was taking metoprolol 200 mg bid, atorvastatin 20 mg qd, aspirin 81 mg qd, and nitroglycerin as needed. No allergies to medications were reported. His vital signs revealed a BP of 129/85 mmHg and a pulse rate of 80 bpm.

MC-3: Angina is defined as transient ischemia of the myocardium. Angina that is increasing in frequency, duration, and severity is classified as ‘unstable’. Possible complications of treating an unstable angina patient are severe, including the risk of the patient developing a myocardial infarction. Patients with this type of unstable condition should be treated under continuous monitoring in a short-procedure unit or an operating room.

DM-1, -2, -3: Before: It is advisable to postpone all elective care until the angina has been stabilized. If care is rendered, the availability of emergency medical personnel needs to be arranged (34). Pre-medication should be introduced to reduce the level of stress. *During:* Stress management and pain control should be emphasized to minimize increases in BP. Continuous monitoring of the patient for rapid recognition and treatment of possible complications needs to be considered. *After:* Institute post-operative pain control and stress management.

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